Toppersnotes
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DISASTER MANAGEMENT AND INTERNAL SECURITY

For UPSC, State PSC Civil Services & Other Exams

Volume – 4

SIERRA INNOVATIONS

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1 CHAPTER Introduction to Disaster Management

Previous Year Questions

Year	Question
2024	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	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.
2023	Dam failures are always catastrophic, especially on the downstream side, resulting in a colossal loss of life and property. Analyze the various causes of dam failures. Give two examples of large dam failures.
2022	Explain the mechanism and occurrence of cloudburst in the context of the Indian subcontinent. Discuss two recent examples.
2021	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	Describe the various causes and the effects of landslides. Mention the important components of the National Landslide Risk Management Strategy.
2020	Discuss the recent measures initiated in disaster management by the Government of India departing from the earlier reactive approach.
2019	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	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.
2018	Describe various measures taken in India for Disaster Risk Reduction (DRR) before and after signing 'Sendai Framework for DRR (2015-30)'. How is this framework different from 'Hyogo Framework for Action, 2005'?
2017	On December 2004, tsunami brought havoc on fourteen countries including India. Discuss the factors responsible for occurrence of tsunamis 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.
2016	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	With reference to National Disaster Management Authority (NDMA) guidelines, discuss the measures to be adopted to mitigate the impact of recent incidents of cloudbursts in many places of Uttarakhand.
2015	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.
2014	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 Niño and La Niña fallouts in India.
2013	How important are vulnerability & risk assessment for pre-disaster management? As an administrator, what are key areas that you would focus on in a Disaster Management System.

Disaster

- According to **UNISDR**, a disaster is defined as "A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources."
- The **Disaster Management Act, 2005**, which governs disaster response and preparedness in India, defines a disaster as "A catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence, which results in substantial loss of life, human suffering, or damage to and destruction of property, or degradation of environment, and is of such a nature or magnitude as to be beyond the coping capacity of the affected area."

$$\text{Disaster} = \frac{\text{Hazard} + \text{Vulnerability}}{\text{Capacity to cope}}$$

Hazard

- A hazard is a potential source of harm that can affect people, property, or the environment. It may lead to death, injury, economic loss, or ecological damage.
- **Types of Hazards**
  1. **Natural Hazards:** These are hazards that arise from natural processes or phenomena. They may occur suddenly or develop gradually over time. Natural hazards can be categorized as follows:
     - ✓ **Geophysical**: Such as earthquakes, landslides, tsunamis & volcanic eruptions.
     - ✓ **Hydrological**: Including floods and avalanches.
     - ✓ **Climatological**: Like droughts, wildfires & extreme temperature events.
     - ✓ **Meteorological**: Such as cyclones, storms, and storm surges.
     - ✓ **Biological**: Including epidemics, pandemics, and infestations by insects or animals.
  2. **Anthropogenic (Human-Induced) Hazards:** These result directly from human activities or negligence. Examples include:
     - ✓ Environmental pollution
     - ✓ Deforestation
     - ✓ Excessive use of chemical agents like pesticides and herbicides
     - ✓ Industrial or chemical accidents, such as toxic spills

Hazard vs Disaster

Hazard	Disaster
Hazard is an event that has potential for causing injury / loss of life or damage to property / environment.	Disaster is an event that occurs suddenly / unexpectedly in most cases and disrupts the normal course of life in affected area.
Hazards can lead to disasters.	A disaster is the result of a hazard but at the same time is also a hazardous event.
Hazards come with warnings.	Ignoring warnings can lead to disaster.
Hazards may be inevitable.	Disasters can be prevented.
Hazard occurs at less populated area.	Disaster occurs at overpopulated area.

Vulnerability

It refers to the likelihood of harm or loss faced by an individual, community, or area during a disaster, influenced by both geographical & social factors.

- **Economic Vulnerability**: Risk of loss due to weak economic resources & limited access to income or production means. Example: Daily wage workers losing livelihoods during disasters.
- **Physical Vulnerability**: Risk arising from the physical location & infrastructure's exposure to hazards. Example: Buildings not earthquake-resistant in seismic zones.
- **Social Vulnerability**: Susceptibility of specific groups like the poor, elderly, or disabled to disaster impacts. Example: Marginalized communities lacking information or support during cyclones.
- **Environmental Vulnerability**: Risk to ecosystems & biodiversity due to environmental degradation or hazards. Example: Deforested hills increase landslide risk.
- **Attitudinal Vulnerability**: Community's risk heightens due to passive mindset & reliance on external help. Example: Communities ignoring cyclone warnings.

Vulnerability can be characterized by:

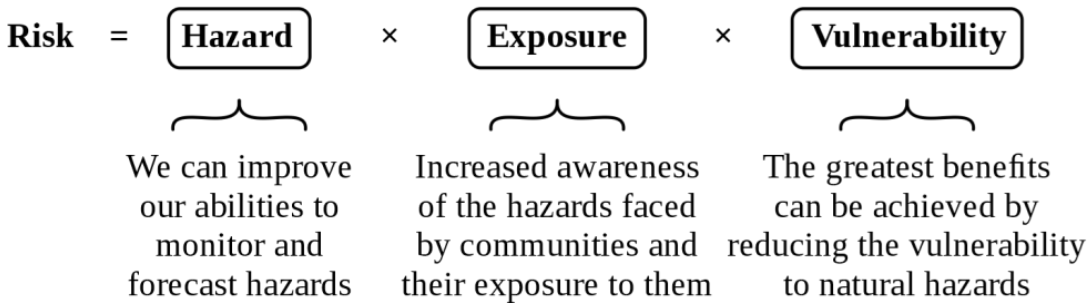
1. **Exposure –** Degree to which people or assets are in harm's way (e.g., living in flood plains or seismic zones).
2. **Sensitivity –** How severely a system or group is affected by a hazard (e.g., elderly or disabled persons during a heatwave).
3. **Adaptive Capacity –** The ability to cope, respond, and recover (e.g., access to early warning systems or emergency shelters).

Risk:

- Risk refers to the potential for loss or harm that may result from a hazardous event occurring within a particular area over a certain time frame.
- It reflects the likelihood and severity of negative outcomes stemming from the interaction between hazards (whether natural or human-made) and the vulnerabilities present in that environment.

Risk = Probability of Hazard x Degree of Vulnerability

How can we Reduce Risk?



Importance of Vulnerability & Risk Assessment in Pre-Disaster Management

Disasters, whether natural or man-made, can cause widespread damage to life, property, and livelihoods. To minimize these impacts, it is essential to shift from a reactive to a proactive approach. Vulnerability and risk assessment plays a crucial role in this shift by identifying who and what is at risk, enabling better planning, preparedness, and resource allocation in the pre-disaster phase. It forms the foundation of any effective disaster management strategy.

Their Importance:

- **Informs Planning and Policy:** Helps in making evidence-based decisions for land use, urban planning, and infrastructure development. Also, guides investment in mitigation and preparedness.
- **Prioritizes Resources:** Ensures that limited resources are allocated to the most vulnerable populations and high-risk areas.
- **Improves Preparedness:** Identifies potential hazards, exposure levels, and coping capacity of communities. It also helps in designing early warning systems and evacuation plans.
- **Reduces Disaster Losses:** Enables targeted interventions that reduce the human, economic, and environmental impact of disasters.
- **Strengthens Community Resilience:** Builds awareness and capacity at the local level to respond effectively when disasters occur.

Capacity

Capacity in disaster management refers to the ability of individuals, communities, organizations, and systems to anticipate, cope with, respond to, recover from, and adapt to the effects of disasters or emergencies.

Types of Capacity

- **Coping Capacity**: The short-term ability to face and survive a disaster (e.g., using food stocks, evacuating, first aid).
- **Adaptive Capacity**: The ability to adjust to long-term changes, like climate change or recurring floods.
- **Transformative Capacity**: The ability to create lasting changes that reduce future disaster risk (e.g., relocating communities, building stronger institutions).

Classification of Disasters

Disasters can be systematically classified based on their origin (source) and duration (time of onset). This classification helps in better understanding, preparedness, and response planning.

A. Classification Based on Source

1. **Natural Disasters:** These disasters arise from natural forces or phenomena and are generally beyond human control. They are usually categorized as:
   - ✓ **Purely Natural Disasters**: Originating entirely due to natural causes such as Cyclones, Earthquakes, Tsunamis & Volcanic eruptions. These events occur due to meteorological, geological, or biological processes and do not involve direct human causation.
   - ✓ **Socio-Natural Disasters**: These have both natural and human-induced factors contributing to their occurrence or severity. Examples include, floods (exacerbated by encroachment, poor drainage, or deforestation), Landslides (triggered by unregulated construction or mining), Droughts (intensified by over-extraction of groundwater or poor agricultural practices), Forest Fires (due to both lightning & human negligence)

2. **Anthropogenic (Man-made) Disasters:** These disasters stem from human actions (intentional or negligent) & technological failures. They are typically associated with industrial activity, infrastructure, or socio-political conflicts. Examples include, Industrial accidents (e.g., gas leaks, explosions), Chemical or radioactive spills, Pollution-related disasters, Dam failures, Urban fires & Conflict-related disasters, including armed conflicts, terrorist attacks & riots and civil unrest.

B. Classification Based on Duration

1. **Rapid-Onset Disasters:** These disasters occur suddenly and with little or no warning, causing immediate and often widespread destruction. Key characteristics include high intensity, short duration and immediate need for emergency response. Examples: Earthquakes, Cyclones, Flash floods, Tsunamis, Industrial explosions.
2. **Slow-Onset Disasters (Creeping Emergencies):** These evolve gradually over time, and their impacts become visible only after prolonged exposure. Characteristics include long-term impact on ecosystems, economies, and human health. They are often neglected due to lack of immediate visibility & require long-term policy attention & adaptation strategies. Examples include Climate change and global warming, desertification, soil degradation, prolonged droughts & sea level rise.

Disaster Management Cycle

The Disaster Management Cycle refers to the continuous and integrated process of planning, organizing, coordinating, and implementing measures to reduce the impact of disasters, and to prepare for, respond to, and recover from them. It involves both pre-disaster Risk Management & post-disaster Crisis Management.

Phases of the Disaster Management Cycle

A. Pre-Disaster Phase (Before a Disaster): This phase includes risk identification, vulnerability assessment, and measures to prevent or mitigate potential disaster effects.

1. **Prevention**
   - ✓ Long-term actions to stop a disaster from occurring or reduce its impact.
   - ✓ Examples:
     - Earthquake-resistant infrastructure
     - Flood zoning and land-use planning
     - Dams and embankments to control floods
2. **Mitigation**
   - ✓ Efforts to reduce the severity or consequences of disaster impacts.
   - ✓ **Structural Measures:**
     - **Retrofitting of buildings:** Strengthening existing structures to withstand earthquakes, floods, or storms. Especially important for schools, hospitals, and lifeline infrastructure.
     - **Dykes, levees, cyclone shelters:** Constructed along rivers or coasts to prevent flooding or storm surges.
   - ✓ **Non-Structural Measures:**
     - **Insurance:** Helps individuals and businesses recover financially after disasters. Encourages risk-aware behavior by attaching a financial cost to risk exposure.
     - **Building codes:** Ensure new constructions are safe and avoid high-risk zones like floodplains or fault lines.
     - **Environmental laws:** Protect forests, wetlands, and mangroves which act as natural buffers against disasters like floods and cyclones.

3. **Preparedness**
   - ✓ Actions that enhance the capacity to respond effectively to a disaster. Preparedness builds resilience and strengthens response coordination.
   - ✓ Individual Level: First-aid training, emergency kits
   - ✓ Community Level: Community disaster drills, awareness campaigns
   - ✓ Government Level: Early warning systems, evacuation plans, resource stockpiling

B. During Disaster Phase (Disaster Occurrence): This phase includes emergency response operations to minimize damage and assist affected populations.

1. **Evacuation:** Safe removal of people from threatened areas.
2. **Search and Rescue:** Locating and helping people trapped, injured, or in danger.
3. **Relief Measures:** Providing essential services related to Shelter, Food and Water, Medical aid, Psychological first aid, Communication and coordination

C. Post-Disaster Phase (After a Disaster): Focuses on recovery and long-term resilience-building.

1. **Relief**
   - ✓ Immediate humanitarian aid to stabilize victims.
   - ✓ Typically short-term: up to a few weeks.
2. **Rehabilitation**
   - ✓ Medium-term actions to restore basic services and infrastructure.
   - ✓ Examples:
     - Reopening schools, hospitals
     - Temporary housing
     - Livelihood support (seed money, loans)
3. **Reconstruction**
   - ✓ Long-term rebuilding of physical and social infrastructure.
   - ✓ Must integrate disaster-resistant technologies and risk reduction strategies.
4. **Recovery**
   - ✓ Re-establishing a sense of normalcy and community well-being.
   - ✓ Includes economic revival, trauma healing, and future risk-proofing.

Disaster management is essential for reducing the impact of natural and human-made hazards on lives and property. It involves coordinated efforts in preparedness, response, mitigation, and recovery. Building resilient communities through effective planning and awareness is key to minimizing risks and ensuring sustainable development.

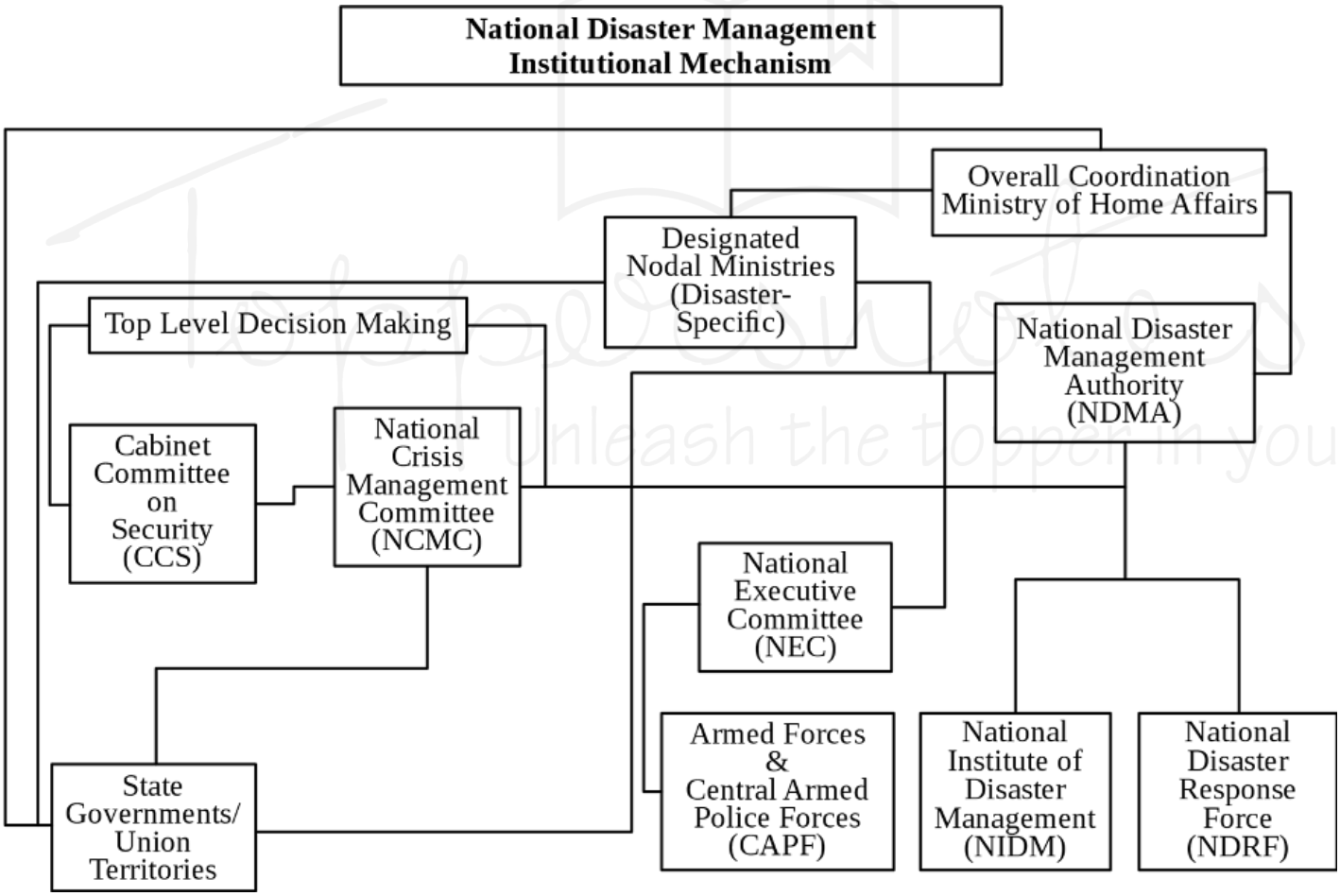
2 CHAPTER

Disaster Management in India

The United Nations International Strategy for Disaster Reduction (UNISDR) defines disaster risk management as a structured approach that involves administrative decisions, organizational measures, operational skills, and societal capacities to implement policies and strategies aimed at reducing the impacts of natural hazards, as well as environmental and technological disasters.

Institutional Framework

In the 1990s, following the declaration of the International Decade for Natural Disaster Reduction, a Disaster Management Cell was established under the Ministry of Agriculture. However, after major calamities such as the Orissa Super Cyclone (1999) and the Bhuj Earthquake (2001), the need for a more comprehensive approach to disaster management became evident. This led to the formulation of a holistic & systematic disaster management framework. As part of this restructuring, in 2002, the responsibility for disaster management was transferred to the Ministry of Home Affairs (MHA).



1. **National Level**
   - ✓ **National Disaster Management Authority (NDMA)**
     - Established under the Disaster Management Act, 2005, under the Ministry of Home Affairs.

- Serves as the apex policymaking body for disaster management in India.
- Responsible for formulating policies, plans, and guidelines for effective disaster response and mitigation.
- Chairperson: The Prime Minister of India.

✓ **National Executive Committee (NEC)**

- Also constituted under the DM Act, 2005.
- Functions as the coordinating and monitoring body for disaster management at the national level.
- Supports the NDMA in implementing disaster management policies and ensuring preparedness and response mechanisms.

✓ **National Disaster Response Force (NDRF)**

- Formed by converting eight battalions of the Central Armed Police Forces into a specialized disaster response force.
- Trained to respond to natural and man-made disasters efficiently and effectively.

2. State Level

✓ **State Disaster Management Authorities (SDMAs)**

- Mandated by the DM Act, 2005, to be established in all states & UTs.
- Responsible for framing state-level disaster management policies and coordinating efforts across departments.
- Chairperson: The Chief Minister of the respective state**.**

✓ **State Executive Committees (SECs)**

- Headed by the Chief Secretary of the state.
- Responsible for implementing the plans and policies laid down by the SDMA and ensuring coordination among various agencies.

✓ **State Disaster Response Force (SDRF)**

- Formed on the lines of the NDRF, each state develops its own specialized disaster response force.
- The SDRF is equipped to handle emergencies at the state level, with training and structure modeled on civil defence mechanisms.

3. District Level

✓ **District Disaster Management Authorities (DDMAs)**

- Established in every district as per the DM Act, 2005.
- Responsible for planning, coordinating, and implementing disaster preparedness and response strategies at the district level.
- Chairperson: The District Magistrate or the Chairperson of the Zila Parishad.

4. Civil Defence Framework

✓ The Civil Defence Act, 1968 was amended in 2010 to better integrate civil defence services into the modern disaster management system.

✓ Civil defence mechanisms now support disaster response activities, especially at the local level.

Disaster Management in India: Laws & Policy Framework

To enhance disaster preparedness and ensure an effective response, the Government of India has developed a comprehensive set of laws, policies, and action plans focused on risk reduction and resilience-building.

1. **Disaster Management Act, 2005:** Enacted in 2005, this landmark legislation marked a shift in India's approach to disaster management, from being reactive and relief-centric to a proactive model emphasizing preparedness, prevention, and risk mitigation. **Key features include:**
   - ✓ Established institutional mechanisms such as the National Disaster Management Authority (NDMA).
   - ✓ Defined roles & responsibilities for authorities at the national, state & district levels.
   - ✓ Promoted the integration of disaster risk reduction (DRR) into development planning.
2. **National Policy on Disaster Management (NPDM), 2009:** The NPDM, introduced in 2009, envisions a disaster-resilient India by adopting a proactive, technology driven, and multi-hazard approach. **Key Highlights include:**
   - ✓ Focuses on all phases of disaster management- prevention, mitigation, preparedness, response, recovery, and reconstruction.
   - ✓ Stresses inclusivity and social equity, ensuring that vulnerable groups are given priority in relief and rehabilitation efforts.
   - ✓ Encourages capacity-building at all levels of governance.
3. **National Disaster Management Plan (NDMP), 2018:** This plan offers a comprehensive framework that addresses the entire disaster management cycle, with a strong emphasis on multi-hazard risk assessment and response. Core principles include:
   - ✓ Integrated approach involving collaboration among central and state governments, private sector, NGOs, and local communities.
   - ✓ Aligns with international standards, particularly the Sendai Framework for Disaster Risk Reduction.
   - ✓ Includes provisions for early warning, community-based preparedness, and post-disaster recovery.
4. **Prime Minister's 10-Point Agenda on Disaster Risk Reduction:** Introduced at the Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR) in 2016, this agenda outlines a broad and inclusive vision for strengthening disaster resilience. **Key areas include:**
   - ✓ Embedding DRR in all development sectors.
   - ✓ Investing in disaster-resilient infrastructure.
   - ✓ Leveraging technology and innovation.
   - ✓ Enhancing community engagement and international cooperation in disaster risk management.

Sendai Framework for Disaster Risk Reduction (2015–2030)

The Sendai Framework was adopted during the Third United Nations World Conference on Disaster Risk Reduction, held in 2015, in Sendai, Japan. This global framework provides a comprehensive roadmap for managing disaster risk across multiple hazards, emphasizing its integration into development planning at all levels and across all sectors. It serves as the successor to the Hyogo Framework for Action (2005–2015): Building the Resilience of Nations and Communities to Disasters, advancing its goals with a stronger focus on risk reduction, resilience building, and sustainable development.

Four Priority Areas for Action

1. **Understanding Disaster Risk**
   - ✓ Improve knowledge of disaster risk in all its dimensions (hazards, exposure, vulnerability, capacity).
   - ✓ Promote risk-informed decision-making and education.
2. **Strengthening Disaster Risk Governance**
   - ✓ Establish clear roles and coordination among institutions.
   - ✓ Integrate disaster risk management into laws, policies, and plans.
3. **Investing in Disaster Risk Reduction for Resilience**
   - ✓ Allocate resources to reduce risks through structural and non-structural measures.
   - ✓ Enhance infrastructure, health systems, and social services to withstand disasters.
4. **Enhancing Disaster Preparedness for Effective Response and "Build Back Better" in Recovery, Rehabilitation, and Reconstruction**
   - ✓ Strengthen early warning systems and emergency response.
   - ✓ Reconstruct in a way that reduces future risks and increases resilience.

Seven Global Targets

1. **Substantially reduce global disaster mortality:** By 2030, lower average global deaths per 100,000 people.
2. **Substantially reduce the number of affected people:** Focus on reducing disaster-related injury, displacement, and disruption.
3. **Reduce direct economic losses:** Especially in relation to global GDP
4. **Reduce disaster damage to critical infrastructure** and disruption of basic services including health, education, water and transport.
5. Increase the number of countries with national and local disaster risk reduction strategies by 2020.
6. Enhance international cooperation to developing countries through adequate support like technology transfer, capacity building and financial support.
7. Increase the availability and access to multi-hazard early warning systems and disaster risk information by 2030, especially for vulnerable communities.

Difference Between Sendai Framework and Hyogo Framework for Action

Aspect	Hyogo Framework for Action (2005–2015)	Sendai Framework for Disaster Risk Reduction (2015–2030)
Main Goal	Reduce disaster losses in lives and property	Prevent and reduce disaster risk and losses in lives, livelihoods, and health
Approach	Focus on disaster management and preparedness	Emphasis on disaster risk reduction and resilience
Scope of Hazards	Primarily natural disasters	All types of hazards: natural, man-made, biological, technological
Number of Priorities	5 Priorities for Action	4 Priority Areas
Priorities for Action	Governance, Risk identification, Knowledge, Risk reduction & Preparedness	Understand risk, Risk governance, Investment, Preparedness and "Build Back Better"

Targets	No specific targets	7 global targets with measurable indicators
Accountability Mechanism	Weak monitoring and reporting systems	Stronger monitoring: Sendai Monitor, global indicators
Stakeholder Inclusion	Government-led; limited inclusion of communities	Multi-stakeholder approach: includes communities, NGOs, private sector

Traditional vs. Recent Disaster Management Approaches in India

In recent years, the Government of India has moved towards a proactive, holistic, and risk-based approach that emphasizes preparedness, mitigation, early warning & resilience building. This shift is evident in the legislative framework, institutional setup, technological interventions, and community participation initiatives. The table highlights the key differences between the traditional and the recent approaches to disaster management in India.

Aspect	**Earlier Reactive Approach**	**Recent Proactive Approach**
Focus	Post-disaster relief and rehabilitation	Pre-disaster risk reduction, preparedness, and resilience
Approach Type	Relief-centric	Holistic and integrated (prevention, mitigation, preparedness, response, recovery)
Legal Framework	Ad hoc mechanisms	Institutionalized under Disaster Management Act, 2005
Key Institutions	Relief Commissioner (state-level only)	National Disaster Management Authority (NDMA), SDMAs, NIDM, NDRF
Community Involvement	Minimal	Emphasis on Community-Based Disaster Risk Management (CBDRM)
Technology Use	Limited to response (e.g., rescue communication)	Use of GIS, remote sensing, early warning systems, mobile apps like SACHET
Capacity Building	Focus on government response teams only	Regular training of officials, communities, and students through mock drills and programs
Disaster Mitigation Funding	Reliant on post-disaster allocations	Pre-allocated funds like National Disaster Response Fund (NDRF) and State Disaster Mitigation Fund (SDMF)
Multi-Hazard Preparedness	Focused mostly on floods and droughts	Inclusive of cyclones, earthquakes, landslides, heatwaves, pandemics, urban floods
Infrastructure Standards	Not disaster-resilient	Promotion of Build Back Better, disaster-resilient infrastructure via initiatives like Coalition for Disaster Resilient Infrastructure (CDRI)
Climate Change Linkages	Ignored	Integrated with National Action Plan on Climate Change (NAPCC) and SAPCCs
Private Sector & NGO Role	Minimal collaboration	Public-private partnerships (PPP) and NGO involvement in response, relief, and awareness

Disaster Resilience

Disaster resilience refers to the ability of individuals, communities, institutions, systems, and societies to anticipate, absorb, adapt to, and recover from the effects of hazardous events in a timely and efficient manner. It includes minimizing the damage caused by disasters, restoring functionality quickly, and learning and adapting to reduce future vulnerabilities.

Determination of Disaster Resilience:

Disaster resilience is influenced by multiple social, economic, environmental and institutional factors, such as:

Factor	Explanation
Exposure to hazards	Geographic location and proximity to disaster-prone areas.
Vulnerability level	Socio-economic status, physical infrastructure, gender, disability, etc.
Preparedness & planning	Availability of early warning systems, emergency plans, drills.
Institutional capacity	Strength and coordination of local governance and disaster management systems.
Recovery capacity	Ability to rebuild and restore services and livelihoods.
Community awareness	Knowledge and behavior of the population regarding risk reduction.

Elements of a Resilience Framework

A comprehensive resilience framework includes both proactive and reactive measures, and typically consists of the following elements:

1. **Risk Identification and Assessment:** Hazard mapping, vulnerability and exposure assessment helps in understanding who and what is at risk.
2. **Preparedness and Early Warning:** Community-based disaster preparedness (CBDP) and investment in early warning systems (EWS), contingency planning, and mock drills.
3. **Infrastructure and Systems Resilience:** Disaster-resilient infrastructure (e.g., flood-resistant housing, earthquake-safe schools) ensures functional continuity of hospitals, transport, water, and energy systems.
4. **Social and Economic Resilience:** Social protection schemes (e.g., crop insurance, MGNREGA in India) helps in livelihood diversification and financial inclusion.
5. **Governance and Institutional Capacity:** Legal and policy frameworks (e.g., DM Act 2005 in India). Also, Multi-level coordination between central, state, and local bodies.
6. **Recovery and Adaptive Capacity:** Speed and effectiveness of post-disaster recovery. Also, the ability to learn from past events and incorporate lessons into future planning (e.g., "Build Back Better" principle).

The Road Ahead for Strengthening India's Disaster Resilience

To build a robust and adaptive disaster resilience framework, India must adopt a multi-pronged, forward-looking approach that integrates risk, technology, infrastructure, community engagement, and environmental sustainability.

1. **Risk-Informed Governance and Planning:** Disaster risk considerations must be fully embedded into development planning and budget allocations. Additionally, investing in ecological buffers such as wetlands, mangroves, and natural drainage systems can offer sustainable, long-term protection against climate-induced hazards.

2. **Technological Modernisation and Early Warning Systems:** India should deploy advanced, hyper-local multi-hazard early warning systems supported by IoT-based micro-sensors to monitor parameters like river flow, slope stability, and soil moisture. Real-time, geo-tagged alerts disseminated through standardized platforms can enhance preparedness at the grassroots level.
3. **Climate-Resilient Infrastructure Development:** It is essential to enforce disaster-resilient construction norms, particularly in hazard-prone regions. Retrofitting critical infrastructure built before 2005 and integrating climate risk assessments into all future infrastructure projects can significantly reduce vulnerabilities.
4. **Community-Centric Preparedness and Empowerment:** District Disaster Management Authorities should be empowered with greater legal authority, technical expertise, and financial autonomy. At the community level, contingency plans must be developed at the village & ward levels to enable a first-response capability.
5. **Strengthening Local Capacity:** Decentralizing decision-making and equipping local institutions with adequate resources and training will enhance frontline preparedness.
6. **Enhanced Institutional Synergy:** A well-coordinated disaster response requires integrated planning across government agencies and inclusion of private sector capabilities beyond token corporate social responsibility.
7. **Financial Preparedness and Risk Transfer Mechanisms:** Expanding access to disaster insurance and establishing dedicated resilience funds are essential steps toward economic preparedness.
8. **Ecological Restoration for Resilience:** Restoring natural ecosystems such as mangroves, forests, and wetlands must be treated as core infrastructure for disaster management.
9. **Capacity Building in Health and Social Resilience:** India should invest in large-scale training of women as disaster volunteers to strengthen grassroots networks.

India's disaster resilience remains vulnerable; however, adopting a comprehensive approach that prioritizes strategic planning, advanced early warning systems, resilient infrastructure, empowered communities, local capacity-building, nature-based solutions, and targeted training can significantly enhance preparedness, minimize losses, and advance progress toward the Sustainable Development Goals (SDGs). This integrated effort can set India firmly on the path to becoming a disaster-resilient nation by 2047.

3 CHAPTER

Disasters in India

India is one of the most disaster-prone countries in the world, owing to its geographical diversity, climatic variations, dense population, and socio-economic vulnerabilities. From earthquakes in the Himalayas, floods in the Gangetic plains, and cyclones along the eastern and western coasts, to droughts in central and western regions, the country is exposed to a wide range of natural hazards. Additionally, man-made disasters such as industrial accidents, fires, chemical leaks, and transport mishaps pose significant challenges.

India's vulnerability profile (Natural Disasters)

India's vulnerability profile is shaped by its geographical diversity, dense population, ecological fragility & socio-economic factors, making it highly prone to multiple natural & man-made disasters.

Multi-Hazard Vulnerability

Hazard Type	Extent of Vulnerability
Earthquakes	India lies on the seismically active boundary between the Indian and Eurasian tectonic plates, making it highly vulnerable to earthquakes. Approximately 58% of India's landmass is prone to seismic activity, classified under Seismic Zones III, IV, and V, with Zone V being the most severe. High-risk regions include: ➢ The entire Himalayan belt (Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh) ➢ The North-Eastern states (Assam, Nagaland, Manipur, Mizoram) ➢ Parts of Bihar, Gujarat & the Andaman & Nicobar Islands ➢ Urban centers like Delhi are also in Zone IV.
Floods	Flooding is one of the most frequent and widespread natural disasters in India. Nearly 12% of India's total land area is flood-prone, with over 75 lakh people affected annually. States highly vulnerable to floods include Bihar, Uttar Pradesh, West Bengal, Assam, Odisha, and parts of Punjab and Maharashtra.
Cyclones	India's long coastline, stretching over 7,500 km, of which approximately 5,700 km is prone to cyclonic storms, makes it highly susceptible to tropical cyclones, especially on the east coast bordering the Bay of Bengal. ➢ Eastern coastal states such as Odisha, Andhra Pradesh, West Bengal & Tamil Nadu face more frequent cyclones. ➢ The western coast (e.g., Gujarat and Maharashtra) is also increasingly affected (e.g., Cyclone Nisarga, Tauktae). ➢ The Andaman & Nicobar Islands are exposed to both cyclones and associated storm surges.

Drought	Around 68% of India's cultivable area is drought-prone. These areas suffer from low rainfall, groundwater depletion, and water mismanagement. Regions vulnerable to drought include Rajasthan, Maharashtra, Gujarat, Karnataka, Andhra Pradesh, Tamil Nadu, Jharkhand, and parts of Madhya Pradesh and Uttar Pradesh.
Landslides	Landslides primarily affect the hilly and mountainous regions of India, particularly during the monsoon or following earthquakes and construction activities. Vulnerable areas include: ➢ The Western Himalayas (Himachal Pradesh, Uttarakhand, Jammu & Kashmir) ➢ The Eastern Himalayas and North-Eastern states (Sikkim, Arunachal Pradesh, Nagaland) ➢ The Western Ghats and Nilgiris in southern India
Tsunamis	Though rare, tsunamis pose a significant threat to the eastern coast of India and the Andaman & Nicobar Islands. The 2004 Indian Ocean tsunami, triggered by a massive undersea earthquake, caused widespread devastation in Tamil Nadu, Andhra Pradesh, Kerala, and the Andaman & Nicobar Islands, claiming over 10,000 lives in India alone. The Indian Ocean remains seismically active, and the presence of submarine fault lines means eastern coastal regions must remain vigilant.
Industrial/Man-made	India's growing industrial base and urbanization have increased exposure to man-made hazards, including: ➢ Chemical leaks and industrial explosions (e.g., Bhopal Gas Tragedy, Vizag gas leak 2020) ➢ Transport-related disasters (train derailments, plane crashes, tanker accidents) ➢ Urban fires in congested markets or illegal buildings (e.g., Delhi's Karol Bagh fire 2019) ➢ Stampedes during festivals or religious gatherings (e.g., Kumbh Mela, temple events)

Factors Contributing to Vulnerability

1. **Geographical Factors**
   - ✓ Location at the intersection of Indian & Eurasian plates → seismic risk.
   - ✓ Long coastlines exposed to cyclones & tsunamis.
   - ✓ River systems (e.g. Ganga, Brahmaputra) → flood prone plains.
2. **Environmental Factors**
   - ✓ Deforestation, encroachments & land degradation increase flood, landslide & drought risks.
   - ✓ Urban heat islands & water scarcity due to unplanned urbanization.
3. **Social and Economic Factors**
   - ✓ High population density, poverty, illiteracy & lack of awareness.
   - ✓ Migration & informal settlements in hazard-prone zones.
   - ✓ Weak enforcement of building codes and disaster-resistant planning.
4. **Institutional and Infrastructure Gaps**
   - ✓ Inadequate early warning systems in interior regions.
   - ✓ Gaps in disaster-resilient infrastructure.
   - ✓ Limited inter-agency coordination & community preparedness**.**

Disaster	Nodal Ministry / Department
Biological	Ministry of Health and Family Welfare (MoHFW)
Chemical and Industrial	Ministry of Environment, Forests and Climate Change (MoEFCC)
Civil Aviation Accidents	Ministry of Civil Aviation (MoCA)
Cyclone / Tornado	Ministry of Earth Sciences (MoES)
Tsunami	Ministry of Earth Sciences (MoES)
Drought / Hailstorm / Cold Wave and Frost / Pest Attack	Ministry of Agriculture and Farmers Welfare (MoAFW)
Earthquake	Ministry of Earth Sciences (MoES)
Flood	Ministry of Water Resources (MoWR)
Forest Fire	Ministry of Environment, Forests and Climate Change (MoEFCC)
Landslides	Ministry of Mines (MoM)
Avalanche	Ministry of Defence (MoD)
Nuclear and Radiological Emergencies	Department of Atomic Energy (DAE)
Rail Accidents	Ministry of Railways (MoR)
Road Accidents	Ministry of Road Transport and Highways (MoRTH)
Urban Floods	Ministry of Urban Development (MoUD)

Earthquakes

An earthquake is the sudden shaking or movement of the Earth's crust caused by the release of energy accumulated due to tectonic stresses. The point inside the Earth where the earthquake starts is called the focus or hypocenter, and the point directly above it on the surface is the epicenter.

Causes of Earthquakes: Earthquakes are mainly caused by tectonic movements along plate boundaries, but can also be triggered by volcanic activity, nuclear explosions, or reservoir-induced seismicity. There are 3 primary types of plate boundaries where earthquakes are common:

- **Divergent:** Plates move away from each other
- **Convergent:** Plates collide with each other
- **Transform:** Plates slide past each other horizontally

Earthquake Risk in India: India lies on the Alpine-Himalayan seismic belt, where the Indian Plate is thrusting under the Eurasian Plate at ~5 cm/year. This makes Northern India and Northeast India highly seismically active.

Major Seismic Zones: India is divided into 4 seismic zones (Zone II to Zone V) based on earthquake risk.

Zone	Risk Level	States/Regions Covered
Zone V	Very High Risk	NE India, J&K, Himachal, Uttarakhand, Andaman & Nicobar, parts of Bihar, Gujarat
Zone IV	High Risk	Delhi, Haryana, parts of Maharashtra, Punjab, parts of Rajasthan
Zone III	Moderate Risk	Kerala, Goa, parts of MP, Tamil Nadu, Karnataka
Zone II	Low Risk	Remaining parts of Peninsular India

Other Seismically Active Regions

- **Rann of Kutch & Gulf of Khambhat** (Gujarat)
- **Andaman & Nicobar Islands**
- **Latur and Killari region** (Maharashtra) – Intracratonic earthquakes
- **Peninsular India** – Once considered stable, now witnessing moderate seismicity