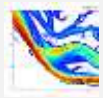
DISASTER MANAGEMENT FOR MULTI HAZARD INDIA

Overview

Introduction of concepts, Mandate to State Governments and SDMA

Overview on Vulnerability analysis and Risk assessment

Paradigm shift in the approach of disaster management



Preparedness in the State Government and Quick response mechanism

Emergency and Safety management process

Participatory Management for Disaster Mitigation

Conceptual Framework

Disaster • Hazard • Risk • Resilience

- **Hazard** natural or human-induced event with potential to cause harm

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- **Exposure** – people, assets, systems in harm's way

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- **Vulnerability** – conditions increasing the likelihood of damage

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- **Risk** – probability and consequences of harmful effects

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- **Disaster** – severe disruption exceeding local capacity

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- **Resilience** – ability to anticipate, absorb, adapt, and recover

India highly exposed to extreme weather events

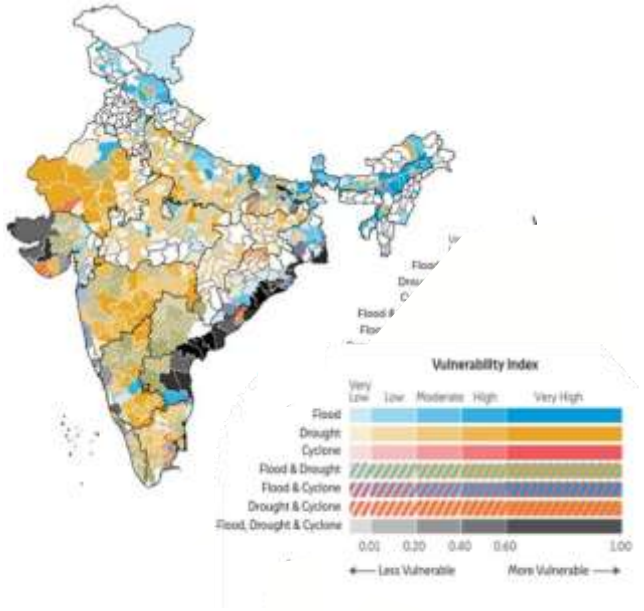
The problem:

- India is ranked as the **7th** most vulnerable country globally to the impacts of climate change (MoF, 2025)
- Nearly **80%** of India's people, infrastructure, ecosystems, and livelihoods are vulnerable to climate change impacts (CEEW, 2021)

Scale:

Total population of India (July 2023): **139.23 Crore**[1], 48.4% women

Impact of Climate Change across sectors: **Agri, health, water, energy**



Impact of climate change on agriculture:

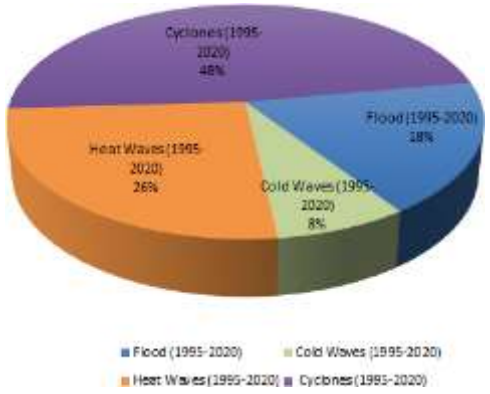
46% population **dependent on agriculture**

70 million ha crop area damaged between 2015/16 and 2021/22

USD 7 billion economic **loss due to crop damage** by 2030

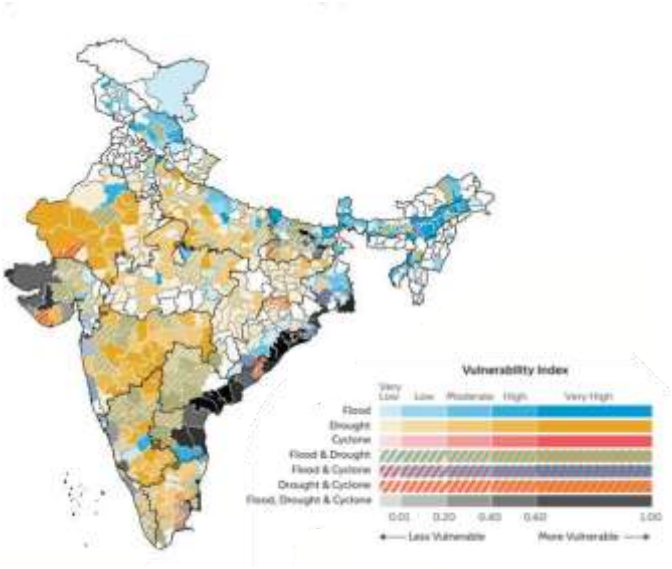
15% GDP contribution

Frequency of Extreme Events



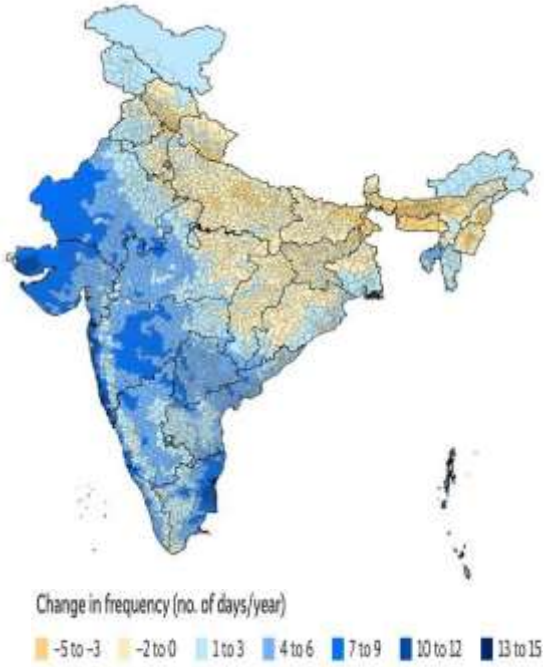
Rise in frequency and intensity of extreme climate events

Hotspots of extreme events



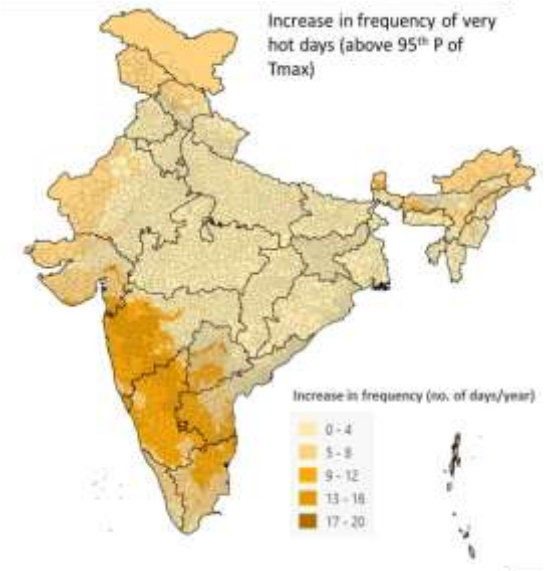
- **5 out of 20 Indians** are highly vulnerable to floods, cyclones as well as droughts.
- **More than 80%** of India's population lives in districts highly vulnerable to extreme hydro-met disasters

Change in heavy rainfall days



- **55% of tehsils witnessed an increase and 11 per cent witnessed a decrease** in southwest monsoon rainfall in the past decade (2012-2022)

Increase in Heatwaves



- Current trends and future climate projections for India indicate an **escalation in the intensity, frequency, and duration of heat waves.**

Climate Risk Assessmentof India

Very high risk:

Andhra Pradesh, Himach Pradesh, J&K Karnataka, Kerala, Odisha, Maharasl Sikkim, T.N, Uttarakhanc

High-risk:

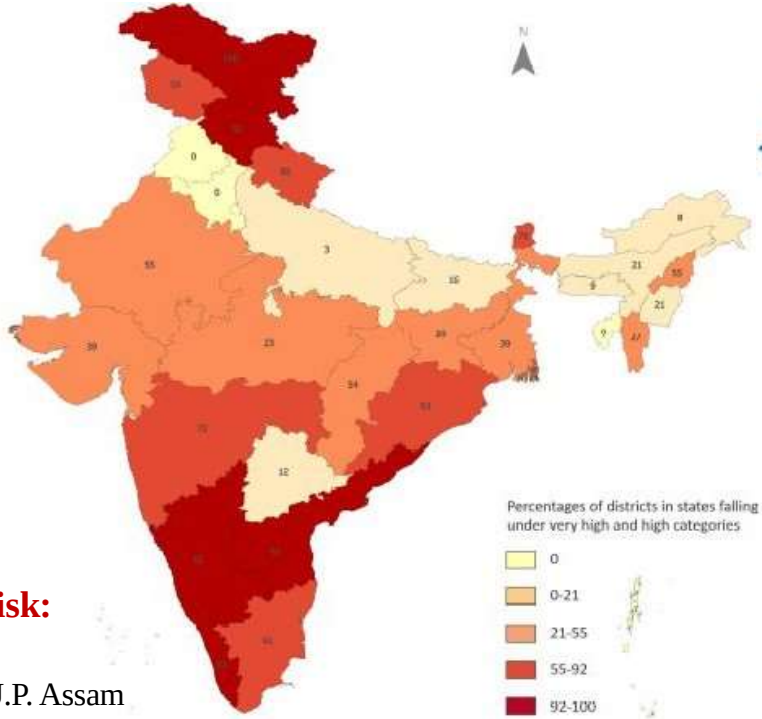
Chhattisgarh, Gujarat, Rajasthan, Madhya Pradesh, West Bengal.

Moderate-risk:

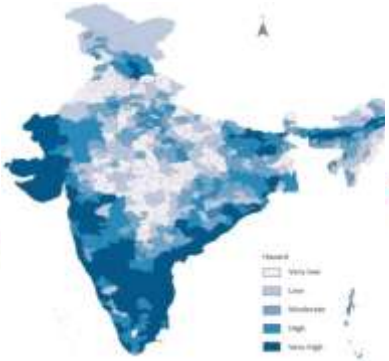
Madya Pradesh, Gujrat, Jharkhand

Low- and Very low-risk:

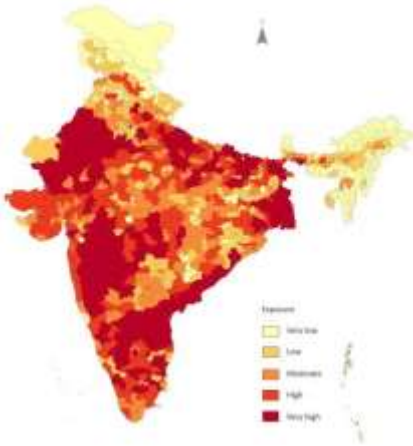
Delhi, Punjab, Haryana, U.P. Assam



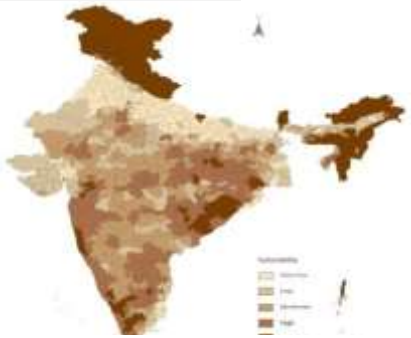
Hazard



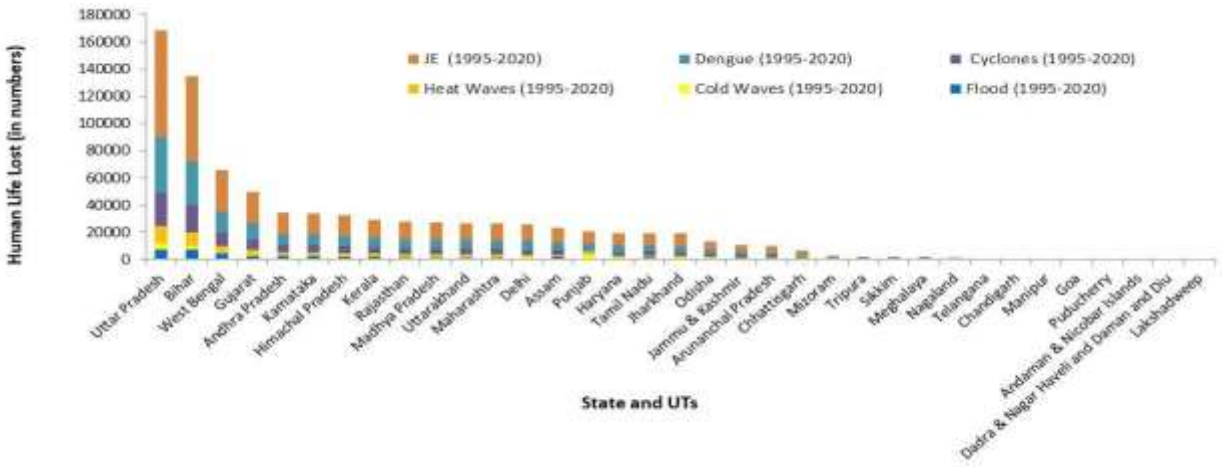
Exposure



Vulnerability



Category	Number of districts
Very High	151
High	266
Moderate	201
Low	78
Very low	36



Impact of Extreme Weather Events at the Ground Level

Agriculture

Climate change poses double whammy for Bihar — floods in 5 districts despite 26% rainfall deficit across state

Erratic weather patterns have been disappointing farmers in Bihar for last 10 years

Climate Change

Climate crisis in North East India: How flooding shifted a village in Assam's Dhemaji

The Kumutiya river floods every year, destroying crops and houses. The river has shifted 3 km since 1960, and an entire village has had to shift with it

Forest dwellers struggle amid depleting forest resources

Water and food shortage imminent in the Himalayas

Experts at IUCN conference in Pakistan sound the alarm for global warming and the resultant food insecurity in Asia

Wayanad landslides: How two villages vanished overnight

Springs are drying up across Himachal Pradesh

Over two-thirds of traditional water sources in the Himalayan state of Himachal Pradesh are dead; experts blame climate change and human activities

The scenic Indian villages devastated by deadly landslides

Recently India are adversely impacted by floods and cyclones

2024

Prolonged floods give rise to vector-borne diseases in Assam, 122 related deaths

The state health department has reported 503 JE cases and 1300 cases of AES.

2021

Telangana's rural hospitals low on beds, manpower: Niti Aayog

In Niti Aayog's report, which analyses the performance of district hospitals in the country, Telangana fares well in support services, paramedic strength.

2018

125-Year-Old Hospital, Among The Best In Country, Ruined In Kerala Floods

The floods have destroyed medicines worth ₹ 1.5 crore, and equipment, including dialysis, ultrasound machines worth ₹ 2.5 crore

ESI Hospital, Chennai, 2023

Nalanda Medical College, Patna, 2018

Overview of Disaster Management Plan

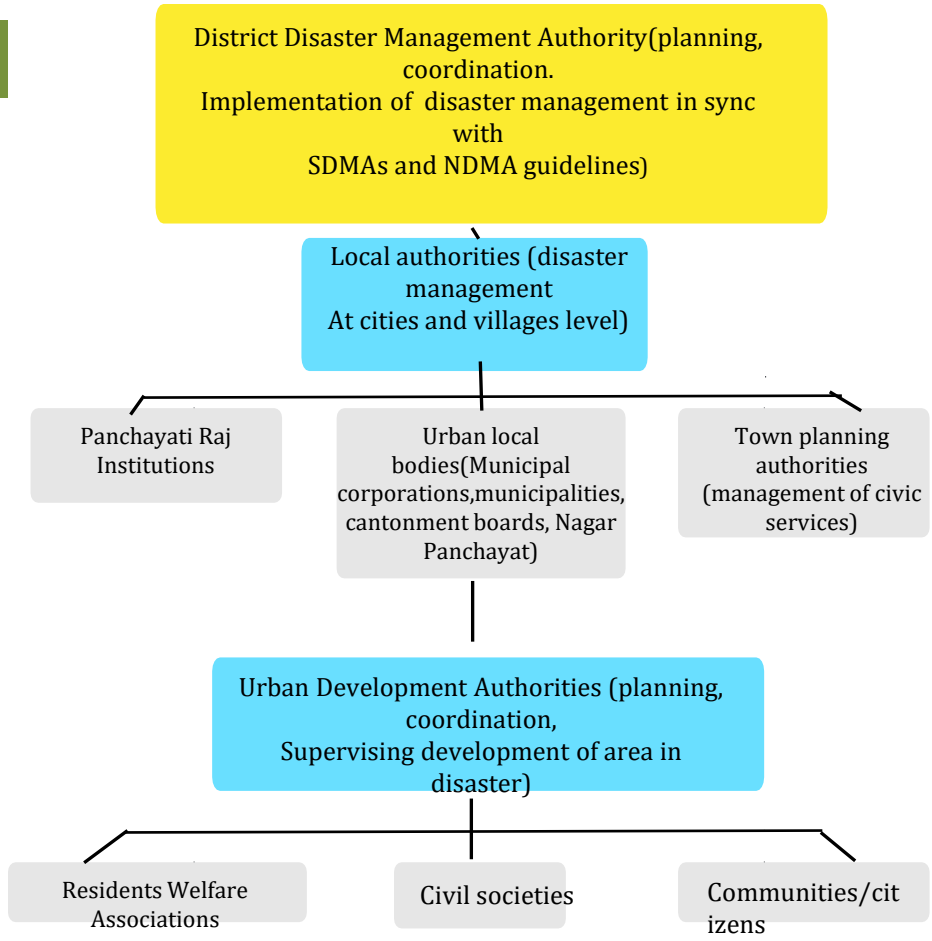
Strategic Lessons and recommendation

•Community-level: traditional water mgmt, elevated structures, crop switching, warning dissemination.

• Institutional: NDMA–SDMA–DDMA mechanisms, disaster-specific guidelines, NDRMF financing.

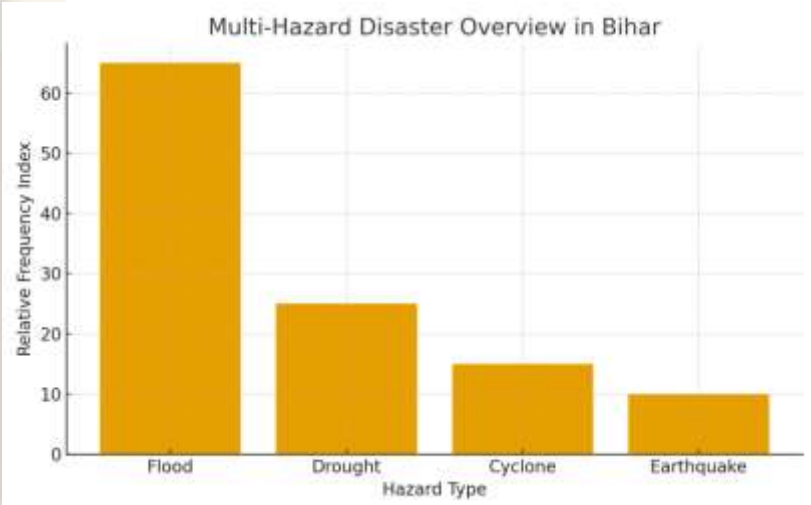
• Climate Change: States needing priority—Floods (UP, Bihar, Assam); Droughts (Rajasthan); Heat waves (Rajasthan, Maharashtra, MP); Cyclones (Maharashtra, Gujarat, Kerala).

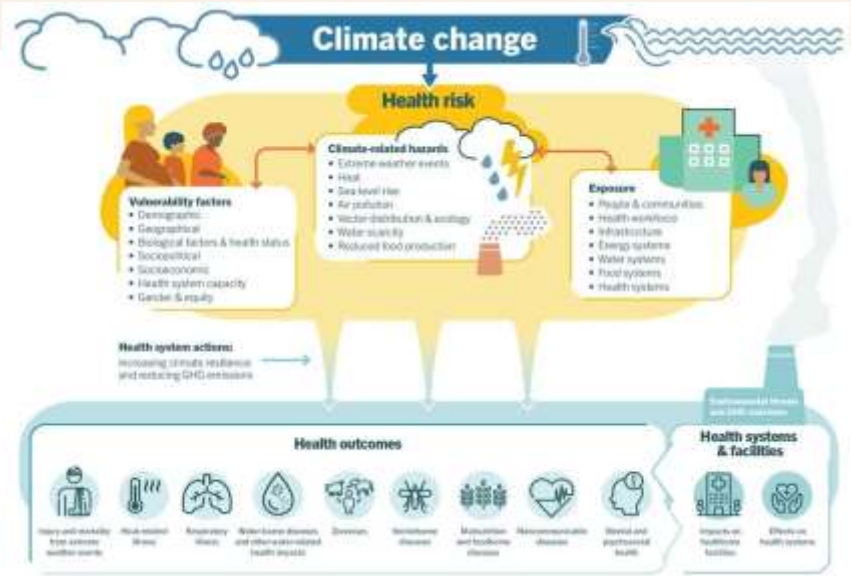
• Recommendation: Strengthen DRR mainstreaming, multi-hazard early warning, poverty-linked vulnerability targeting, climate-smart development.

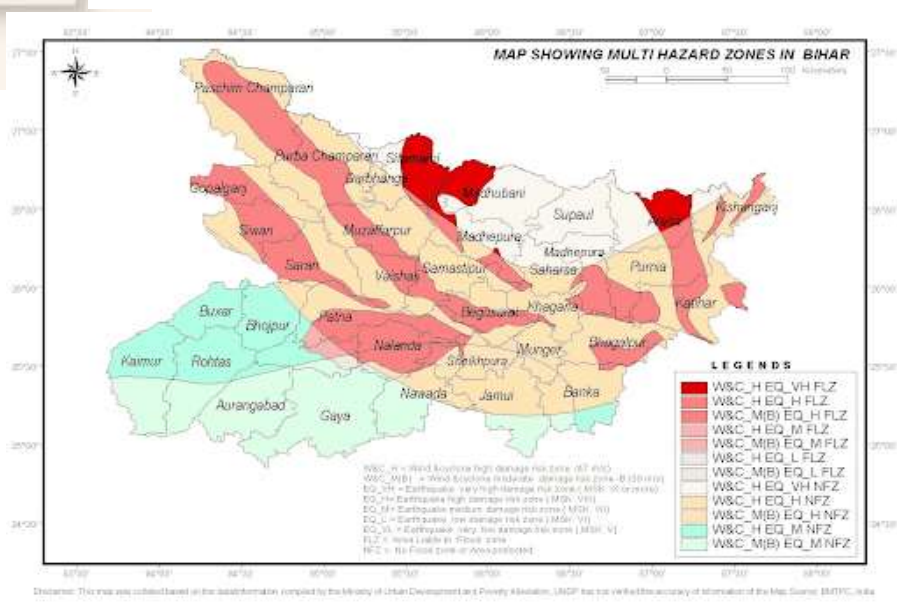


District Level Disaster Respond Mechanism

Disaster Profile of Bihar: A Snapshot







Disaster Profile of Bihar: A Snapshot

Underlying Drivers of Vulnerability

- **High Population Density:** Leads to more people being affected per square kilometer.
- **Widespread Poverty:** Limits people's capacity to cope with and recover from disasters.
- **Siltation of Rivers:** Reduces water-carrying capacity, exacerbating floods.
- **Unplanned Urbanization:** Especially in Patna, leading to waterlogging and increased risk during floods and earthquakes.

Overall Impact

The cycle of disasters in Bihar results in:

- **Human Tragedy:** Loss of life, injury, and psychological trauma.
- **Economic Losses:** Repeated damage to agriculture (the mainstay), infrastructure, and property stalls development.
- **Development Setbacks:** Resources that could be used for growth are constantly diverted to relief and reconstruction, creating a **poverty-disaster cycle**.

In short, Bihar's disaster profile is dominated by **annual floods** and the looming threat of a **major earthquake**. Its high vulnerability, driven by geography and socio-economic factors, makes disaster risk reduction not just a relief activity but a core requirement for the state's sustainable development.

Flood Disaster

Floods in Bihar are not an occasional disaster but an **annual, predictable phenomenon** that shapes the state's geography, economy, and social fabric.

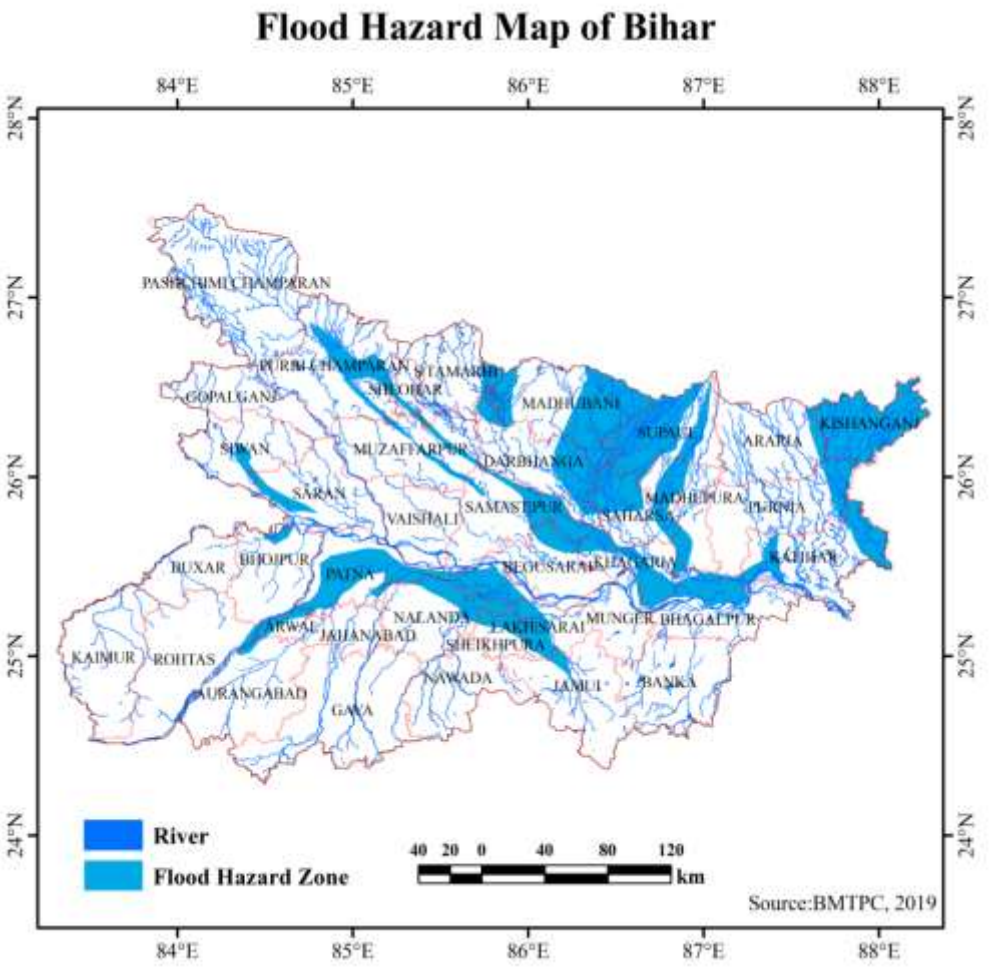
Core Reasons:

1.Geographical Destiny: Bihar is a downstream state for major Himalayan rivers like the **Kosi, Gandak, and Bagmati**. These rivers carry a massive amount of silt from the mountains, raising their riverbeds and causing them to change course frequently.

2.The "Sorrow of Bihar": The **Kosi River** is particularly notorious. It has shifted its course over 160 km westwards in the last 250 years. Embankments built to control it have often trapped water inside, worsening waterlogging.

3.Heavy Monsoon Rainfall: Intense rainfall in the catchment areas of Nepal and North Bihar leads to a sudden surge of water that the plains cannot drain quickly.

Bihar's floods are a complex, man-made exacerbated natural disaster. They are a cycle of destruction that the state is forced to manage rather than solve, with the common citizen bearing the brunt of the collateral damage between the Himalayas and the Gangetic plains.



Flood Disaster

Key Impacts:

•**Human & Social:** Widespread displacement, loss of lives (human and livestock), destruction of homes, and outbreaks of water-borne diseases.

•**Economic:** Submergence of agricultural land (the backbone of Bihar's economy), destruction of crops, damage to infrastructure (roads, bridges), and a huge financial burden on relief and rehabilitation.

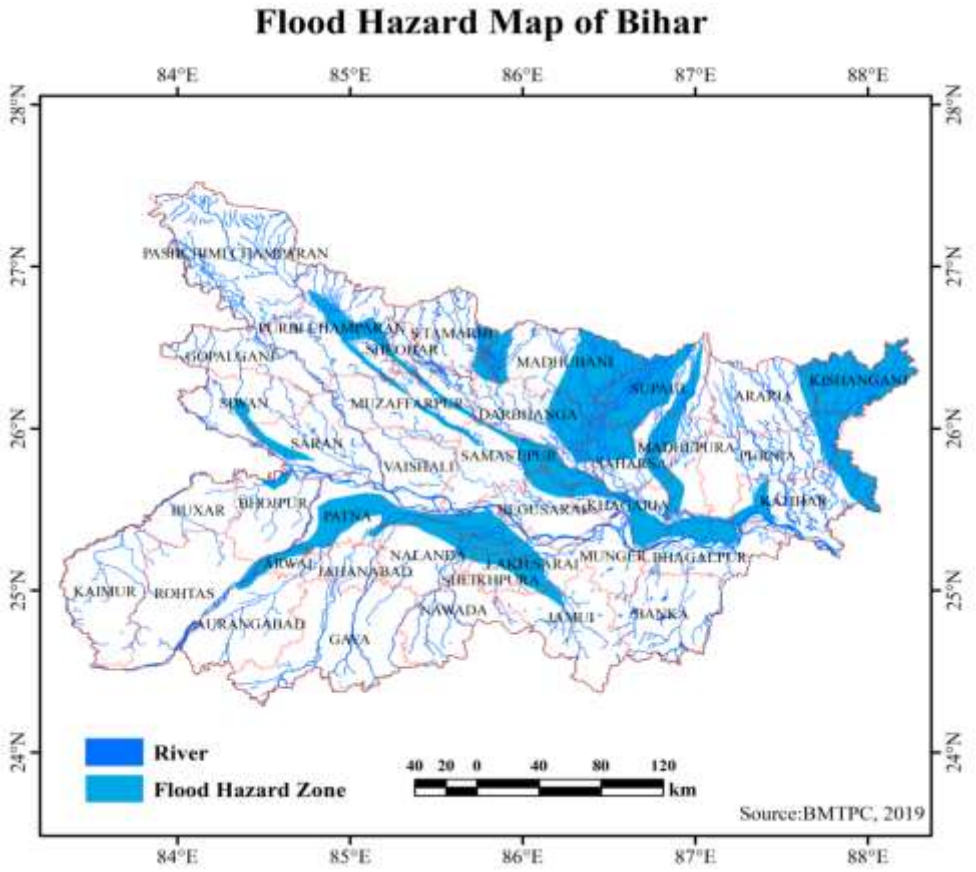
•**Environmental:** Soil erosion, loss of topsoil, and sedimentation that affects long-term agricultural productivity.

Management & Challenges:

•**Structural Measures:** The primary response has been building **embankments** (over 3,000 km). However, these are often breached, and their silting leads to waterlogging, creating a "flood-protected but drainage-denied" scenario.

•**Non-Structural Measures:** Early warning systems and disaster management plans exist but face challenges in last-mile connectivity and execution.

•**The Biggest Challenge:** A **transboundary issue**. The rivers originate in Nepal, requiring robust bilateral cooperation for effective water and catchment area management, which has been historically difficult to achieve.



Earthquake Disaster

1. The Primary Cause: The Himalayan Thrust

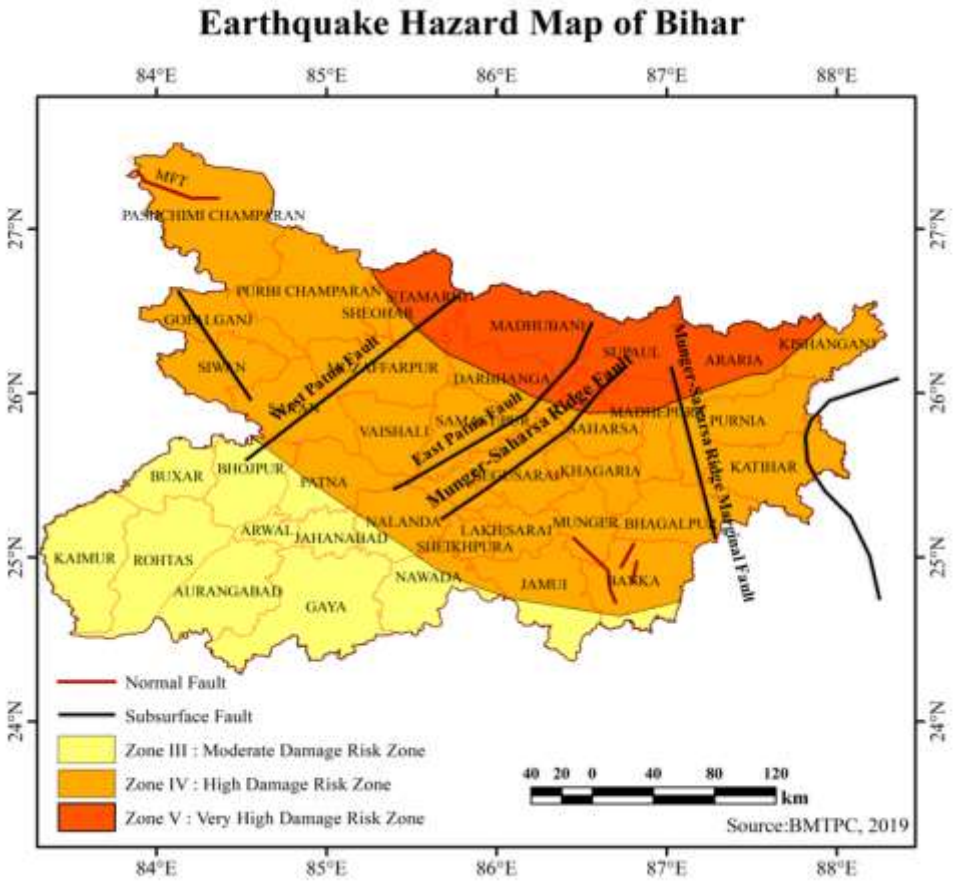
Bihar sits on the Gangetic plains but is critically close to the active and massive **Himalayan Frontal Thrust**. This is where the Indian tectonic plate is continuously pushing under the Eurasian plate, building up immense stress that is released as earthquakes.

2. History: A Legacy of Devastation

Bihar's history is marked by catastrophic earthquakes, proving its high vulnerability:

•1934 Bihar-Nepal Earthquake (Magnitude 8.2): One of the worst in Indian history. It destroyed vast areas of Northern Bihar, including Muzaffarpur and Darbhanga, and caused widespread liquefaction (sand and water spewing from the ground), which amplified the damage.

•1988 Bihar-Nepal Earthquake (Magnitude 6.6): A more recent reminder of the region's susceptibility, causing significant damage and loss of life.



Earthquake Disaster

3. High Risk & Vulnerability:

•**Seismic Zone:** Most of North Bihar falls under **Seismic Zone V** (very high risk) and **Zone IV** (high risk) on India's seismic map.

•**Amplification by Soil:** The soft alluvial soil of the Gangetic basin amplifies seismic waves, making the shaking more intense than in rocky areas.

•**Population Density & Infrastructure:** A very high population density and the presence of many old, non-earthquake resistant buildings make the region extremely vulnerable to high casualty rates.

4. Potential Impact:

A major earthquake in this region today would be catastrophic due to:

•**Liquefaction:** This remains the biggest threat, causing buildings and bridges to sink or collapse.

•**High Casualties:** The combination of strong shaking, weak infrastructure, and dense population.

•**Damage to Lifelines:** Critical disruption of roads, bridges, and communication lines.

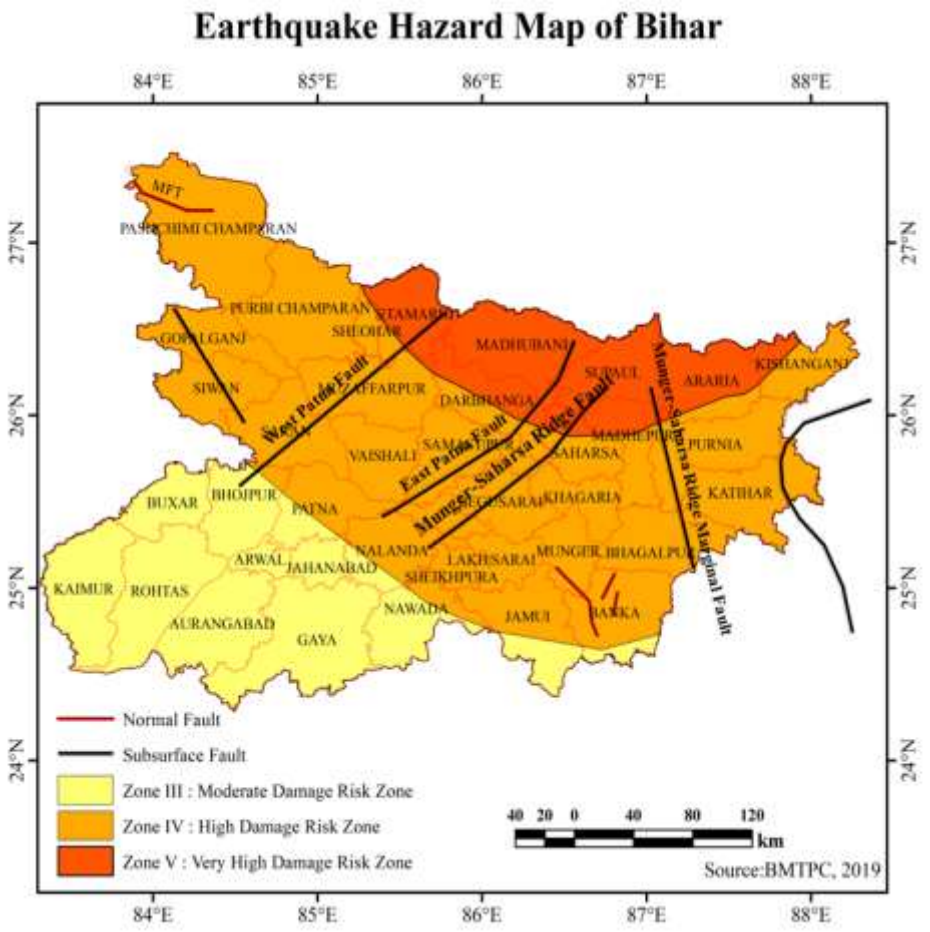
5. Preparedness:

There is a growing emphasis on:

•Enforcing building codes for earthquake-resistant construction.

•Public awareness and disaster response drills.

•Strengthening early warning systems.



Wind Hazard

1.Thunderstorms & Squalls (Norwesters):

1. **Nature:** Locally known as "**Kal Baisakhi**," these are violent evening thunderstorms common in the pre-monsoon months (April-June).

2. **Impact:** They bring sudden, high-velocity winds (often 70-100 km/h), heavy rain, and lightning, causing widespread damage to huts, trees, electricity poles, and standing crops.

2.Cyclonic Storms:

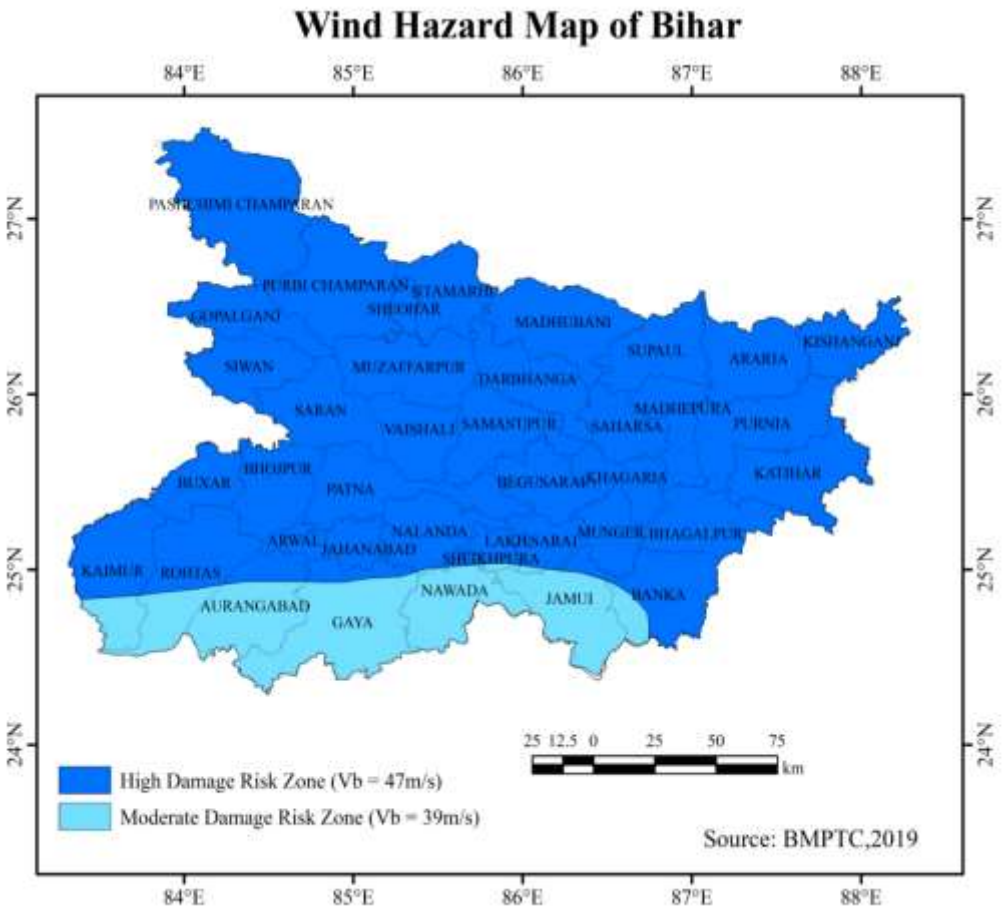
1. **Nature:** Bihar is occasionally affected by the remnants of cyclonic storms that originate in the Bay of Bengal. While they lose energy over land, they still bring very strong winds and torrential rain.

2. **Impact:** These events lead to severe flooding and wind damage, compounding the disaster. Examples include Cyclone Aila (2009) and Cyclone Amphan (2020).

3.Dust Storms:

1. **Nature:** Occur during the summer, especially in the western parts of the state, carrying large amounts of dust and sand.

2. **Impact:** Reduce visibility to zero, disrupt transport, and can cause respiratory problems.



Wind Hazard

Primary Impacts:

•**Human Casualties:** Due to collapsing structures, falling trees, and lightning.

•**Agricultural Loss:** Widespread flattening of staple crops like wheat and pulses, devastating farmers' livelihoods.

•**Infrastructure Damage:** Destruction of kutcha houses, damage to power grids, communication towers, and roads.

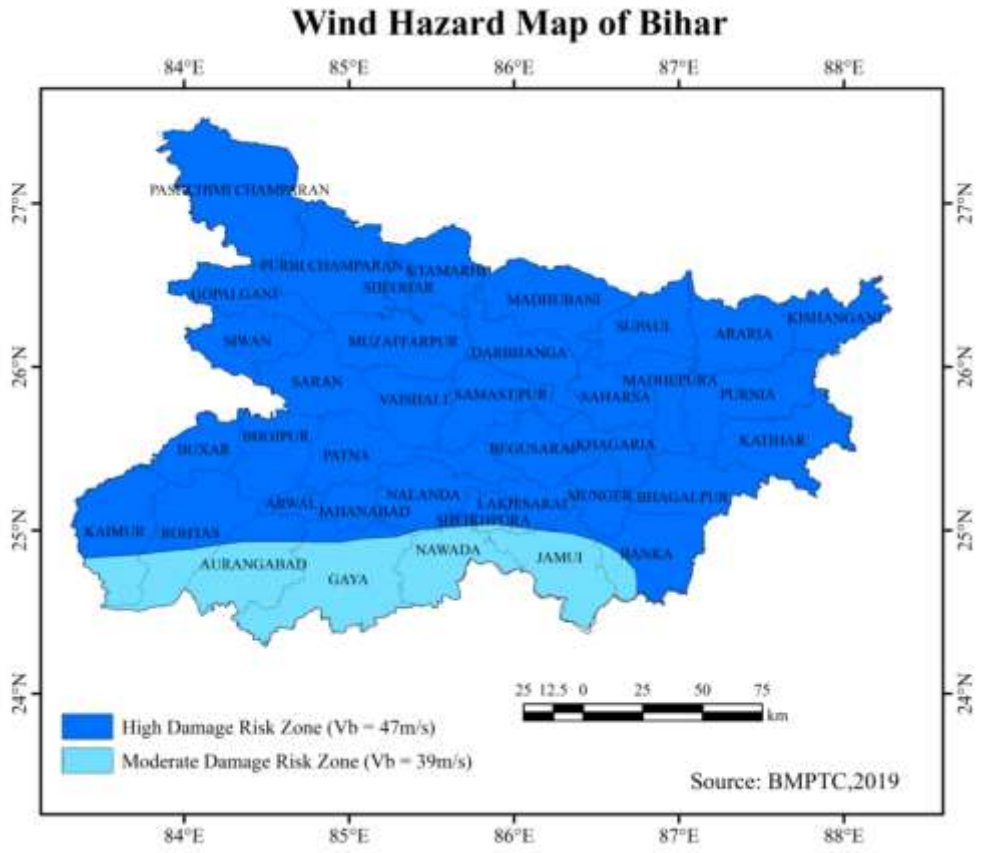
•**Power Outages:** High winds regularly snap power lines, leading to prolonged blackouts.

Why is Bihar so Vulnerable?

•**Geographical Location:** It lies in the path of moisture-laden winds from the Bay of Bengal and is susceptible to the troughs and systems that form during the monsoon and pre-monsoon periods.

•**High Population Density:** Increases exposure, leading to higher potential for loss of life and property.

•**Vulnerable Infrastructure:** A large number of non-engineered, kutcha houses and overhead cables are easily damaged by strong winds.



Thunderstorm Hazard

The period from 1981 to 2015 saw Bihar as one of India's most thunderstorm-vulnerable states. These storms, often severe, were a recurring and destructive feature, primarily during two distinct seasons.

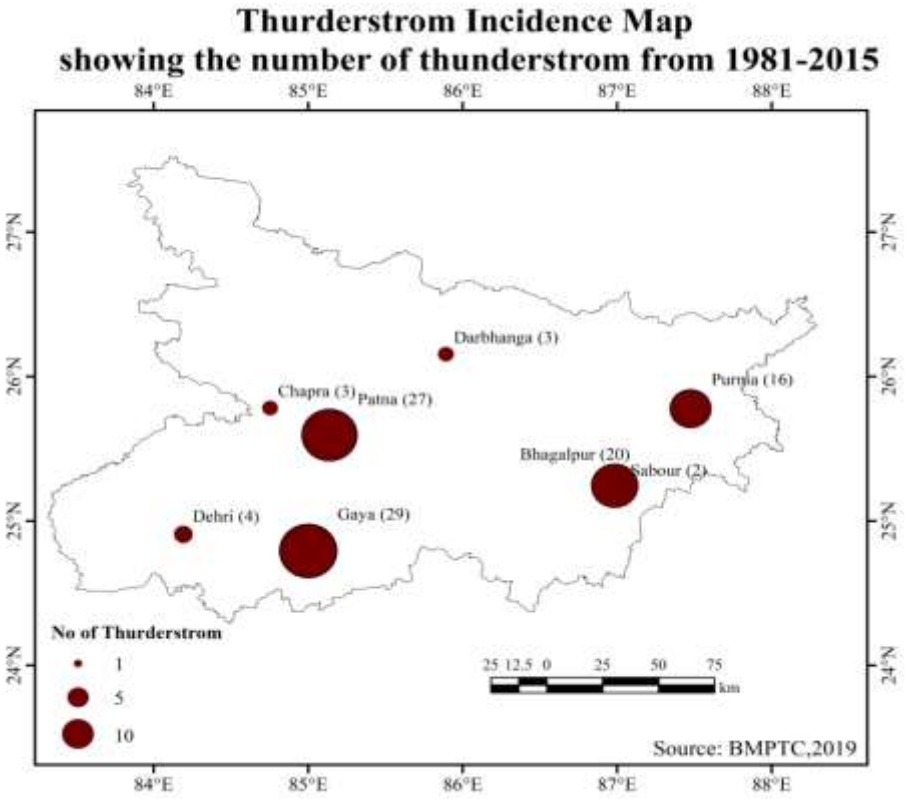
1. Primary Season: The Pre-Monsoon (April-June)

•This was the most active and hazardous period. The combination of intense solar heating, high humidity, and incoming western disturbances created a "perfect storm" environment.

•The storms during this season were frequently **Nor'westers** (*Kalbaisakhi*), known for their sudden onset, squally winds (often 60-100 km/h), and intense lightning.

2. Secondary Season: The Post-Monsoon (October-November)

•A smaller, secondary peak occurred during the retreating monsoon. These storms were generally less severe than the pre-monsoon ones but still posed significant risks.



Thunderstorm Hazard

Key Hazards and Impacts:

•**Squalls and Derechos:** The most destructive feature was often the fierce, gusty winds that could topple trees, electricity poles, and damage houses, leading to casualties and widespread power outages.

•**Lightning:** A major cause of human and animal fatalities, especially for farmers and laborers in open fields.

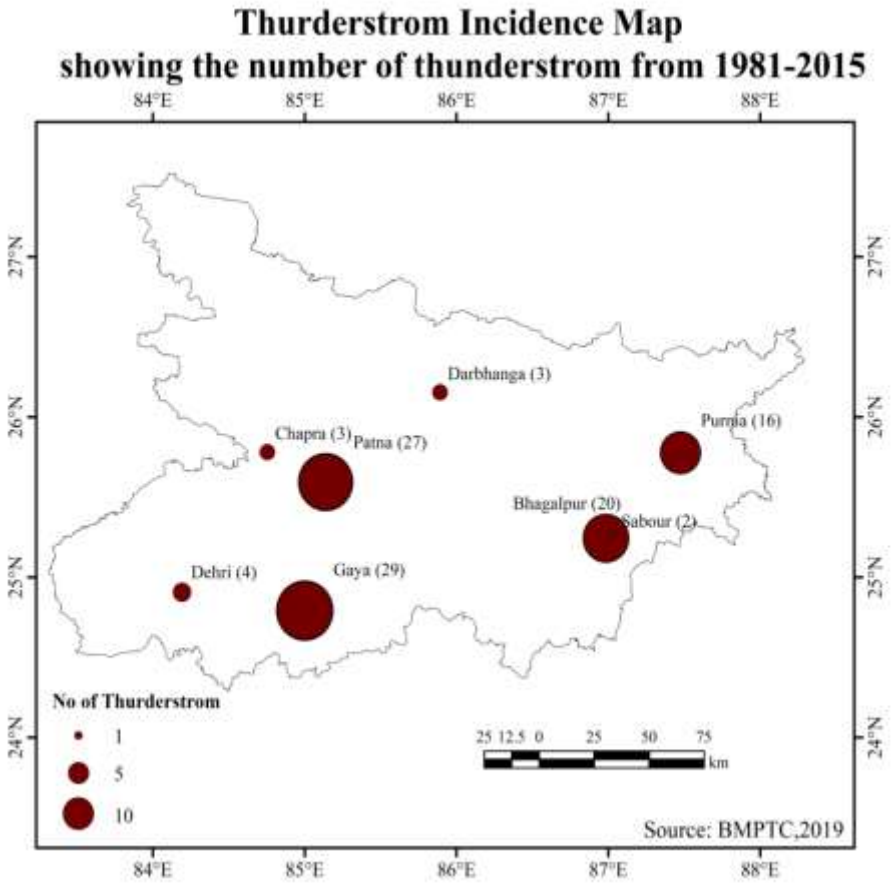
•**Heavy Rainfall & Hail:** Intense, short-duration rain caused localized flooding and waterlogging, while hail damaged standing crops, particularly wheat and mangoes, causing significant agricultural losses.

Spatial Pattern:
Northern and central districts of Bihar (e.g., Supaul, Madhubani, Darbhanga, Samastipur, Patna) were consistently more affected than the southern parts. The Ganga River basin acted as a convergence zone for moisture-laden winds, fueling storm development.

Overall Significance:
During this 35-year window, thunderstorms were not just a weather phenomenon but a major **recurring disaster**.

•**Human Toll:** They caused hundreds of deaths, primarily from lightning and structural collapses.

•**Economic Cost:** Annual damage to agriculture, property, and infrastructure ran into millions of dollars, making them a critical concern for state disaster management.



Key Pillars of the New Approach in Bihar

KEY PILLARS

1. From Reactive to Proactive & Preparedness-Oriented:

Early Warning Systems: Advanced meteorological forecasts and community-based dissemination (e.g., mobile alerts, sirens).

Pre-emptive Evacuations: Systematic evacuation of people and livestock *before* peak flooding, saving thousands of lives annually.

Pre-Positioning of Relief: Stockpiling food, medicine, and boats in vulnerable areas before the disaster season.

2. Empowering the Community:

Aapda Mitra (Disaster Friend): Training local volunteers in flood-prone villages in basic rescue, first aid, and response. This creates a first line of defense.

Community-based Disaster Management Plans (CBDMPs): Involving villages in creating their own preparedness and response plans.

3. Integrated and Holistic Planning:

Focus on Resilience: Moving beyond just floods to address earthquakes, droughts, and heatwaves.

Linking Disaster Risk Reduction (DRR) with Development: Incorporating disaster resilience into infrastructure projects (e.g., building raised flood-proof *pucca* shelters, embankments with proper care).

Eco-based Mitigation: Emphasis on restoring natural drainage, afforestation, and sustainable water management to reduce flood risk.

4. Strengthening Governance and Systems:

Institutionalization: The BSDMA provides dedicated institutional leadership, research, and policy guidance.

Technology Integration: Use of GIS for mapping vulnerable areas, satellite imagery for monitoring river flow, and digital platforms for managing relief.

Preparedness in the State Government and Quick response mechanism

A. Preparedness: The Proactive Shield

The state's preparedness rests on four key pillars:

1.Institutional Framework:

1. **Bihar State Disaster Management Authority (BSDMA):** The apex body for policy, planning, and guidelines. Chaired by the Chief Minister, it provides strategic direction.
2. **Disaster Management Department (DMD):** The nodal executive agency for implementation, coordination, and day-to-day operations. It acts as the secretariat for the BSDMA.
3. **State Emergency Operation Center (SEOC):** The 24x7 nerve center in Patna for monitoring, early warning, and coordination.

2.Planning and Capacity Building:

1. **State Disaster Management Plan (SDMP):** A comprehensive, living document outlining roles, responsibilities, and standard operating procedures for all types of disasters.
2. **Training and Mock Drills:** Regular training for officials, police, and **SDRF** personnel. Community-level mock drills, especially in flood-prone areas, are conducted annually.
3. **Flood Preparedness:** Pre-positioning of relief materials (food, boats, medicines) in vulnerable districts before the monsoon season.

3.Early Warning Systems:

1. **Floods:** Close coordination with the Central Water Commission (CWC) for real-time river level data and forecasts.
2. **Cyclones & Weather:** Alerts from the India Meteorological Department (IMD) are disseminated down to the village level.
3. **Heatwaves:** The state implements a **Heat Action Plan** with colour-coded alerts and public advisories.

4.Community Involvement:

1. Engagement of NGOs and Civil Society Organizations.
2. Promotion of **Aapda Prabandhan Mitra** (Disaster Management Friends), a community volunteer program for first response at the village level.

Emergency and Safety management process

1. The Governing Structure & Key Agencies

•State Level:

- **Bihar State Disaster Management Authority (BSDMA):** The apex body chaired by the **Chief Minister**. It lays down policies, plans, and guidelines for the entire state.
- **State Executive Committee (SEC):** Headed by the **Chief Secretary**, it implements the policies of the BSDMA and coordinates the response of all state departments.
- **Disaster Management Department (DMD):** The nodal department for day-to-day administration and execution of disaster management plans.

•District Level:

- **District Disaster Management Authority (DDMA):** Chaired by the **District Magistrate** (with the elected MP as Co-Chairperson). It is the **most critical unit** for on-ground execution. It prepares district-level plans, conducts mock drills, and manages disasters within the district.

•Local Level:

- **Local Authorities:** Including Panchayati Raj Institutions (PRIs), Urban Local Bodies (ULBs), and line departments. They are the first responders.
- **Community-Based Organizations:** Volunteers and NGOs play a significant role, especially in early warning dissemination and initial relief.

Emergency and Safety management process

2. The Four-Phase Management Process
The process follows the standard disaster management cycle:

A. Prevention & Preparedness (Before a Disaster)
•**Early Warning Systems:** Close coordination with the Indian Meteorological Department (IMD) and Central Water Commission (CWC) for flood, cyclone, and heatwave alerts.
•**Preparedness Plans:** Developing and updating State and District Disaster Management Plans.
•**Capacity Building:** Training for officials, police, and firefighters.
•**Mock Drills:** Regular community and school-level drills for earthquakes, fires, and floods.
•**Public Awareness:** Campaigns on do's and don'ts for various disasters.

B. Emergency Response (During a Disaster)
•**Activation of Emergency Operations Centers (EOCs):** The State EOC in Patna and District EOCs become the nerve centers for coordination.
•**Search and Rescue:** Deployment of NDRF (National Disaster Response Force), SDRF (State Disaster Response Force), and local teams.
•**Relief Measures:** Immediate provision of food, water, medicine, and temporary shelters in relief camps.
•**Evacuation:** Large-scale evacuation of people and livestock from vulnerable areas, particularly during floods.

C. Relief and Recovery (After the Immediate Crisis)
•**Damage and Needs Assessment:** Official assessment of losses to crops, houses, and public infrastructure.
•**Distribution of Compensation:** Providing financial aid to affected families as per state government norms (e.g., for damaged houses, loss of life).
•**Restoration of Essential Services:** Quick repair of roads, electricity, and communication lines.
•**Livelihood Support:** Initiatives to help people regain their sources of income.

D. Mitigation & Reconstruction (Long-Term)
•**Structural Measures:** Building and strengthening embankments, flood shelters (*pucca koshtha ghars*), and raised platforms.
•**Non-Structural Measures:** Promoting disaster-resistant construction, afforestation, and land-use planning.