LOTUSARISE IAS

FREE SAMPLE · 2027 EDITION

UPSC CIVIL SERVICES · PRELIMS & MAINS GS PAPER III

Disaster Management for UPSC

The complete GS Paper III disaster management book: every hazard, the law and institutions, finance, early warning and global frameworks, every Mains PYQ from 2013 to 2026 with an expert approach, and banks of case studies, schemes and data. Updated to October 2026.

Compiled by Arvind KrS

27 chapters • **47** PYQs • **7** units • **136** diagrams

IN THIS BOOK

I	Understanding Disasters	II	Natural Hazards of India
III	Human-Induced and Biological Disasters	IV	Law, Institutions, Plans and Finance
V	Global Frameworks and India's Role	VI	Cross-Cutting Themes
VII	Answer-Writing Resources		

lotusarise.com

Updated to October 2026

LOTUSARISE IAS

Disaster Management for UPSC

Notes for UPSC Civil Services Prelims and Mains General Studies Paper III

2027 Edition · Compiled October 2026 · Compiled by Arvind KrS

Free sample. This sample carries the cover, the full contents, two unit pages and two complete chapters of the book. You may share this sample as it is, without changes.

© 2026 LotusArise IAS. All rights reserved. The complete book is licensed to the purchaser for personal study only. Copying, sharing, reselling or uploading it to any website, drive or group, in whole or in part, is not permitted.

Cover artwork and all diagrams: original illustrations created for this book. UPSC questions are reproduced verbatim for study.

Questions or corrections: support@lotusarise.com

Contents

UNIT I **Understanding Disasters** 5

01 Disasters, Hazards, Vulnerability and Risk IN THIS SAMPLE 6

02 The Disaster Management Cycle, DRR and Resilience 16

UNIT II **Natural Hazards of India** 26

03 Earthquakes 27

04 Tsunamis 37

05 Tropical Cyclones 47

06 Floods, Flash Floods, Cloudbursts, GLOFs and Dam Safety IN THIS SAMPLE 58

07 Urban Flooding 68

08 Droughts and Heat Waves 78

09 Landslides, Avalanches and Land Subsidence 88

10 Lightning, Forest Fires, Cold Waves, Dust Storms and Hail 99

UNIT III **Human-Induced and Biological Disasters** 108

11 Industrial and Chemical Disasters 109

12 Nuclear and Radiological Emergencies 118

13 Biological Disasters, Epidemics and Pandemics 127

14 Fires, Building Collapses and Crowd Disasters 137

15 Transport, Mining and Other Accidents 147

UNIT IV **Law, Institutions, Plans and Finance** 157

16 The Disaster Management Act, 2005 and the 2025 Amendment 158

17 Institutions of Disaster Management 168

18 Plans, Policies and the Shift to Proactive DRR 177

19 Financing Disaster Risk 186

20 Early Warning, Technology and Communication 196

UNIT V **Global Frameworks and India's Role** 205

21 International Frameworks for DRR 206

22 India's Global Role in Disaster Management 216

UNIT VI **Cross-Cutting Themes** 225

23 Climate Change, Development and Disaster Risk 226

24 Community, Vulnerable Groups and Social Dimensions 236

UNIT VII **Answer-Writing Resources** 246

25 Case Studies Bank 2013–2026 247

26 Schemes, Laws and Frameworks Bank 256

27 Data, Reports and Indices Bank 266

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

UNIT I
2 CHAPTERS

Understanding Disasters

Disaster and disaster management — hazards, vulnerability, exposure, risk and resilience; the classification of disasters; India's risk profile; the disaster management cycle and disaster risk reduction.

CHAPTERS

01 Disasters, Hazards, Vulnerability and Risk 6
02 The Disaster Management Cycle, DRR and Resilience 16

TOPICS COVERED IN THIS UNIT

01 **Disasters, Hazards, Vulnerability and Risk**
What Makes an Event a Disaster · The Risk Equation · Types of Vulnerability · Classifying Hazards and Disasters · Compound, Cascading and NATECH · India's Risk Profile · Levels of Disaster and "Severe Nature"

02 **The Disaster Management Cycle, DRR and Resilience**
From Relief to Risk Reduction · The Disaster Management Cycle · Prevention and Mitigation · Risk Assessment: HRVA · Preparedness and Early Warning · Response, Recovery, Build Back Better · Resilience: Meaning and Measurement

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

DISASTER MANAGEMENT
PRELIMS & MAINS · GS PAPER III

Disasters, Hazards, Vulnerability and Risk

The WorldRiskReport 2025 ranked India second among 193 countries for disaster risk, with a score of 40.73, behind only the Philippines. Yet on exposure alone India stood seventh, well below China, Mexico and Japan. What lifts India up the table is vulnerability: crowded floodplains, unsafe buildings, poverty and thin local capacity. That gap between where hazards strike and who gets hurt is the subject of this chapter. A hazard is a natural or human process; a disaster is what happens when it meets people who are exposed, vulnerable and unable to cope.

SYLLABUS

PRELIMS — **Current events of national and international importance; General issues on Environmental Ecology, Bio-diversity and Climate Change**

MAINS · GS PAPER III — **Disaster and disaster management**

CONTENTS

01 What Makes an Event a Disaster
02 The Risk Equation
03 Types of Vulnerability
04 Classifying Hazards and Disasters
05 Compound, Cascading and NATECH
06 India's Risk Profile
07 Levels of Disaster and "Severe Nature"
08 Previous Year Questions

This chapter covers:

- hazard, exposure, vulnerability, capacity, risk and disaster: the working vocabulary;
- the risk equation and the ideas of acceptable, residual, intensive and extensive risk;
- types of vulnerability and why the poor lose most;
- how hazards and disasters are classified, including compound, cascading and NATECH events;
- India's multi-hazard risk profile and how it is measured;
- levels L0 to L3, a "disaster of severe nature", and how disasters are counted.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

The disaster management cycle, risk reduction and resilience are in Chapter 2; each hazard has its own chapter in Units II and III; the law and institutions are in Chapters 16 and 17.

01 What Makes an Event a Disaster

Earthquakes, cyclones and floods are events of nature; disasters are events of society. The United Nations Office for Disaster Risk Reduction (**UNDRR**), in the terminology adopted by the UN General Assembly in February **2017**, treats a disaster as a serious disruption of the functioning of a community or society, at any scale, produced when a hazardous event interacts with conditions of exposure, vulnerability and capacity, and causes human, material, economic or environmental losses. The emphasis on interaction matters: the same cyclone can be a weather event in one district and a catastrophe in the next.

Indian law is narrower and more practical. Section **2(d)** of the **Disaster Management Act, 2005** treats a disaster as a catastrophe, mishap, calamity or grave occurrence in any area, caused by natural or man-made causes, accident or negligence, which leads to substantial loss of life or human suffering, or damage to property or the environment, and which is beyond the coping capacity of the affected community. It sets three tests: a cause, a substantial loss, and a scale beyond local coping capacity. The **Disaster Management (Amendment) Act, 2025** (in force from 9 April **2025**) added an Explanation that "man-made causes" **do not include** law-and-order situations, and clarified that "disaster management" includes disaster risk reduction, which it defines as reducing exposure and vulnerability and improving preparedness, resilience and capacity; it also defines disaster risk, in UNDRR's terms, as a function of hazard, exposure, vulnerability and capacity.

TERM	WHAT IT MEANS (UNDRR, 2017)	INDIAN ILLUSTRATION
Hazard	A process, phenomenon or human activity that may cause loss of life, injury, damage or disruption	A Bay of Bengal cyclone; a chlorine tank; a crowded ghat
Exposure	People, property, systems and assets located in hazard-prone areas	The **5,700** km of coast open to cyclones and tsunamis; Delhi's Yamuna floodplain colonies
Vulnerability	Physical, social, economic and environmental conditions that increase susceptibility to a hazard's impact	Unreinforced masonry; landless labourers; degraded mangroves
Capacity	The strengths, resources and attributes available to manage and reduce risk	Cyclone shelters, Aapda Mitra volunteers, SDRF balances
Disaster risk	Potential loss over a period, determined as a function of hazard, exposure, vulnerability and capacity	Expected annual flood losses in the Kosi basin
Disaster	The realised disruption and loss when the hazard strikes exposed, vulnerable people	Wayanad landslides, 30 July **2024**; Kerala floods, August **2018**

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

Losses are **direct** (lives, injuries, assets), **indirect** (lost output, broken supply chains, interrupted schooling, migration) and **intangible** (trauma, lost heritage, weakened trust). EM-DAT recorded **393** natural-hazard disasters worldwide in **2024**, with **16,753** deaths, **167** million people affected and losses of about US$**242** billion; for India it counted **733** heat deaths, noting heavy under-reporting. What can be measured and explained can also be reduced, which is why the language of risk has replaced the language of calamity and relief.

02 The Risk Equation

Disaster risk is usually written as a shorthand formula: **Risk = Hazard × Exposure × Vulnerability ÷ Capacity**. The signs are more important than the arithmetic. Risk rises with the frequency and intensity of the hazard and with the number of people and assets in its path, rises again with their fragility, and falls with capacity. Since little can be done about the hazard itself, risk reduction works on the other three variables: keep people and assets out of harm's way, make them stronger, and build the capacity to warn, respond and recover.

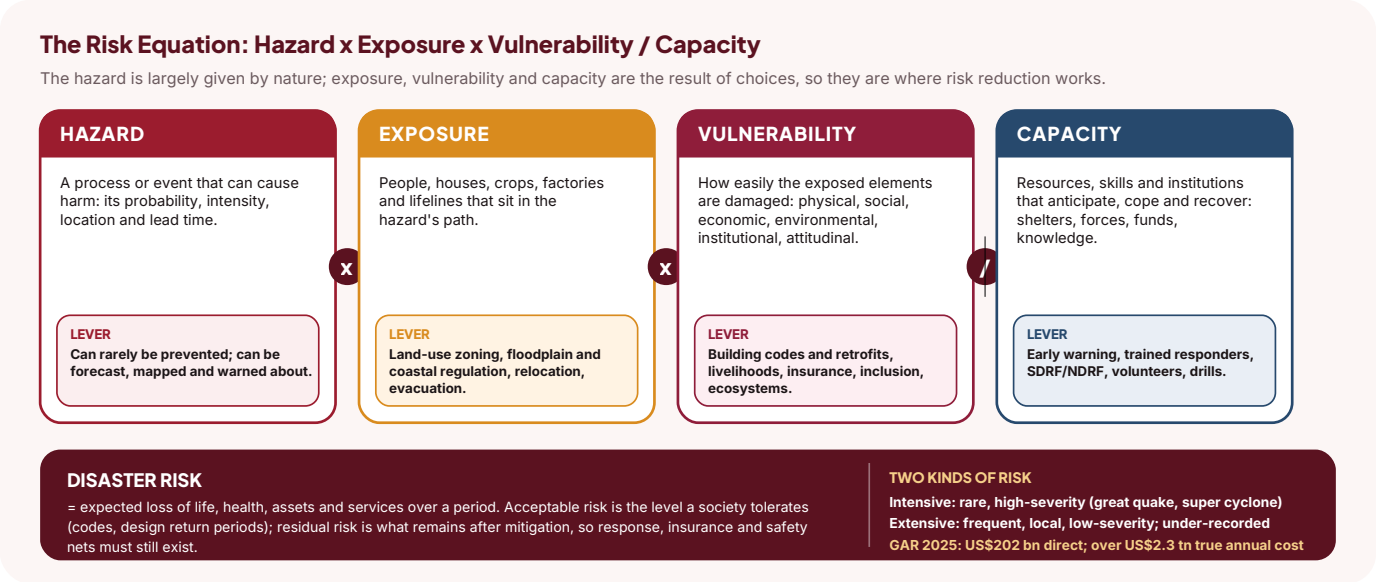


Fig. 1.1 The four variables of disaster risk, what each means, and the levers that policy can move; the hazard is largely given, the rest is chosen.

UNDRR separates **intensive risk**, from rare, high-severity events such as a great Himalayan earthquake, from **extensive risk**, from the frequent, localised floods, lightning strikes and small landslides of every monsoon. Extensive risk is poorly recorded, yet over decades it kills and impoverishes more people than the headline catastrophes. The Global Assessment Report **2025** put direct disaster losses at about US$**202** billion a year, and the full bill, with cascading and ecosystem losses, at over US$**2.3** trillion.

CONCEPT: ACCEPTABLE AND RESIDUAL RISK

No society can reduce risk to zero. **Acceptable risk** is the loss a community judges tolerable; building codes encode it by designing for a shaking or wind speed of a chosen return period, not the worst imaginable. **Residual risk** is what remains after reasonable mitigation, which is why emergency services, insurance and safety nets must exist even in well-prepared places. The **underlying risk**

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

drivers pushing both upward are poverty and inequality, unplanned urbanisation, climate change, weak land-use regulation and declining ecosystems.

03 Types of Vulnerability

Vulnerability is the most human part of the equation and the one that explains why identical hazards produce unequal outcomes. It is multi-dimensional, dynamic and specific to hazard and place: a concrete frame that resists a cyclone may fail in an earthquake. Disaster-risk practice in India commonly distinguishes six dimensions. **Physical** vulnerability lies in where and how people build: random-rubble houses in Zone V, slums on storm drains, schools without exits. **Social** vulnerability marks groups with less voice, mobility or support; women died at several times the male rate in the **1991** Bangladesh cyclone, and migrant workers were stranded by the **2020** lockdown. **Economic** vulnerability is poverty without savings or insurance, the marginal farmer after a drought or the daily-wage worker in a flooded city. **Environmental** vulnerability is a degraded buffer: lost mangroves, bare catchments, sand-mined riverbeds. **Institutional** vulnerability is unenforced bye-laws, expired fire licences and untested plans; **attitudinal** vulnerability is fatalism and low awareness, the family that refuses to leave before a cyclone.

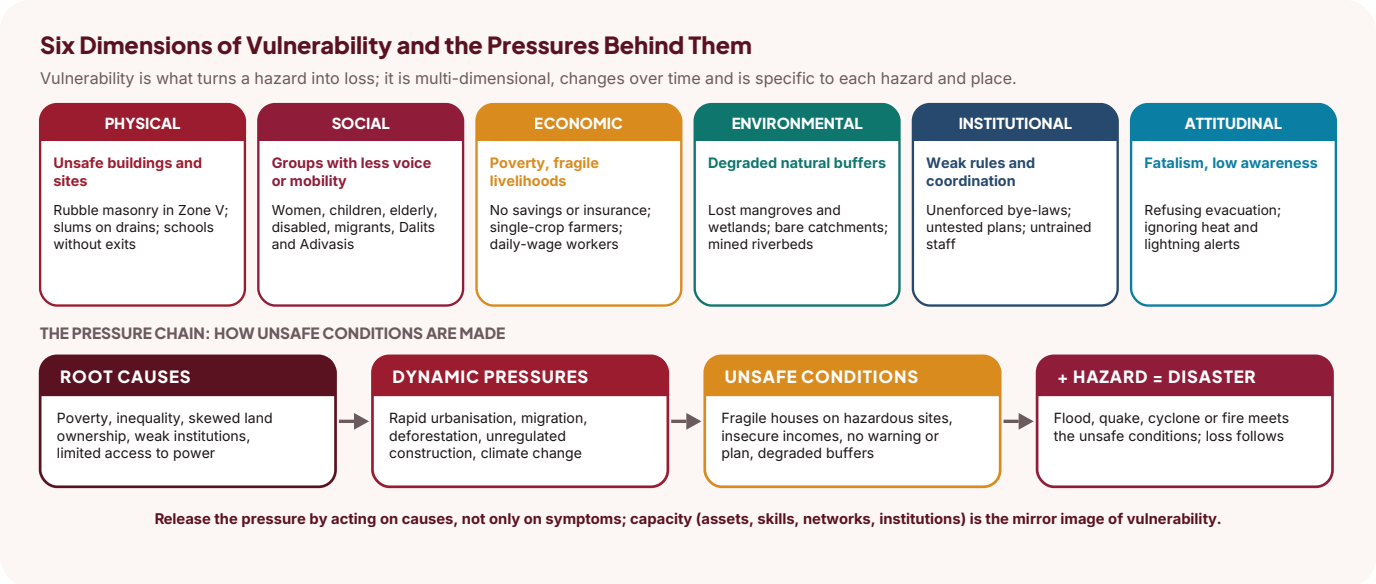


Fig. 1.2 Six dimensions of vulnerability and the "pressure" from root causes to unsafe conditions that disaster-risk analysts trace in every community.

Analysts trace unsafe conditions back through a chain of pressures, from root causes such as poverty and weak institutions to dynamic pressures such as migration and unregulated construction; releasing the pressure means acting on causes, not symptoms. **Capacity** is the mirror image: assets, skills, savings, networks, local knowledge and institutions that let people anticipate, cope and recover.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

CASE IN POINT: LATUR, 30 SEPTEMBER 1993

At about 3.56 am a magnitude 6.2–6.4 earthquake struck near Killari in Maharashtra's Latur district, in the Deccan plateau that geologists had long regarded as stable; the area lay in Zone I, the lowest zone of the then seismic map. Shaking reached intensity VIII–IX, and about 8,000 people died (the official count was 7,928), almost all crushed in random-rubble stone houses with mud mortar and heavy roofs. Engineered buildings largely survived. A moderate hazard plus extreme physical vulnerability equalled one of India's deadliest earthquakes. The zoning map was redrawn in 2002 (Zone I merged into II; Latur moved to Zone III) and the villages were rebuilt to earthquake-resistant designs.

04 Classifying Hazards and Disasters

Classification decides which ministry leads, which warning agency speaks and which guideline applies. The scheme followed by the National Disaster Management Plan (2019) and by the international disaster database EM-DAT sorts natural hazards into families by their origin: geophysical, hydrological, meteorological, climatological, biological and, in EM-DAT's list, extraterrestrial. Each primary hazard breeds secondary ones: an earthquake triggers landslides, liquefaction, fires and dam failures; a cyclone brings storm surge and urban flooding; a flood brings epidemics and embankment breaches.

Families of Hazards Used in Indian Planning

Natural hazards are grouped by origin (the NDMP and EM-DAT scheme); human-induced hazards by the system that fails; onset may be rapid or slow.

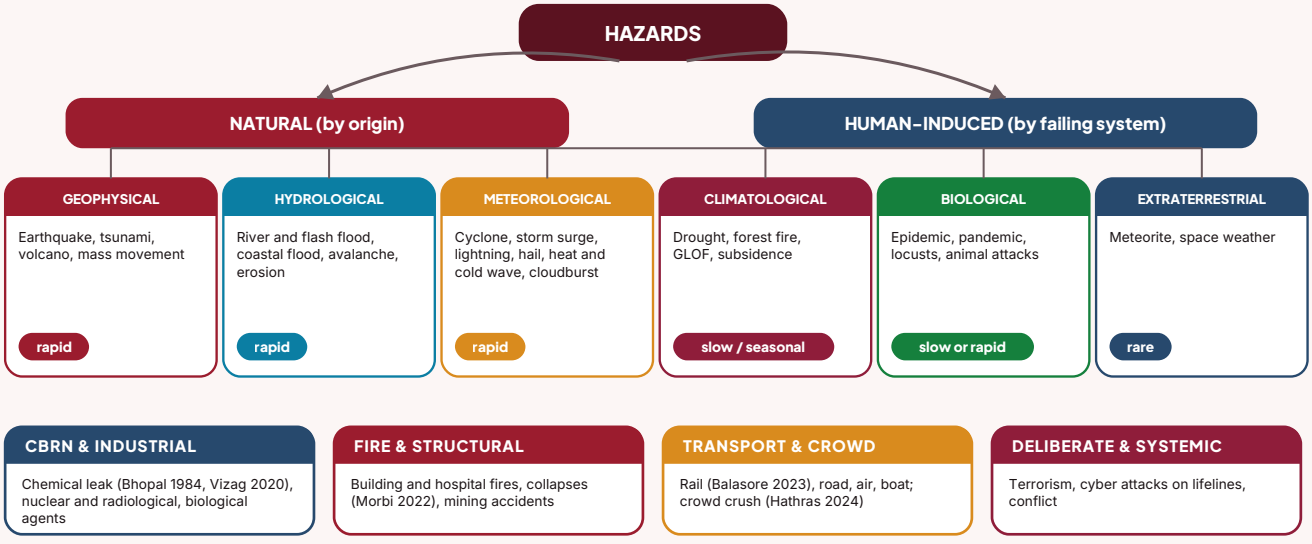


Fig. 1.3 The families of natural and human-induced hazards used in Indian planning, with their characteristic onset.

The **UNDRR–ISC Hazard Definition and Classification Review** (2020) listed 302 hazards under eight types (meteorological and hydrological, extraterrestrial, geohazards, environmental, chemical, biological, technological and societal); Hazard Information Profiles (2021) describe each, and their 2025 update lists 281 hazards in the same eight types. Two other cuts are useful. By **onset**, hazards are rapid (earthquake, flash flood, crowd crush) or slow and creeping (drought, sea-level rise, desertification, pandemics). By **origin**, they are natural, human-induced or, increasingly, mixed.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

COMMON CONFUSION: "NATURAL DISASTERS" ARE NOT NATURAL

Hazards may be natural; disasters never are. A strong earthquake under an empty desert is an event; under an unplanned city it is a disaster. UNDRR and the NDMP therefore speak of "disasters caused by natural hazards", **not** "natural disasters". The distinction moves responsibility from fate to choices about land use, construction, warning and preparedness, which is the premise of risk reduction, and it explains why India's law counts negligence and accident as causes of disaster.

05 Compound, Cascading and NATECH

Modern risk rarely comes one hazard at a time. **Compound events** are two or more hazards occurring together or in quick succession, so that their combined impact exceeds the sum of the parts; the IPCC's Sixth Assessment Report (2021) found concurrent heat and drought, and surge plus heavy rain, becoming more frequent. Cyclone Amphan struck West Bengal on 20 May 2020 in the middle of the COVID-19 lockdown, forcing several lakh people into shelters, many of them already in use as quarantine centres, where distancing was impossible.

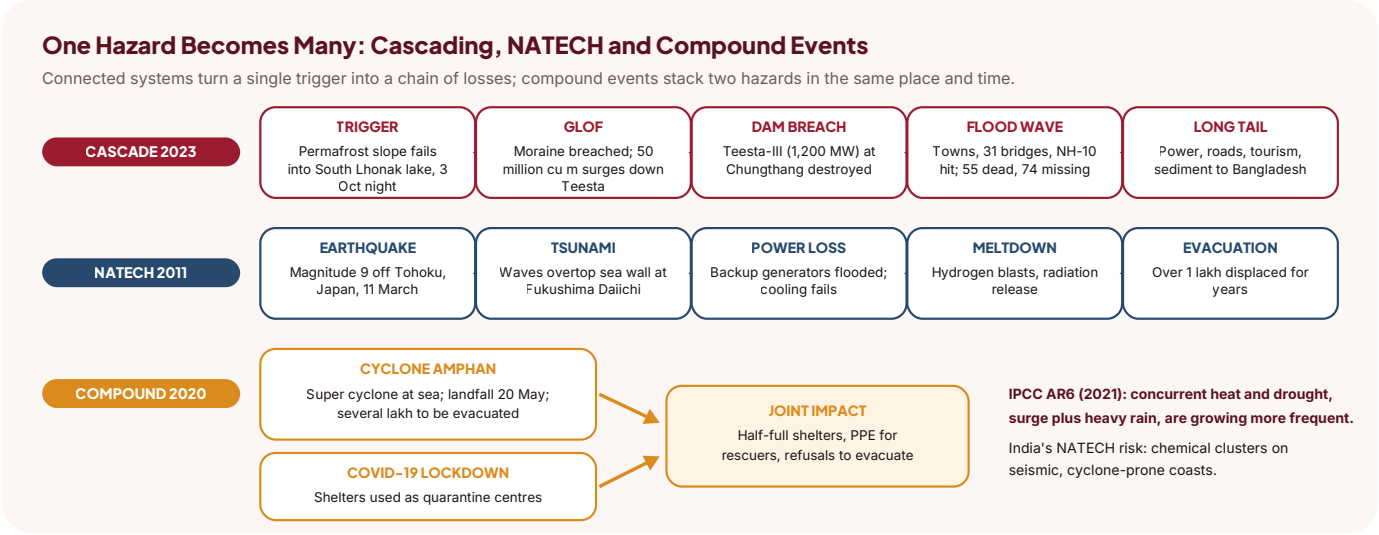


Fig. 1.4 How one hazard becomes many: the South Lhonak cascade of October 2023, the Fukushima NATECH chain of 2011, and the compound emergency of Amphan during COVID-19.

Cascading disasters are chains in which one event triggers the next through connected systems. On the night of 3–4 October 2023 the South Lhonak glacial lake in Sikkim burst, the surge breached the Teesta-III dam at Chungthang, and the flood swept down the Teesta valley, killing 55 people in Sikkim, with 74 more missing, destroying the 1,200 MW project, damaging 31 major bridges and cutting National Highway 10. **NATECH** (natural-hazard-triggered technological) accidents are a special case: the 2011 Tohoku earthquake and tsunami disabled the Fukushima Daiichi plant's cooling and caused a nuclear emergency. In India the risk sits in chemical clusters on seismic, cyclone-prone coasts. **Climate-induced disasters**, the hydro-meteorological hazards that warming is intensifying, are the subject of Chapter 23.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

06 India's Risk Profile

India's geography assembles almost every hazard family: a young, rising Himalaya; vast alluvial plains fed by monsoon rivers; a hard-rock peninsula that nonetheless shakes; a long, low coast on the most cyclone-prone bay on earth; arid tracts in the west and the rain-shadow interior. On top sit **1.4** billion people, rapid urbanisation and a warming climate. NDMA's annual reports repeat the official profile below.

HAZARD	EXTENT OF EXPOSURE (OFFICIAL PROFILE)	MOST AFFECTED REGIONS
Earthquake	**58.6%** of landmass in Zones III–V (moderate to very high); Zone V covers the North-East, Kutch, parts of Himachal, Uttarakhand, J&K, Bihar and the Andamans	Himalayan belt, North-East, Kutch, Indo-Gangetic plain
Flood and erosion	Over **40** million hectares, about **12%** of land; about **7.2** million ha flooded in an average year (CWC, **1953–2020**)	Ganga–Brahmaputra basins: Assam, Bihar, UP, West Bengal
Cyclone and tsunami	About **5,700** km of the **7,516** km coastline (re-measured at **11,098** km in **2024**); **84** coastal districts	Odisha, Andhra Pradesh, West Bengal, Tamil Nadu, Gujarat
Drought	**68%** of cultivable area; about a third of the country chronically drought-prone	Rajasthan, Marathwada, Bundelkhand, interior Karnataka and Andhra
Landslide	About **0.42** million sq km, **12.6%** of land area excluding snow cover (GSI); NDMA, adding avalanche terrain, says about **15%**	Himalaya, North-East, Western Ghats, Nilgiris
Urban flooding	Over **5,000** urban local bodies flagged as prone (NDMA)	Mumbai, Chennai, Bengaluru, Hyderabad, Delhi



Kerala, August 2018



Sikkim, 4 October 2023

Fig. 1.5 Two faces of the same hazard family: the Periyar in spate at Angamaly during the 2018 Kerala floods, and a Sikkim river valley choked with flood sediment on the morning of 4 October 2023, hours after the South Lhonak outburst.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

Of **36** States and UTs, **27** are officially disaster-prone. The profile is dynamic: lightning is the largest single natural killer in NCRB data, heat waves killed hundreds in **2024** and **2025**, and glacial lakes are multiplying as the Himalaya warms.

Measuring Risk: HRVA and Indices

A **Hazard, Risk and Vulnerability Assessment** (HRVA) is the first step of any disaster management plan: map each hazard's probability and intensity, overlay the people and assets exposed, score their vulnerability and capacity, and rank the resulting risk. Sendai's first priority, "understanding disaster risk", rests on it. The Vulnerability Atlas of India (first edition **1997**, second **2006**, third **2019**, all by BMTPC) maps earthquake, wind and flood hazard to district level with housing-type vulnerability tables.

INDIA: THE NATIONAL DISASTER RISK INDEX

The Ministry of Home Affairs, with UNDP, built India's first **National Disaster Risk Index** (draft **2018**) for **640** census districts, combining **14** hazards, **14** vulnerability indicators and two exposure indicators (population, and agriculture and livestock). Maharashtra, West Bengal and Uttar Pradesh headed the State list and Delhi the Union Territories; hill States with higher hazard scored lower overall because the index also credited their capacity. The lesson it taught is the one the WorldRiskIndex repeats internationally: risk follows vulnerability and weak capacity as much as it follows the hazard map.

07 Levels of Disaster and "Severe Nature"

Because States bear the primary responsibility, Indian planning grades a disaster by the level of government whose capacity it exceeds, a scale proposed by the High Powered Committee (**2001**) and used in the NDMP.

LEVEL	MEANING	WHO LEADS
L0	Normal times, used for risk reduction, planning, training and mock drills	All tiers, continuously
L1	Manageable within district resources; State stands ready	District Collector and DDMA
L2	Needs State-level mobilisation and agencies; Centre on alert	SDMA and State Executive Committee
L3	A catastrophic situation that overwhelms State and district; national assistance	NCMC, NEC, NDMA; Centre deploys NDRF, forces

These levels have **no** statutory basis, and the DM Act has **no** provision to declare a "national disaster", a point raised after the Kerala floods of **2018**, which the Centre treated as a calamity of severe nature, in effect an L3 event. What the financial rules recognise is a **"disaster of severe nature"**: a notified calamity whose losses exceed what a State can meet from its State Disaster Response Fund and which therefore qualifies for additional assistance from the National Disaster Response Fund. There is no numerical threshold. An Inter-

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

Ministerial Central Team assesses the damage, a sub-committee of the National Executive Committee under the Union Home Secretary examines its report, and the High Level Committee chaired by the Union Home Minister approves the amount. Since 19 August **2019** the Central Team is sent immediately after a severe calamity, without waiting for the State's memorandum.

IN THE NEWS 2026: COUNTING RISK BY LAW

The **2025** amendment made risk knowledge a legal duty. NDMA must now create a **National Disaster Database** and each SDMA a State database, holding disaster assessments, fund allocations and expenditure, preparedness and mitigation plans, and a risk register by type and severity. Both must take periodic stock of disaster risks, including emerging climate risks, and NDMA may audit a State's preparedness and response after a severe disaster. The Home Ministry's National Disaster Management Information System already has a Sendai module in which districts enter loss data for Targets A to D, and in March **2026** Parliament was told the database would combine risk assessments, mitigation plans and real-time disaster data. For the first time India will count its extensive, everyday losses, not only its headline catastrophes.

USING THIS CHAPTER IN MAINS

Open definitional questions by separating hazard from disaster and writing the risk equation in one line; then place the question's theme inside it. For vulnerability, use the six types with one Indian example each and show that they interact (Latur, Wayanad, the 2020 lockdown). Quote current numbers sparingly but precisely: India's official hazard profile, WorldRiskIndex 2025 (second, score 40.73), GAR 2025 (US$202 billion direct, US$2.3 trillion true cost) and EM-DAT 2024. Bring in the 2025 amendment wherever risk knowledge or databases are relevant, and end with the idea that risk reduction targets exposure, vulnerability and capacity because the hazard cannot be legislated away.

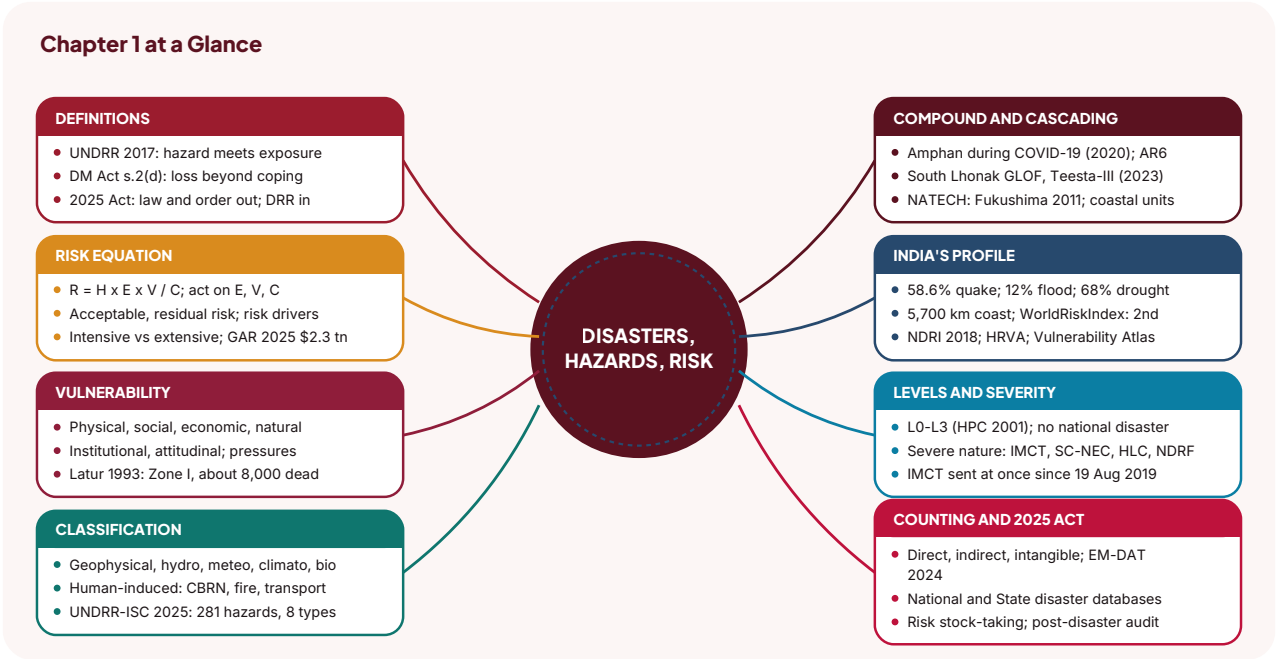


Fig. 1.6 Chapter 1 at a glance: the whole chapter on one page for quick revision.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

Previous Year Questions

2019 GS III · 10 MARKS

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.

Approach: Open with the UNDRR definition and the risk equation (Risk = Hazard × Vulnerability × Exposure ÷ Capacity). Characterise vulnerability by who/what is exposed, susceptibility and coping capacity, and show it is dynamic and place-specific. Then list the types with one Indian example each: physical (random-rubble houses, Latur 1993), social (women in the 1991 Bangladesh cyclone, migrants in the 2020 lockdown), economic (the marginal farmer after drought, the daily-wage worker in a flooded city), environmental (lost mangroves, bare catchments), institutional and attitudinal (unenforced bye-laws, refusal to evacuate). Close: Sendai Priority 1 asks countries to understand risk in all its dimensions, vulnerability included, and Priority 3 to invest in reducing it; the 2025 amendment writes reduced vulnerability into the legal meaning of DRR. (Sections 01, 02, 03)

LOTUSARISE IAS

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

UNIT II | 8 CHAPTERS

Natural Hazards of India

Disaster and disaster management — earthquakes, tsunamis, cyclones, floods, cloudbursts, GLOFs, dam failures, urban flooding, droughts, heat waves, landslides, avalanches, lightning, forest fires and other climatic hazards: mechanisms, India's vulnerability, recent episodes and mitigation.

CHAPTERS

03	Earthquakes	27
04	Tsunamis	37
05	Tropical Cyclones	47
06	Floods, Flash Floods, Cloudbursts, GLOFs and Dam Safety	58
07	Urban Flooding	68
08	Droughts and Heat Waves	78
09	Landslides, Avalanches and Land Subsidence	88
10	Lightning, Forest Fires, Cold Waves, Dust Storms and Hail	99

TOPICS COVERED IN THIS UNIT

03 **Earthquakes**
Why the Ground Shakes · India's Seismic Zones · The Himalayan Seismic Gap · Intraplate and Induced Quakes · What Recent Earthquakes Teach · Reducing the Risk: Codes and Retrofitting · Early Warning and Response · Gaps and the Way Forward

04 **Tsunamis**
What a Tsunami Is · India's Exposure · 26 December 2004: Anatomy of a Disaster · The Indian Tsunami Early Warning Centre · NDMA Guidelines on Tsunamis (2010) · Tsunami Ready Communities · Lessons from Elsewhere · Gaps and the Way Forward

05 **Tropical Cyclones**
What a Tropical Cyclone Is · India's Cyclone Risk Profile · Classification, Naming and Warnings · Hazards: Wind, Surge and Rain · Recent Cyclones and Their Lessons · The Odisha Model of Zero Casualty · Mitigation: NCRMP, Shelters, Coasts · Gaps and the Way Forward

06 **Floods, Flash Floods, Cloudbursts, GLOFs and Dam Safety**
Floods: Causes and India's Exposure · Flash Floods and Cloudbursts · Glacial Lake Outburst Floods · Flood Management in India · Dam Safety and Dam Failure · Lessons and the Way Forward

07 **Urban Flooding**
A Different Kind of Flood · Why Indian Cities Flood · Episodes That Shaped the Debate · The NDMA Guidelines of 2010 · Warning the City in Time · Programmes, Funds and Law · Sponge Cities and Blue-Green Fixes · The Way Forward

08 **Droughts and Heat Waves**
Drought: The Creeping Disaster · Watching the Rain: Indices and Tools · Declaring Drought: The Manual · El Nino, La Nina and the IOD · NDMA Guidelines and Mitigation · Heat Waves: Criteria and Trends · Heat Action Plans and the 2026 Shift · The Way Forward

09 **Landslides, Avalanches and Land Subsidence**
What a Landslide Is · India's Landslide Provinces · Wayanad, 30 July 2024 · Hazard Zonation and Mapping · Policy: Guidelines and the 2019 Strategy · Early Warning and Mitigation · Avalanches and Land Subsidence · Gaps and the Way Forward

10 **Lightning, Forest Fires, Cold Waves, Dust Storms and Hail**
Lightning: The Largest Natural Killer · Lightning: Warning, Policy and Safety · Forest Fires: Causes and Season · Forest Fires: Detection and Response · Cold Waves · Dust Storms · Hailstorms · A Warmer, Wilder Atmosphere · The Way Forward

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

DISASTER MANAGEMENT
PRELIMS & MAINS · GS PAPER III

Floods, Flash Floods, Cloudbursts, GLOFs and Dam Safety

On 2 September 2025 Punjab declared all 23 districts flood-hit. About 2,000 villages went under, at least 48 people died, crops on more than 1.7 lakh hectares were lost and the State put the bill above ₹13,000 crore, its worst flood since 1988. Rain was only half the story: gates of the Madhopur barrage gave way on 27 August after the Ranjit Sagar dam released over 2 lakh cusecs into the Ravi. Floods in India are made by the monsoon and finished by what people build in its way, which is the theme of this chapter.

SYLLABUS

PRELIMS **Indian and World Geography – Physical, Social, Economic Geography of India and the World; Current events of national and international importance**

MAINS · GS PAPER III **Disaster and disaster management**

CONTENTS

01 Floods: Causes and India's Exposure
02 Flash Floods and Cloudbursts
03 Glacial Lake Outburst Floods
04 Flood Management in India
05 Dam Safety and Dam Failure
06 Lessons and the Way Forward
07 Previous Year Questions

This chapter covers:

- why and where India floods, and what it costs each year;
- flash floods and cloudbursts: mechanism, forecasting limits, 2025 events;
- glacial lake outburst floods and the national GLOF programme;
- India's flood management framework: guidelines, forecasting, FMBAP, zoning;
- embankments versus room for the river; the Kosi and Kerala lessons;
- dam failures, the Dam Safety Act 2021 and reservoir operation.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

Urban flooding is Chapter 7, landslides and avalanches Chapter 9, cyclone rain and surge Chapter 5, early-warning technology Chapter 20 and Himalayan development pressures Chapter 23.

01 Floods: Causes and India's Exposure

A **flood** is water where it should not be: a river over its banks, rain the ground cannot absorb, the sea pushed inland, or a lake or dam suddenly emptied. Most Indian floods are riverine and seasonal, because three-quarters of the year's rain falls in four monsoon months on rivers already carrying Himalayan silt. The Rashtriya Barh Ayog (**1980**) put the area liable to floods at **40** million hectares, about an eighth of the country; the XII Plan working group found that **49.8** mha had been flooded in the worst single year. CWC's averages for **1953–2020** show about **7.2** mha flooded, about **1,680** lives lost and damage of about ₹**6,400** crore (current prices) every year, with Assam, Bihar, Uttar Pradesh, West Bengal, Odisha and Andhra Pradesh bearing the most.

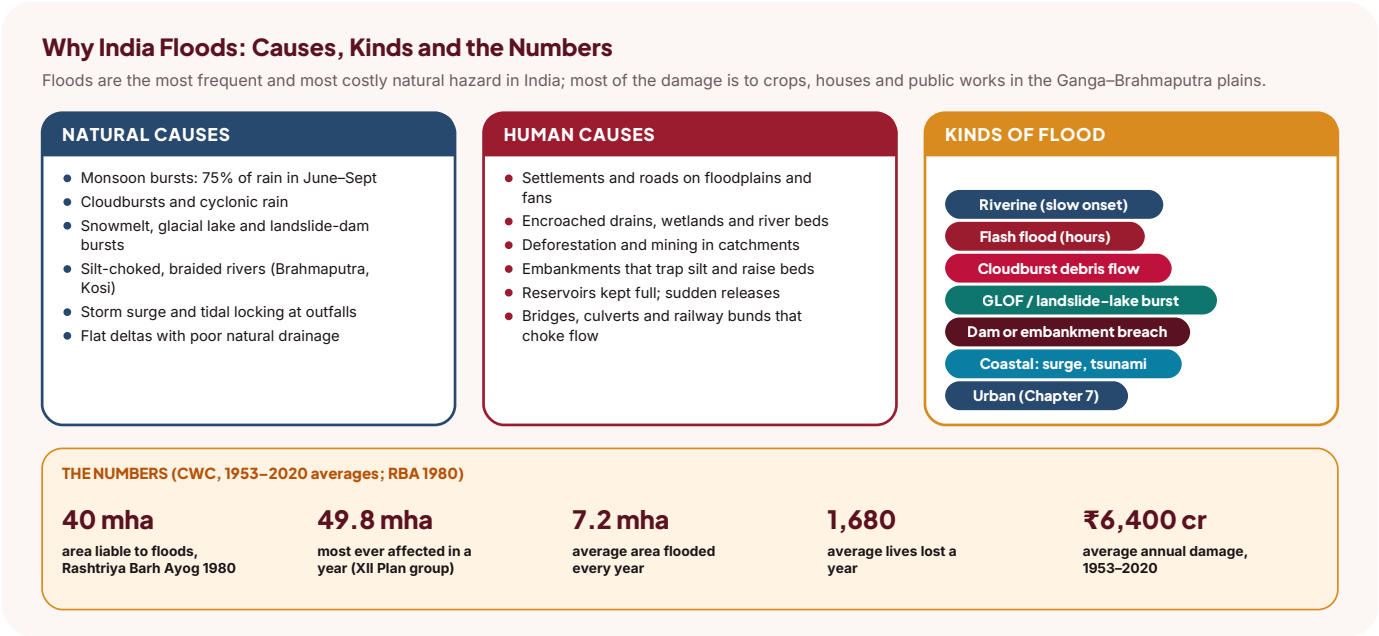


Fig. 6.1 Natural and human causes, the kinds of flood India faces, and the long-run averages that measure the hazard.

The regions differ in kind. The **Brahmaputra and Barak** valleys flood every year for weeks, with heavy bank erosion (Assam's **2024** floods hit over **24** lakh people). The **Ganga plains** suffer silt-laden Nepal rivers, embankment breaches and drainage congestion in Bihar and eastern Uttar Pradesh. The **north-west** (Sutlej, Beas, Ravi, Jhelum, Tawi) floods from reservoir releases and hill cloudbursts, as in Punjab in **2023** and **2025**; the **peninsular deltas** see short, intense floods and dam-release floods; and the **Himalaya** faces flash floods, debris flows and GLOFs.

02 Flash Floods and Cloudbursts

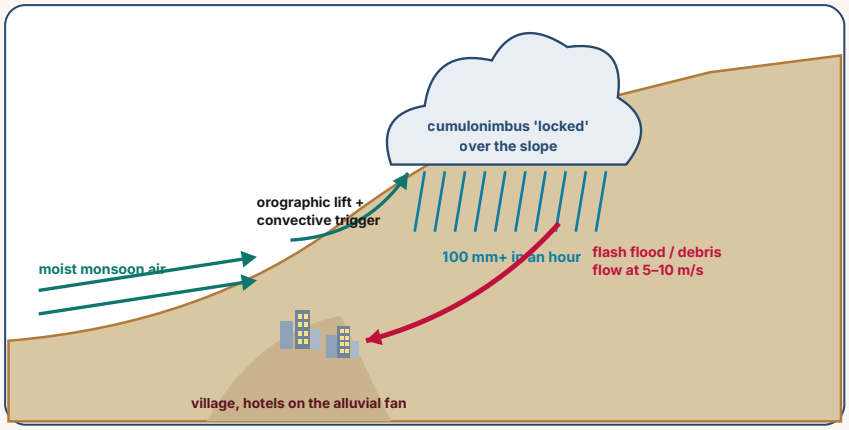
A **flash flood** arrives within six hours of its cause, usually a cloudburst, a dam or embankment breach or the collapse of a natural dam. A **cloudburst**, by IMD's definition, is rainfall of **100** mm or more in an hour over a patch of **20–30** sq km. It is not a cloud exploding but a thunderstorm trapped. Moisture-laden monsoon air is forced up a steep slope; orographic lifting and a convective trigger together build a cumulonimbus tower in

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

half an hour, and the cloud, "locked" against the ridge, holds its growing drops aloft on strong updrafts until the column can bear them no longer and the load falls at once on one valley. A western disturbance meeting the monsoon, as over Uttarakhand in June **2013**, adds the lift. Most Indian cloudbursts strike the southern rim of the Himalaya between **1,000** and **2,500** m, with Garhwal the worst hit; the Western Ghats and the north-eastern hills follow. On slopes of loose glacial and landslide debris the rain becomes a wall of mud and boulders moving at **5–10** m/s, which is why a village on an alluvial fan has no time to run.

How a Cloudburst Happens, and Why the Hills Pay for It

IMD's threshold: 100 mm or more of rain in an hour over a patch of 20–30 sq km. Most Indian events strike the southern rim of the Himalaya at 1,000–2,500 m.



WHAT MAKES IT DEADLY

- Steep slopes turn rain into a wall of water, boulders and mud within minutes
- Loose glacial and landslide debris in the catchment feeds the flow
- Pilgrim routes, markets and homestays sit on fans and terraces
- No warning: a 1-km cell can live less than an hour and hide behind ridges

Forecast limits

Models predict heavy rain 2–3 days out but not a single cell; X-band radars (Jammu, Srinagar, Leh, Banihal, Mukteshwar) give 1–3 hour nowcasts.

Recent events: Leh 6 Aug 2010 (about 250 dead) · Kedarnath 16–17 June 2013 · Pithoragarh–Chamoli July 2016 · Amarnath 8 July 2022 · Mandi (Thunag) 30 June 2025 · Dharali 5 Aug 2025 · Chashoti 14 Aug 2025

Fig. 6.2 The cloudburst mechanism, what turns it into a disaster, and why it cannot yet be forecast.

COMMON CONFUSION: EVERY HILL DISASTER IS NOT A CLOUDBURST

The word is used loosely. IMD recorded only about **31** mm in two hours at the Amarnath cave on 8 July **2022**, when a flash flood killed **16** pilgrims; it called the event highly localised rain, not a cloudburst, with heavier falls likely in the unmonitored upper reaches. The Dharali debris flow of 5 August **2025** followed about **195** mm of rain over the previous month that saturated glacial debris in the **17** sq km Kheer Gad catchment; the nearest gauges logged about **100** mm over two days, and experts ruled out a GLOF. Kedarnath in **2013** was days of extreme rain plus the bursting of the Chorabari moraine lake. Use "cloudburst" for the rainfall threshold and "flash flood" or "debris flow" for what reaches the valley.

Cloudbursts cannot be predicted anywhere in the world: a cell a kilometre wide that lives under an hour is smaller than any model's grid, and ridges hide it from radar. What can be done is to forecast heavy-rain spells two or three days ahead, nowcast with X-band radars, densify rain gauges to map cloudburst-prone slopes, and keep people off the fans and terraces the floods reclaim. Himachal Pradesh counted **45** cloudbursts, **95** flash floods and **135** major landslides between 20 June and 7 September **2025**, with over **200** rain-related deaths and losses above ₹**4,000** crore. Jammu recorded **380** mm in **24** hours on 26–27 August, the most since its observatory opened in **1910**, and a landslide on the Vaishno Devi track killed **34** pilgrims that afternoon.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

Two episodes of **2025** are the ones to remember. At **Dharali** in Uttarkashi, on the road to Gangotri, a debris flow from the Kheer Gad spread a fan of mud metres deep over about **18** hectares on 5 August, burying a bazaar of hotels and homestays whose built-up area had doubled since **2011** despite a warning in **2013**; over **50** people were dead or missing, most never found. At **Chashoti** in Kishtwar, the base village of the Machail Mata yatra, a cloudburst at midday on 14 August sent a torrent through langars and shops where more than a thousand pilgrims had gathered: **63** bodies recovered, **30** still missing a year later, over **120** injured. Both share one anatomy: a known hazard, a pilgrim economy on the only flat land, and no warning possible.



Fig. 6.3 Houses sheared off by the Mandakini at Rudraprayag after the June 2013 Uttarakhand floods.

03 Glacial Lake Outburst Floods

As Himalayan glaciers retreat they leave meltwater ponded behind loose moraine. A **GLOF** occurs when that natural dam fails, by overtopping after an ice or rock avalanche into the lake, by piping through the moraine, or by an earthquake. India has about **7,500** glacial lakes; ISRO's monitoring shows many growing fast, and the risk now runs through hydropower dams and towns tens of kilometres downstream.

Glacial Lake Outburst Flood: The Chain from a Melting Glacier to a Broken Dam

South Lhonak, Sikkim, 3–4 October 2023: the sequence every Himalayan valley with a moraine lake now has to plan for.

1 GLACIER RETREATS
Meltwater pools behind the loose end-moraine; South Lhonak grew twelvefold, 0.11 to 1.4 sq km (1962–2023)

2 TRIGGER
A slab of moraine slid into the lake at night, with ice calving from the snout; quakes, rain or piping can do the same

3 BREACH
The wave overtopped and cut the moraine 'dam'; most of the lake drained within hours

4 FLOOD WAVE
Teesta rose over 15 ft; the 1,200 MW Teesta-III dam at Chungthang, about 60 km down, failed; Rangpo and NH-10 hit

5 TOLL
55 dead and 74 missing in Sikkim; 31 major bridges, hydropower and the Sikkim–Siliguri road lost

INDIA'S RESPONSE: NATIONAL GLOF RISK MITIGATION PROGRAMME (approved 25 July 2024)

- Rs 150 crore (135 from the National Disaster Mitigation Fund) for Sikkim, Himachal, Uttarakhand and Arunachal Pradesh
- About 7,500 glacial lakes in India; NDMA shortlisted 189 high-risk lakes (195 on its 2026 list) for expeditions and lake lowering
- Automatic weather and water-level stations, sensors and sirens downstream; NDMA GLOF guidelines, October 2020
- CWC now reviews the design flood of 47 dams exposed to GLOFs; GLOF studies compulsory for new dams below glacial lakes

Fig. 6.4 The GLOF sequence as it unfolded at South Lhonak in October 2023, and the national programme that followed.

CASE IN POINT: SOUTH LHONAK AND TEESTA-III, 3–4 OCTOBER 2023

South Lhonak, at **5,200** m in north Sikkim, had been flagged for a decade: it grew about twelvefold, from **0.11** sq km in **1962** to about **1.4** sq km in **2023**, siphons were laid in **2016**, and an NDMA–Swiss expedition installed a weather station in September **2023**, about fifteen days before it burst. Late on 3 October some **14.7** million cubic metres of frozen moraine slid into the lake; the **20**-m wave cut the outlet and sent a surge down the Teesta that destroyed the **1,200** MW Teesta-III dam at Chungthang, about **60** km away, swept away **31** major bridges and NH-10, and killed **55** people in Sikkim, with **74**

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

missing. The lessons: a dam below a known lake must be designed for the GLOF, not just the rain flood; monitoring is useless without sirens and evacuation plans downstream; and lake-lowering works need to be finished, not piloted.

The response came in 2024. The **National GLOF Risk Mitigation Programme**, approved on 25 July 2024 with ₹150 crore (₹135 crore from the National Disaster Mitigation Fund), covers Sikkim, Himachal Pradesh, Uttarakhand and Arunachal Pradesh. NDMA first shortlisted 189 high-risk lakes; its updated 2026 list counts 195 across six Himalayan States and UTs, 67 of them in the very-high-risk category. Expeditions in the short summer window carry out bathymetry, install weather and water-level stations and plan lake lowering and downstream sirens, with Ladakh and Jammu and Kashmir also surveyed. CWC now reviews the design flood of 47 dams exposed to glacial lakes and requires a GLOF study for every new dam with glacial lakes in its catchment. NDMA's GLOF guidelines (October 2020) set the standard operating procedure for averting threats from glacial and landslide-dammed lakes.

04 Flood Management in India

Policy moved from relief to engineering after the floods of 1954: a National Flood Policy, then decades of embankments, drainage channels and multipurpose dams, and the Ganga Flood Control Commission (1972) and Brahmaputra Board (1980). The Rashtriya Barh Ayog (1980) made 207 recommendations, many still unimplemented. NDMA's **National Guidelines on Management of Floods** (January 2008) asked for scientific mapping of flood-prone areas, basin-wise forecasting, data cooperation with Nepal, Bhutan and China, flood cushions in new dams, pre- and post-monsoon inspection of embankments and dams, zoning laws with incentives, wetland protection, raised shelters and incident command for response. Floods remain a State subject; the Centre supplements through schemes and forecasts.

INSTRUMENT	WHAT IT DOES (STATUS 2025–26)
CWC flood forecasting	360 stations (201 level, 159 inflow) in 20 basins (2026); 24-hour forecasts, 7-day basin advisories, unified portal (July 2025), AI/ML models, alerts through the Common Alerting Protocol and the Flood Watch India app
Flood Management and Border Areas Programme	Approved 21 February 2024 for 2021–26: ₹4,100 crore (₹2,940 crore for State works at 60:40, 90:10 for hill and north-eastern States; ₹1,160 crore for border rivers at 100%); 431 completed projects protect 5.13 mha and 5.5 crore people (2026); zoning incentives
Flood-plain zoning	Model bill circulated 1975; enacted only by Manipur, Rajasthan, Uttarakhand and the former J&K; four more States adopted it by policy; NMCG orders of 2016 for the Ganga
Finance	SDRF and NDRF for relief; mitigation funds (15th Finance Commission) for projects; 15th FC window for urban flooding in the seven most populous cities

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

INSTRUMENT	WHAT IT DOES (STATUS 2025–26)
Data and cooperation	Kosi and Gandak agreements with Nepal; flood-season data MoUs with China on the Brahmaputra and Sutlej lapsed in **2023** and **2020** and data stopped; in **2025** China agreed only to share emergency data on humanitarian grounds, and renewal was still under talks in **2026**; ISRO flood maps through NDEM and Bhuvan

India's **35,000** km of embankments protect millions in a normal year. Their trouble is the long run: silt settles inside the levees, the bed rises, the river hangs above the land, and a breach is a wall of water into villages that believed themselves safe, as at Kusaha on the Kosi on 18 August **2008**, when the river jumped **120** km east at a fraction of its design flood and affected about **33** lakh people in Bihar. The alternative, the Dutch **Room for the River** approach, moves embankments back, restores wetlands and detention basins and lets the river spread where it costs least. The future is neither walls nor no walls but zoning backed by forecasts and insurance.

Kerala's flood of August **2018** tested the whole system at once. Rain **42%** above normal, with the heaviest spell from 10 to 16 August, put all **44** rivers in spate, triggered thousands of landslides and forced **35** dams to open together; **483** people died, over **10** lakh went to relief camps and recovery needs were put at ₹**31,000** crore. CWC concluded that the dams, already full by 14 August, neither caused nor could have cut the flood; the High Court's amicus curiae found that reservoirs were run for power and irrigation with no flood cushion, no emergency action plans and late red alerts. Both are true, which is why rule curves, inflow forecasts and flood cushions now sit at the heart of dam safety.



Fig. 6.5 Villages marooned on the Brahmaputra plain, Assam, July 2012: a scene repeated almost every monsoon.

05 Dam Safety and Dam Failure

India has the third largest stock of large dams in the world: **6,545** operational "specified" dams and **83** under construction in the **2025** register, led by Maharashtra, Madhya Pradesh and Gujarat; in the **2023** register **3,789** were older than **25** years and **224** older than a century. A dam fails when water exceeds its design, when its body or foundation is eroded, when its machinery fails, or when it is operated badly. CWC's record of Indian failures puts breaching in floods, essentially overtopping, first, followed by piping and foundation problems.

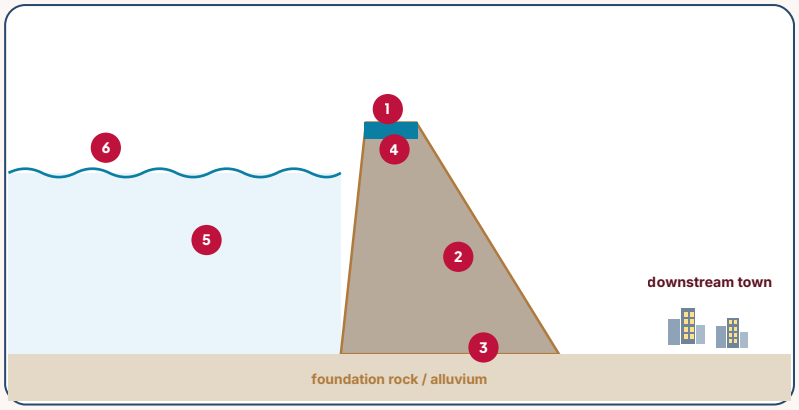
FAILURE	CAUSE	TOLL AND LESSON
Machchhu-II, Morbi, 11 Aug 1979	Inflow far above the spillway's design; earthen flanks overtopped and washed out	Thousands dead (estimates **1,800** to over **10,000**); design floods must use probable maximum flood
Malpasset, France, 2 Dec 1959	Thin arch dam; faulted, permeable rock under the left abutment lifted and slid	**423** dead at Frejus; investigate the foundation, not just the structure

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

FAILURE	CAUSE	TOLL AND LESSON
Tiware, Ratnagiri, 2 Jul 2019	Small earthen dam breached after heavy rain; seepage, poor construction and repair	About **20** dead in seven villages; small State dams need inspection too
Teesta-III, Sikkim, 4 Oct 2023	GLOF wave overtopped a concrete-faced rockfill dam designed without the glacial flood	Dam and **1,200** MW plant lost; GLOF studies now compulsory
Derna, Libya, 10–11 Sep 2023	Storm Daniel; two neglected embankment dams with small spillways overtopped in sequence	Over **4,000** dead and thousands missing; failure turned a storm into a catastrophe

How Dams Fail, and the Law That Now Watches Them

Most failures come from water the dam was not built for or from neglect; the Dam Safety Act 2021 puts every 'specified dam' under a four-tier watch.



FAILURE MODES

1. Overtopping: flood bigger than the spillway (Machchhu 1979, Banqiao 1975, Derna 2023)
2. Piping and internal erosion through the body or foundation (Tiware 2019)
3. Foundation failure: weak or faulted rock (Malpasset 1959)
4. Gate or mechanical failure (Tungabhadra crest gate, Aug 2024)
5. Upstream hazards: GLOF, landslide, quake (Teesta-III 2023)
6. Operation: no flood cushion, late release (Kerala 2018, Ranjit Sagar 2025)

Dam Safety Act 2021 (in force 30 Dec 2021)

- National Committee on Dam Safety: policy, standards
- National Dam Safety Authority (18 Feb 2022): regulator
- State Committee and State Dam Safety Organisation
- Inspections, emergency action plans, instruments, penalties

'Specified dam': height above 15 m, or 10–15 m with a large reservoir, long crest or special hazard. India had 6,545 such dams in operation in 2025, and 224 were over 100 years old in 2023; the CWC's record shows breaching by floods as the largest cause of Indian failures, followed by piping and foundation problems.

Fig. 6.6 Six ways a dam fails, with the Indian and world examples that illustrate each, and the four-tier structure of the Dam Safety Act.

The **Dam Safety Act, 2021** (in force 30 December **2021**) applies to every specified dam, meaning one over **15** m high, or **10–15** m with a large reservoir, a long crest or difficult foundations. It creates the National Committee on Dam Safety under the CWC chairman to set standards, the **National Dam Safety Authority** (18 February **2022**) as regulator and arbiter between States, and a State Committee and State Dam Safety Organisation in each State. Owners must inspect before and after every monsoon, classify hazards, install instruments and flood-warning systems, prepare operation manuals and emergency action plans, earmark repair funds and report incidents; non-compliance can mean imprisonment. NDSA's first major inquiry, into the sinking piers of Telangana's Medigadda barrage (October **2023**), faulted planning, design, construction and upkeep (final report, April **2025**), and since **2025** it has been risk-screening every specified dam. In August **2024** a single snapped chain swept away crest gate 19 of the **70**-year-old Tungabhadra dam: ageing machinery is a safety issue too. The pre-monsoon round of **2023** found **4** dams with deficiencies that could cause failure and **169** needing prompt repair. Money comes through the Dam Rehabilitation and Improvement Project: Phase I (**2012–21**) rehabilitated **223** dams for ₹**2,567** crore; Phases II and III (**2021–31**) cover **736** dams in **19** States at ₹**10,211** crore, co-financed by the World Bank and AIIB.

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

CONCEPT: FLOOD CUSHION AND THE RULE CURVE

A reservoir can only absorb a flood if it has space. The **flood cushion** is storage deliberately kept empty during the monsoon; the **rule curve** is the schedule of permitted levels through the year that creates it. Dams run for power and irrigation fill early, so a late burst forces releases as large as the inflow: Ranjit Sagar discharged **2.15** lakh cusecs into the Ravi on 26 August **2025**, while Pong, with its highest-ever July–August inflow, held releases below **1** lakh cusecs. The answer is reservoir operation on inflow forecasts, warnings before gates open, and a cushion **not** traded for a fuller reservoir.

06 Lessons and the Way Forward

The Indian flood is changing shape. Extreme rain is more concentrated, so cloudburst torrents and short, violent river peaks now kill more than the slow annual floods of the plains; the hills, with pilgrim and tourist economies on their fans and terraces, have become the deadliest ground; and the links between weather, reservoirs and downstream towns are where most avoidable losses occur. The country forecasts well and warns unevenly, protects with walls it cannot maintain and zones floodplains it cannot clear.

- **Zone and enforce:** flood-plain and hazard-line zoning; no building on fans, terraces and river beds; clear encroached drains and wetlands.
- **Warn to the last mile:** CWC and IMD alerts by cell broadcast; sirens below dams and glacial lakes; rain gauges and X-band radars in the hills.
- **Operate dams for floods:** rule curves, flood cushions, emergency action plans; audit ageing gates; give rivers room with set-back embankments.
- **Protect the Himalaya:** carrying capacity for pilgrim traffic, GLOF-proof dam design, lake lowering; data-sharing with Nepal, Bhutan and China.

IN THE NEWS 2026: COUNTING THE MONSOON OF 2025

The **2025** monsoon, **108%** of the long-period average, was one of the deadliest in the hills in years. Himachal Pradesh's losses passed ₹**4,000** crore; Punjab, Jammu and Delhi's Yamuna all flooded within a fortnight. CWC's unified flood portal (2 July **2025**) and AI-based short-range models at its Smart Water Resources Modelling Organisation (**2024**) began their first full season, and in **2026** the Union Home Minister asked for early-warning systems at **60** high-risk glacial lakes, double the **30** first planned.

USING THIS CHAPTER IN MAINS

Classify floods by type and anchor them in the exposure numbers. For cloudbursts, give IMD's threshold, explain orographic lift plus convective triggering in the 1,000–2,500 m belt, cite Dharali and Chashoti (2025) and pair NDMA's 2008 guidelines with zoning, radars and gauges. For dam failures,

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

sort causes into overtopping, piping, foundation, mechanical, upstream hazard and operation, pair Machchhu or Malpasset with Teesta-III, and close on the Dam Safety Act. Use Kosi 2008 and Kerala 2018 to weigh embankments against room for the river.

Chapter 6 at a Glance

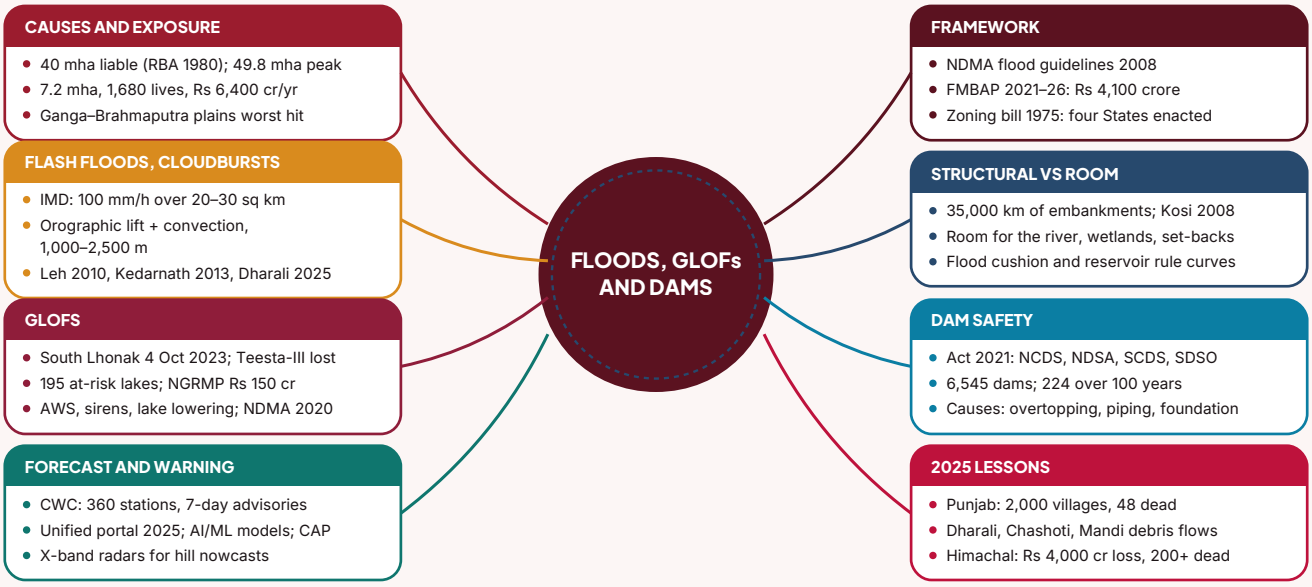


Fig. 6.7 Chapter 6 at a glance: the whole chapter on one page for quick revision.

Previous Year Questions

2024 GS I · 10 MARKS

What is the phenomenon of 'cloudbursts'? Explain.

Approach: Define a cloudburst by the IMD criterion—over 100 mm of rain in one hour over an area of about 20–30 sq km. Explain the mechanism: moist monsoon air forced up steep Himalayan slopes (orographic lift), towering cumulonimbus clouds, strong updrafts hold raindrops aloft until the column collapses in a sudden downpour; aided by warm air, Langmuir precipitation and Western Disturbance–monsoon interaction. Give examples: Leh 2010, Kedarnath 2013, Amarnath 2022, Dharali–Uttarkashi 5 August 2025 and Himachal 2025. Effects: flash floods, debris flows, GLOF-like surges, landslides. Close with difficulty of prediction, Doppler radar gaps and NDMA advice on avoiding river-bed construction. (Section 02)

FREE SAMPLE - COMPLETE BOOK AT STORE.LOTUSARISE.COM

2023 GS III · 10 MARKS

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.

Approach: Open with India's 6,545 operational specified dams (2025 register), about 3,800 of them over 25 years and 224 over a century old (2023 register), and the Dam Safety Act 2021 context. Causes: hydrological (overtopping from extreme rainfall or GLOF, inadequate spillway), structural (piping and internal erosion in earthen dams, foundation seepage, poor design or construction), geological (earthquakes, landslides into reservoirs), operational (poor gate maintenance, delayed releases, siltation), and human/institutional (weak inspection, encroached downstream floodplains). Examples: Machchhu-II, Morbi 1979 (overtopping, thousands dead), Malpasset 1959 (foundation failure), Banqiao 1975, Tiware 2019, Teesta-III/Chungthang 2023 (GLOF). Close with NDSA, emergency action plans and risk-based inspection. (Sections 03, 05)

2022 GS III · 10 MARKS

Explain the mechanism and occurrence of cloudburst in the context of the Indian subcontinent. Discuss two recent examples.

Approach: Define cloudburst (IMD: over 100 mm/hour over 20–30 sq km) and explain the mechanism: orographic uplift of moisture-laden monsoon winds against Himalayan slopes, formation of deep cumulonimbus, strong updrafts suspending large droplets until the cloud collapses; interaction with Western Disturbances and warming that loads more moisture. Occurrence: Uttarakhand, Himachal, J&K, Ladakh and the North-East during July–August, usually at 1,000–2,500 m, in afternoons; rising frequency. Two recent examples: Amarnath flash flood (8 July 2022, 16 dead; IMD could not confirm a cloudburst) and Kedarnath (June 2013) or Dharali–Uttarkashi (5 August 2025). Close with impacts (flash floods, debris flows) and NDMA measures (radar, zoning, no construction on stream beds). (Section 02)

2016 GS III · 12.5 MARKS

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.

Approach: Introduce cloudbursts (over 100 mm/hour in a small area) and the Uttarakhand episodes (Kedarnath 2013, Pithoragarh and Chamoli 2016). Draw on NDMA's flood (2008), landslide (2009) and Himalayan guidance: hazard mapping and zonation of cloudburst-prone valleys; dense Doppler weather radar and automatic rain-gauge network with nowcasts; flood-plain and stream-bed zoning, ban on construction and pilgrim camps on river terraces; slope stabilisation and check dams; early warning sirens and community volunteers; safe pilgrim management (Char Dham registration, carrying capacity); strengthened SDRF and NDRF pre-positioning; school and hospital safety; insurance and relief norms. Close with the need for a Himalayan-specific risk policy. (Sections 02, 04, 06)

LOTUSARISE IAS

2027 EDITION

Liked the sample? Get the complete book.

You have read 2 of 27 chapters.

The full Disaster Management book runs to 274 pages: every hazard, law, institution and framework in the same depth and current to October 2026, 47 PYQs from 2013 to 2026 with expert approaches, 136 original diagrams and photographs, and banks of case studies, schemes and data.

27	7	47	136
CHAPTERS	UNITS	PYQS 2013–2026	ORIGINAL DIAGRAMS

ALL SEVEN UNITS IN THE FULL BOOK

I	Understanding Disasters	2 ch · p5
II	Natural Hazards of India	8 ch · p26
III	Human-Induced and Biological Disasters	5 ch · p108
IV	Law, Institutions, Plans and Finance	5 ch · p157
V	Global Frameworks and India's Role	2 ch · p205
VI	Cross-Cutting Themes	2 ch · p225
VII	Answer-Writing Resources	3 ch · p246

₹149

GET THE FULL BOOK

Scan the code or visit store.lotusarise.com · One-time payment, instant PDF download