



DISASTER MANAGEMENT

OFFICERS' IAS ACADEMY

GS-III

DISASTER

MANAGEMENT

Mains Harvest

**ISO 9001:2015
CERTIFIED ACADEMY**

OFFICERS IAS ACADEMY
(IAS Academy by IAS Officers)

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MESSAGE FROM THE DIRECTOR

Dear Aspirant,

This book is dedicated to YOU, the untiring civil service aspirant who has the drive and commitment to persevere towards clearing this exam which is considered as one of the toughest exams in the world.

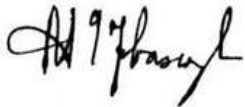
We congratulate you on choosing this book for “**Disaster Management**”. Our attempt here is to simplify important concepts without losing the key points. Hence, we hope you will find this book useful in your civil services journey.

About this book

This book is a distillation of the expertise of the faculty at Officers IAS academy, explained in simple and easy to understand language. What you get to study in this book has been painstakingly collated by our faculty through their years of teaching and mentoring thousands of aspirants.

A strong zeal from you to clear this exam combined with our coaching and textbook will, I am sure help you scale great heights.

I wish you the very best in the most important endeavour of your life.



R. A. Israel Jebasingh

(IAS, 2004 Batch All India Rank 59)

Director of Officers IAS Academy

HOW TO USE THIS BOOK?

Hello Aspirant!

There is a subtle difference between putting in effort and putting in the right and focussed effort. That difference could determine whether you get into the civil services or not! This statement becomes highly relevant during the UPSC Main Examination stage.

Aspirants know that every mark scored or missed in the Main examination determines their presence as well as their place in the All-India Rank list. Unlike the Preliminary examination, Main exams are fairly predictable. But with Mains, completing the examination on time becomes the biggest challenge.

Even with persistent efforts, aspirants generally tend to struggle in completing the Mains Syllabus. And even when the syllabus is covered, there is a struggle in recollecting appropriate points during the examination.

Such challenges are faced by all UPSC Mains Candidates. This is because of the sheer mindboggling number of topics, dimensions, and links with current affairs that aspirants have to sift through in their mind before writing an answer – something that is indeed a herculean task.

We in the R&D team of the Officers IAS Academy, have been pondering over this challenge, and have found a solution.

Our R&D team spent a year meticulously combing through the *past 47 years'* Mains General Studies question papers, to identify all possible topics and dimensions ever covered for each subject in an UPSC Main examination. Our researchers, then set out to prepare a series of books for each of the 'Main exam subjects' (pertaining to GS1, GS2, & GS3) where all relevant content is covered in a scientific and precise manner. Aspirants can confidently use these books to 'complete' the UPSC Main Exam syllabus effectively and efficiently.

Please note, we do not advocate the use of these 'Mains Harvest' books as 'Standard' sources. However, instead of reading endless number of books for the UPSC preparation, aspirants can focus on the standard books (NCERTs) for foundational knowledge and then devote the rest of their time in studying the Officers IAS Academy's Mains Harvest books.

For you, dear aspirants, we have practically 'harvested' the 'essence' of the UPSC main examination to produce the 'Mains Harvest' book series. Use them well!

Thanking and wishing you all the very best in your preparations,

R&D Team,

Officers IAS Academy, Chennai.

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DISASTER AND VULNERABILITY

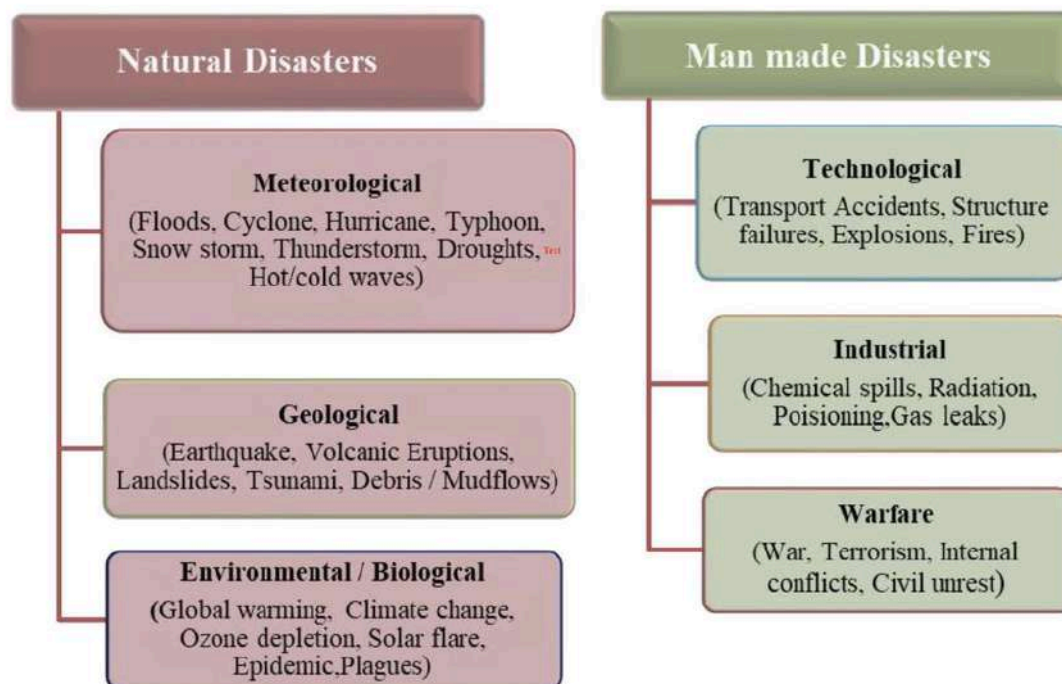
1) What is a disaster?

- The **UNISDR** defines a disaster as: "A serious disruption of the functioning of a community or a society involving widespread human, material, or environmental losses and impacts which exceeds the ability of the affected community to cope using only its own resources."

Types of disasters

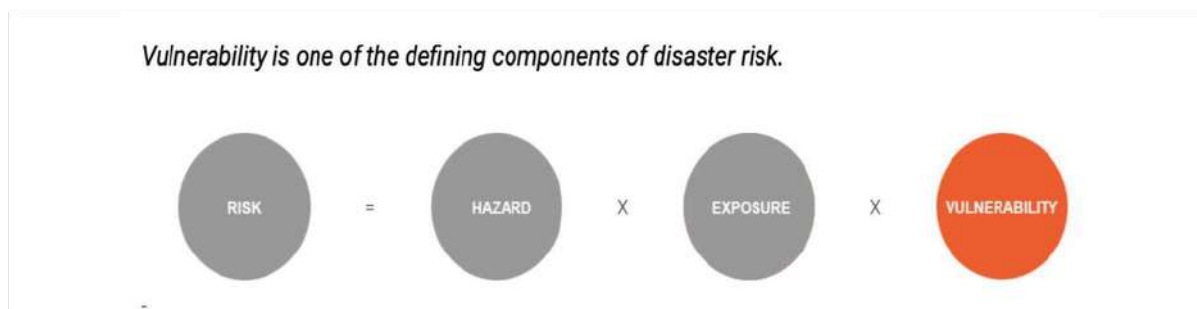
- Disasters are classified as per origin, into natural and man-made disasters.

Types of Disasters



2) What is Vulnerability?

- UNDRR defines vulnerability as the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.
- The concept of vulnerability therefore implies a **measure of risk combined with the level of social and economic ability to cope** with the resulting event in order to resist major disruption or loss.
- This susceptibility and vulnerability to each type of threat will **depend on their respective differing characteristics**. For instance, while the 1993 Marathwada earthquake in India left over 10,000 dead, technically the much more powerful Los Angeles earthquake of 1971 left over 55 dead.



Different types of vulnerabilities

- 1) Vulnerabilities can be classified as tangible and intangible depending on whether it can be quantified or measured.
 - **Tangible Vulnerability:** can be measured or quantified
 - i) Potential loss of Crops, livestock, machinery, equipment, buildings and infrastructure, loss of lives.
 - **Intangible Vulnerability:** cannot be measured
 - i) loss of social cohesion due to disruption of community, loss of reputation, psychological consequences resulting from disaster impacts, cultural effects, etc.
- 2) Vulnerabilities can also be classified as physical, economic, social, environmental, political and attitudinal.
 - **Physical Vulnerability:** It refers to the potential **impact on the physical environment**. The physical vulnerability of an area also depends on its geographic proximity to the source and origin of the disasters. It also may be determined by aspects such as population density levels, remoteness of a settlement, the site, design and materials used for critical infrastructure and for housing (UNISDR). For example,
 - If an area lies near the coast lines, fault lines, unstable hills etc. it makes the area more vulnerable to disasters like Tsunami and earthquakes as compared to an area that is far away from the origin of the disaster.
 - Wooden homes which are less likely to collapse in an earthquake are more vulnerable to fire.
 - **Economic Vulnerability:** It refers to the **potential impact of hazards on economic assets**. Economic vulnerability of a community can be assessed by determining how varied its sources of income are, the ease of access and control over means of production (e.g. farmland, livestock, irrigation, capital etc.), adequacy of economic fall back mechanisms and the availability of natural resources in the area. For example,
 - Poorer families may live in squatter settlements because they cannot afford to live in safer (more expensive) areas.
 - **Social Vulnerability:** It represents the **potential impact of events on certain groups** such as the poor, pregnant or lactating women, disabled, children, and elderly. It can be characterized by weak family structures, lack of leadership and unequal participation in decision making, weak or no community organizations, and with discrimination.
 - Eg: Kosi river floods in Bihar affected the scheduled caste concentrated villages.
 - **Attitudinal Vulnerability:** Attitudinal vulnerability includes human characteristics **pertaining to morale and personal resilience**, stress, and general mental health, which affect the ability to resist the impact of hazards and other stressful situations.

- A community which has negative attitude towards change and lacks initiative in life resultantly become more and more dependent on external support which make them victims of conflicts, hopelessness and pessimism which reduces their capacity of coping with a disaster.
- **Environmental Vulnerability:** It represents the potential **impact of events on account of the environmental conditions** (flora, fauna, ecosystems, biodiversity). Natural resource depletion and resource degradation are key aspects of environmental vulnerability.
 - Wetlands, for example, are sensitive to increasing salinity from sea water, and pollution from stormwater runoff containing agricultural chemicals, eroded soils, etc.
 - Sand mining has left the coastal areas more vulnerable to flooding and erosion.
- **Political vulnerability:** It refers to the **impact of disaster on political stability and political legitimacy**. It can be determined by assessing the problems related to governance (loss of services, administrative problems, and rehabilitation of displaced population due to disaster).
 - Eg: Man-made disasters like war may create political stability.

Characteristics of vulnerability to disasters

Vulnerability is,

- **Multi-dimensional:** One of the characteristics of vulnerability is that it is multi-dimensional, that is it can be categorized as physical, social, economic, environmental, institutional, and even human factors can define vulnerability
- **Dynamic:** Vulnerability changes over time and from one disaster to another disaster.
- **Scale-Dependent:** Vulnerability can be expressed in different scales from human to household to community to country resolution;
- **Site-Specific:** Every site and locality has its own vulnerability and is different from the other ones.

How can vulnerability be characterized/assessed?

1. **Scientific Method:** This method considers various theories, research, and methodologies that help in understanding the impact of the vulnerability in a particular area and in disaster risk reduction.
2. **Geographical Information Systems (GIS) and CEM:** GIS is a powerful tool used in every phase of the Comprehensive Emergency Management (CEM) to characterize disaster vulnerability.
 - a. CEM is a **system of applying science and technology** to manage and deal with disasters that can exert an enormous amount of damage.
 - b. GIS helps in **collecting spatial data** and integrating them within the systems to manage the disaster event activities.
 - c. GIS helps in **dynamic monitoring** and interoperability on human and physical processes
3. **Policy method:** It is a spatial method which demarcates distribution of disaster prone zones to tackle the vulnerability to disaster. This helps authorities to take appropriate action to mitigate the impacts.

Steps for vulnerability assessment and preparedness

- Following steps are imperative for the vulnerability assessment and preparedness in high-risk zones:
 - Identification of various hazard prone areas. Preparation of detailed vulnerability profiles, mapping food insecurity, aviation hazard, landslide hazard etc.
 - Vulnerability and risk assessment of buildings
 - Developing disaster damage scenarios

- Developing technical guidelines for hazard resistant constructions
- Upgrading of hazard resistance of existing housing stock by Retrofitting, and
- Crafting techno-legal regime to be adopted for infrastructure development.

Importance of vulnerability and risk assessment for pre disaster management

- A proper system of disaster management has both **pre disaster and post disaster components.**
 - **Prevention, Mitigation and Preparedness** are the components of pre disaster phase and **Response, Rehabilitation and Reconstruction** are part of post disaster phase.
- Prevention, Mitigation and Preparedness can be developed properly only if we know the underlying risks.
- Vulnerability assessments and risk analyses allow for the **identification of areas of critical concern** and help to guide mitigation efforts.
- A hazard vulnerability assessment (HVA) systematically **evaluates the damage** that could be caused by a potential disaster, the **severity of the impact**, and the available medical resources during a disaster to reduce population vulnerability and increase the capacity to cope with disasters.
- Vulnerability assessment, if properly conducted, confers advantages to vulnerable people in terms of raising **public awareness, sensitizes a community and empowers them** by giving the community knowledge of risks and capacities.
- Hence vulnerability and risk assessment is essential to take up pre disaster management steps.

3) Vulnerability profile of India

- Among the top ten disaster prone countries, India stands second after China.
- More than 6% of the total population bear the brunt of natural disasters.
- Reason being India's large population, geo-climatic conditions, Industrialisation, unplanned urbanization and climate change.
- According to an estimate
 - 59 per cent land in India is prone to **earthquake**,
 - 12 per cent of land is vulnerable to **flood and soil erosion**,
 - 76 percent coastline is prone to **cyclone and tsunami**,
 - 68 percent cultivable area is prone to **drought**,
 - Around 78.29 million hectares of forest area is prone to **forest fire**.
- Besides, India is also vulnerable to Chemical, Biological, Radiological and Nuclear (CBRN) disasters.

Questions

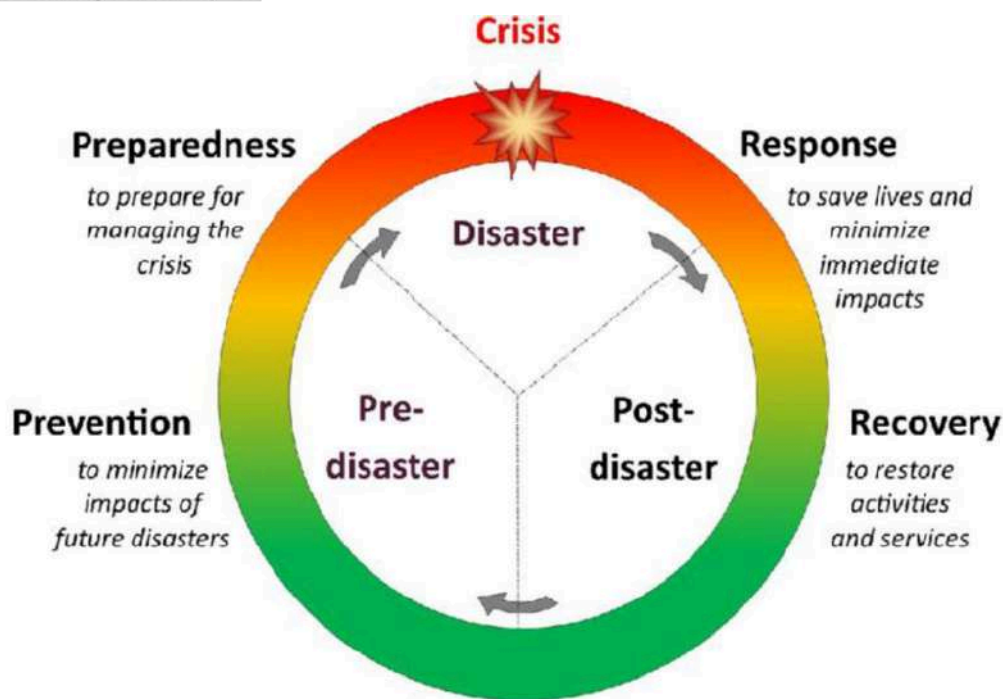
1. How important are vulnerability and risk assessment for pre-disaster management? As an administrator, what are the key areas that you would focus on in a disaster management system.
2. Vulnerability is an essential element for defining disaster impacts and its threat to people. How and in what ways can vulnerability to disasters be characterized? Discuss different types of vulnerability with reference to disasters.

DISASTER MANAGEMENT

1) What is disaster management?

- Disaster management is a process of **effectively preparing for and responding to disasters**.
- It involves strategically **organizing resources** to lessen the harm that disasters cause.
- It also involves a **systematic approach to managing the responsibilities** of disaster prevention, preparedness, response, and recovery.

Disaster Management cycle



- It is a continuous process requiring multidimensional and multi-institutional activities aiming to rehabilitate the affected people and reconstruct the affected region. In other words, disaster management includes anticipation, assessment, and rehabilitation.
- There are three key stages of activities in disaster management:
 1. **Before a disaster:** to reduce the potential for human, material, or environmental losses caused by hazards and to ensure that these losses are minimized when disaster strikes
 - a. Includes prevention, mitigation and preparedness.
 2. **During a disaster:** to ensure that the needs and provisions of victims are met to alleviate and minimize suffering; and
 3. **After a disaster:** to achieve rapid and durable recovery which does not reproduce the original vulnerable conditions.
- In brief, disaster management is a multi-stage process of:
 - **Mitigation**, i.e. mitigating the causes responsible for disaster. It is a stage in planning that either checks the causes of disaster or reduces the effects.
 - **Infra-structural preparedness** i.e. the stage of alert to cope with the actual occurrence of disaster. This involves administrative and economic preparedness, an advance outlay of resources, which can reduce the loss of sufferings, both human and infra structural.

- **Rehabilitation, Reconstruction and Resettlement, i.e. saving lives, restoring infrastructure and communications, and normalizing life as soon as possible.**

Disaster Preparedness

- Disaster preparedness consists of a **set of measures undertaken in advance** by governments, organizations, communities, or individuals to **better respond and cope with the immediate aftermath of a disaster**, whether it be human-induced or caused by natural hazards.
- Disaster preparedness has three main elements:
 1. Forecasting events and issuing warnings.
 2. Taking precautionary measures in response to warnings.
 3. Improving response by organizing and strengthening capacity to deliver timely and effective rescue, relief and assistance.
- Disaster preparedness therefore has two main aims:
 - To help people to avoid impending disaster threats; and
 - To put plans, resources and mechanisms in place to ensure that those who are affected receive adequate assistance.

Recent measures in Disaster Management

Preparedness

- 1) **Coalition for Disaster Resilient Infrastructure (CDRI):** It aims to increase the resilience of infrastructure systems to climate and disaster risks, thereby ensuring sustainable development.
- 2) **NDMA earthquake guidelines 2014:** Recommended for seismic retrofitting of deficient buildings and structures.
- 3) **Drought tool box:** The United Nations Convention to Combat Desertification (UNCCD) is currently testing a drought toolbox which uses a total of 15 to 30 different parameters to assess drought risk and vulnerability of a geographical region.

Mitigation

- 4) **National disaster mitigation fund:** The objective is for funding the projects exclusively for the purpose of mitigation. Set up as a part of the National Disaster Management Plan, 2016.
- 5) **National Disaster Risk Index:** The National Disaster Risk Index would map hazards and vulnerabilities including economic vulnerabilities across 640 districts and all states including UTs.
- 6) **E-course on Vulnerability Atlas of India: Launched by the** Ministry of Housing and Urban Affairs, it aims to create awareness and understanding about natural hazards and help in identification of regions with high vulnerability with respect to various hazards such as earthquakes, and landslides etc.,

Response

- 7) **Capacity building:** It is an ongoing process that equips officials, stakeholders and the community to perform their functions in a better manner during a crisis/disaster.
- 8) **Awareness generation:** Process of educating and empowering the population through sharing knowledge and information about the various types of disasters and their potential risks as widely as possible so that people act appropriately when a disaster happens.
- 9) **Aapada Mitra:** It is a Central Sector scheme to identify suitable individuals in disaster-prone regions who can be trained to be first responders in times of disasters.

2) National Disaster Management Authority

- The National Disaster Management Authority (NDMA) is the **apex body for Disaster Management** in India.
- **Disaster Management Act, 2005** envisaged the creation of National Disaster Management Authority (NDMA), **headed by the Prime Minister**, and State Disaster Management Authorities (SDMAs) headed by respective Chief Ministers, to spearhead and implement a holistic and integrated approach to Disaster Management in India.

NDMA Vision

- To build a **safer and disaster-resilient India** by a holistic, proactive, technology driven and sustainable development strategy that involves all stakeholders and fosters a culture of **prevention, preparedness and mitigation**.

Functions and Responsibilities

- NDMA, as the apex body, is mandated to **lay down the policies, plans and guidelines for Disaster Management** to ensure timely and effective response to disasters. Towards this, it has the following responsibilities:-
 - Lay down policies on disaster management.
 - Approve the National Plan.
 - Approve plans prepared by the Ministries or Departments of the Government of India in accordance with the National Plan.
 - Lay down guidelines to be followed by the State Authorities in drawing up the State Plan.
 - Lay down guidelines to be followed by the different Ministries or Departments of the Government of India for the Purpose of integrating the measures for prevention of disaster or the mitigation of its effects in their development plans and projects.
 - **Coordinate the enforcement** and implementation of the policy and plans for disaster management.
 - Recommend **provision of funds** for the purpose of mitigation.
 - Provide such **support to other countries affected by major disasters** as may be determined by the Central Government.
 - Take such other **measures for the prevention of disaster, or the mitigation, or preparedness and capacity building** for dealing with threatening disaster situations or disasters as it may be considered necessary.
 - Lay down broad policies and guidelines for the functioning of the National Institute of Disaster Management.

National Disaster Management Policy Framework

- NDMA has adopted a **mission-mode approach** involving a number of initiatives with the help of various institutions operating at the national, state and local levels.
- Central ministries, States and other stakeholders have been involved in the participatory and consultative process of evolving policies and guidelines.
- This Policy framework is also **in conformity with the International Strategy for Disaster Reduction, the Rio Declaration, the Millennium Development Goals and the Hyogo Framework 2005-2015**. The themes that underpin this policy are:-

- **Community-based disaster management**, including last mile integration of the policy, plans and execution.
- **Capacity development** in all related areas.
- **Consolidation of past initiatives** and best practices.
- **Cooperation** with agencies at the national, regional and international levels.
- **Compliance and coordination** to generate a multi-sectoral synergy.

Institutional Framework

- The National Policy on Disaster Management puts in place an enabling environment for all i.e., the Centre, State and District.
- Under the provisions of the Act, the Disaster Management Authority has been established at 3 levels viz. National, State and District.
- The **National Disaster Management Authority (NDMA)** has been established under the Chairmanship of the Prime Minister and **National Executive Committee (NEC)** of Secretaries has been created to assist the NDMA in the performance of its functions.
- At the **State level**, a **State Disaster Management Authority** has been created under the Chairmanship of Chief Minister of the State, which has been assisted by a State Executive Committee.
- At the **District level**, **District Disaster Management Authorities** have been created.

National Executive Committee (NEC)

- The NEC as the **executive committee of the NDMA** is statutorily mandated to assist the Authority in the discharge of its functions and ensure compliance of the directions issued by the central government.

Composition

- The NEC consists of the following members
 - **Secretary to the GoI** of the ministry or department having **administrative control of DM** who shall be the ex-officio chairperson
 - Secretaries to the GoI in the **Ministries/Departments of Agriculture, Atomic Energy, Defence, Drinking Water Supply, Environment and Forests, Finance (Expenditure), Health, Power, Rural Development, Science and Technology, Space, Communications, Urban Development, Water Resources, and the Chief of the Integrated Defence Staff of the Chiefs of Staff Committee** as members.

Powers and Functions of NEC

- The NEC is the executive committee of the NDMA and is mandated to **assist the NDMA** in the discharge of its functions and also ensure compliance of the directions issued by the Central Government.
- The NEC is to **coordinate the response** in the event of any threatening disaster situation or disaster.
- The NEC will **prepare the National Plan** based on the National Policy on DM as well as monitor its implementation.
- The NEC will **monitor the implementation of Guidelines** issued by NDMA.
- Provide necessary **technical assistance** to the State Governments and the State Authorities for preparing their disaster management plans in accordance with the guidelines laid down by the National Authority.

- **Evaluate the preparedness** at all governmental levels for responding to any threatening disaster situation or disaster and give directions, where necessary, for enhancing such preparedness;
- Plan and coordinate **specialized training programme** for disaster management for different levels of officers, employees and voluntary rescue workers;
- Require any department or agency of the Government to make available to the National Authority or State Authorities such **men or material resources** as are available with it for the purposes of emergency response, rescue and relief;
- Advise, assist and coordinate the activities of the Ministries or Departments of the Government of India, State Authorities, statutory bodies, other governmental or non-governmental organizations and others engaged in disaster management;
- **Promote general education** and awareness in relation to disaster management
- It will also perform such other functions as may be prescribed by the Central Government in consultation with the NDMA.

Questions

1. What is disaster management? Discuss the steps required to tackle natural disasters.
 2. Composition and functions of the National Executive Committee of the National Disaster Management Authority. Comment.
-

NATURAL DISASTERS- METEOROLOGICAL

1) Floods

What are floods?

- Sudden submergence or inundation of land area with water is called a flood. The occurrence of floods can be due to both natural and human causes.

Causes of flood

Anthropogenic causes of floods include:

- **Deforestation:** Lack of vegetation cover leads to decreased water holding capability of soil which causes excessive water flow into the ground, resulting in flooding.
- **Urban development:** The clearing of land for development of residential, commercial and industrial complexes prevent infiltration of rainwater into the ground which results in increased runoff flowing into the rivers resulting in flooding.
- **Improper farming and other land use practices:** The combination of absence of forest cover on one hand, and inappropriate farming and land-use practices on the other have aggravated the flood devastation.
- **Enhanced Greenhouse effect:** Various human activities resulting in increased greenhouse effect and causing global warming are leading to various climate changes such as higher rainfall in short duration, melting of more ice etc. All these have led to increased incidences of floods.

Natural causes of floods:

1. **Excessive rainfall:** Floods occur when rainwater is unable to seep into the ground quickly enough or rivers overflow their banks because river channels cannot contain excess water.
2. **Storm Surges:** It occurs when strong winds raise the waves in the ocean to exceptionally high levels, causing them to crash into the coast and flood the land. It is common in coastal areas with low-lying relief.
3. **Melting Snow:** Melting of snow in spring releases large amounts of water into the rivers, causing them to overflow their banks. It is common in places with cool temperate climates.
4. **Global Atmospheric processes:** Abnormal weather phenomenon such as El Nino (warming of surface ocean waters at Southeastern part of Pacific Ocean).
5. **Earthquakes:** Earthquakes can bring about landslides or trigger tsunamis. When landslides occur, loosened soil, rocks, mud debris etc. may be deposited in rivers causing overflowing of these rivers. Tsunamis triggered by strong undersea earthquakes can flood and devastate coastal settlements.

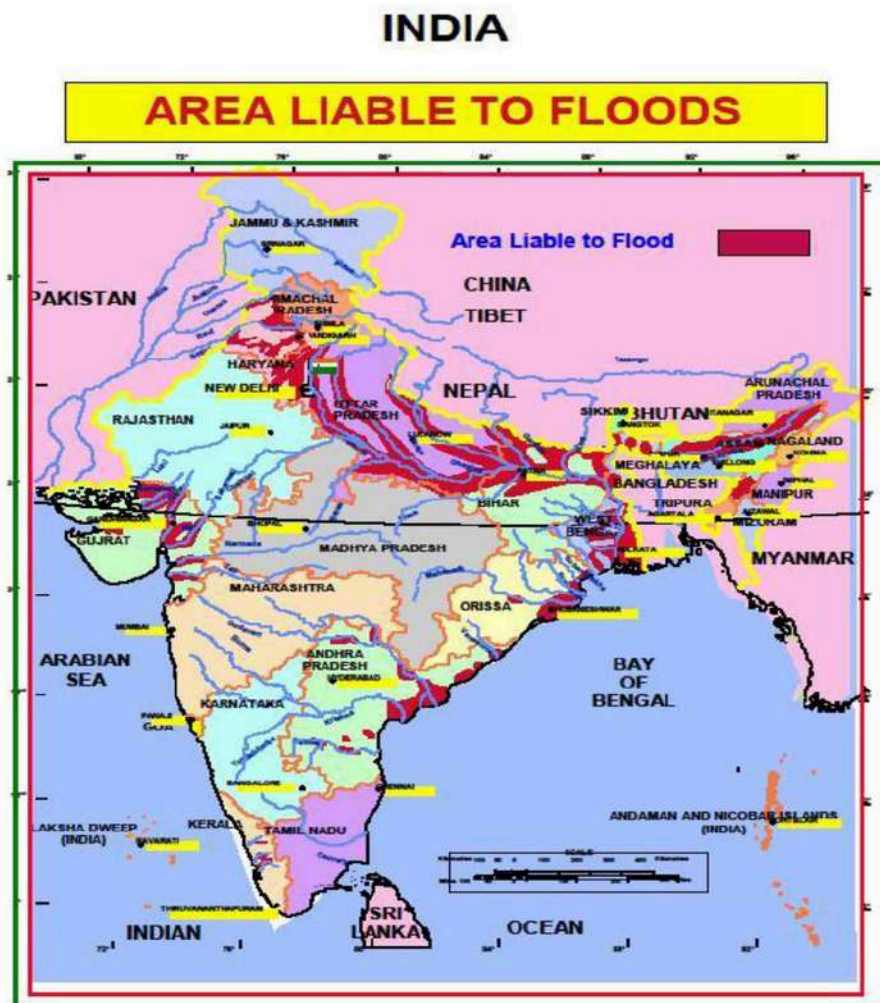
Impact of floods

1. **Loss of life:** Floods mostly strike people unprepared, leading to loss of lives in drowning along with livestock and other life forms.
2. **Damage to infrastructure and property:** Floods cause huge losses to homes, roads, power supply and other infrastructure.
3. **Spread of Diseases:** After flood water recedes, shallow stagnant water may cover areas over a considerable period of time which may result in an outbreak of waterborne diseases. Further homeless flood victims are housed in temporary shelters which are mostly overcrowded and with poor sanitation conditions which may turn the situation worse.
4. **Loss of natural habitat:** Trees, vegetation and other natural habitats may get destroyed leading to loss of biodiversity.

- 5. Frequent inundation of agricultural land and human settlement has serious **consequences on the national economy and society.**

Vulnerability to floods

- According to government data from a project by the **Assam State Disaster Management Authority, India is the worst flood-affected country in the world after Bangladesh** and accounts for one-fifth of the global death count due to floods.
- About **40 million hectares (12%) of land** in the country are liable to floods according to the National Flood Commission, and on an average of 18.6 million hectares of land are affected annually.



Mitigation of floods/ NDMA guidelines on flood management

- Floods can be mitigated by structural, water control and non-structural measures such as:
 1. **Structural methods** include,
 - **Building dams, reservoirs, and other water storages-** Lakes, low lying depressions, tanks, dams, reservoirs store significant proportions of flood water and the stored water can be released subsequently when the flood has receded.

- **Channel management-** Channel improvement aims at increasing the area of flow or the velocity of flow (or both) to increase its carrying capacity so that flood can be prevented.
 - **Embankments, flood walls, flood levees-** Properly designed embankments/flood walls in the river restricts the flow of river to its existing course and prevents it from overflowing the banks.
 - **Selective desilting/dredging** at outfalls/confluences or local reaches can be adopted as a measure to tackle flood locally.
 - **Drainage improvement:** Constructing new channels and/or improving the capacity of existing channels constitute an effective means of flood control as surface water drainage congestion due to inadequacy of natural or manmade drainage channels results in flooding in many areas.
 - **Diversion of flood water:** Diverting all or a part of the discharge into a natural or artificially constructed channel, lying within or in some cases outside the flood plains is a useful means of lowering water levels in the river. Eg: The **flood spill channel skirting Srinagar city and the supplementary drain in Delhi** are examples of diverting excess water to prevent flooding of the urbanized areas.
2. **Water control methods:** include increasing forest and vegetation cover, watershed management, flood proofing and catchment modifications, schemes of drainage and flood protection.
- Watershed management measures such as developing the vegetative cover i.e. afforestation and conservation of soil cover in conjunction with structural works like check dams, detention basins etc. serve as an effective measure in reducing flood peaks and controlling the suddenness of the runoff.
3. **Non-structural methods:** Non-structural measures strive to keep people away from flood waters. It contemplates the use of floodplains judiciously, simultaneously permitting vacating of the same for use by the river whenever the situation demands.
- **Flood plain zoning:** The basic concept of flood plain zoning is to regulate land use in the flood plains in order to restrict the damage due to floods, while deriving maximum benefits from the same.
 - **Flood proofing:** The techniques adopted consist of providing raised platforms for flood shelter for men and cattle, raising the public utility installation especially the platforms for drinking water hand pumps and borewells above flood level, promoting construction of double-storey buildings wherein the first floor can be used for taking shelter during floods.
 - **Flood forecasting, flood warning and emergency preparedness systems,** flood insurance, public information and education, and flood relief are also some non-structural methods.

2) Urban floods

What are urban floods?

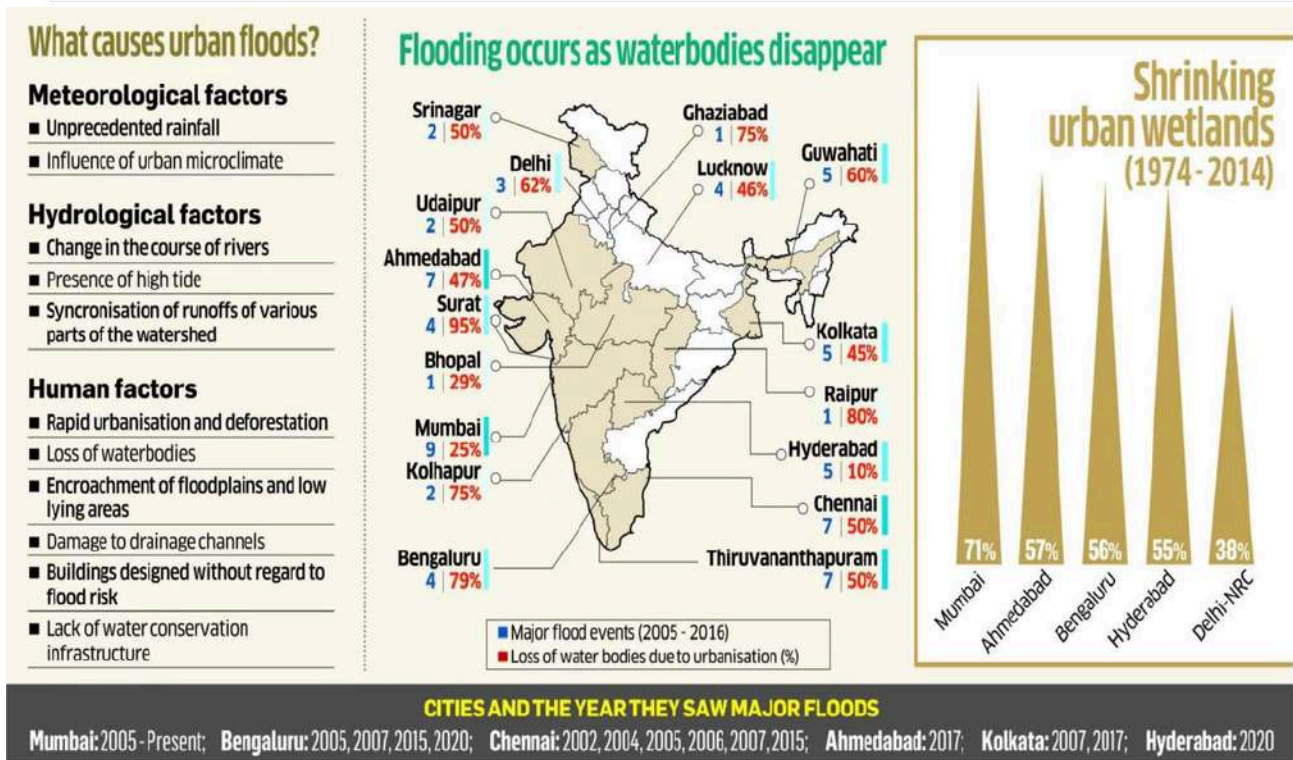
- Urban flooding is the inundation of land or property in a built environment, particularly in more densely populated areas, caused by rainfall overwhelming the capacity of drainage systems.
- Incidences of urban flooding: Patna(2019), Kerala (2018, 2019), Chennai (2015), Kashmi (2014), Uttarakhand(2013)

Causes of urban floods

- **Meteorological factors:** High rainfall frequency and intensity, storms
- **Hydrological factors:** high groundwater levels, high extent of impervious surface.
- **Anthropogenic factors:** land-use changes, exploitation of floodplains by construction and similar activities, poor solid waste management and destruction of drainage, encroachment of water bodies.
- **Others:** Weak implementation of regulatory mechanisms, failure of India’s land policy in managing urban floods etc.,

Vulnerability to urban floods

- Urban flooding is significantly different from rural flooding as urbanization leads to developed catchments, which increases the **flood peaks from 1.8 to 8 times and flood volumes by up to 6 times.**



NDMA guidelines for mitigation of urban floods

- **Early Warning System and Communication:** National Hydro-meteorological Network and Doppler Weather Radars should be integrated with the urban area planning for giving real time data.
- **Design and Management of Urban Drainage:** Rapid urbanization has resulted in increased impermeable surfaces in the form of pavements, roads and built-up areas, thereby reducing the infiltration and natural storage. Hence proper management of the drainage system is necessary to ensure that the water does not get stored in place.
- **Vulnerability Analysis and Risk Assessment:** Identification of areas at risk, classification of structures according to function and estimation of risk for each structure and function using Hazard Risk Zoning.

- **Urban Flooding Cells:** A separate Urban Flooding Cell (UFC) will be constituted within MoUD which will coordinate all UFDM activities at the national level. ULBs will be responsible for the management of urban flooding at the local level.
- **Response:** Emergency Operation Centres, Incident Response System, flood shelters, search and rescue operations, emergency logistics are some key action areas of flood response mechanism.
- **Sanitation:** Diseases like malaria, dengue and cholera can spread if adequate sanitation and disinfection are not carried out.
- **Capacity Development, Awareness Generation and Documentation:** Participatory urban flood planning and management involving both local government and the community.
- **Conservation of water bodies:** Urban water bodies like lakes, tanks and ponds also play a very important role in the management of urban flooding by reducing the stormwater runoff by capturing it.

3) Cloudbursts

What are cloudbursts?

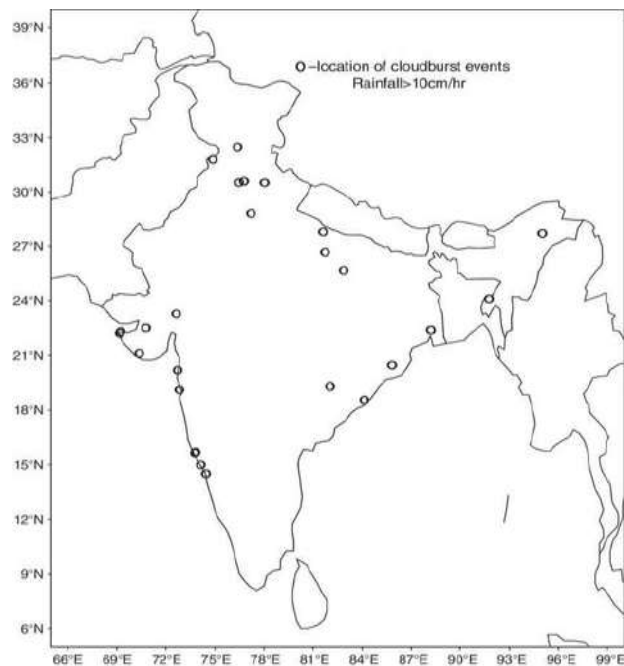
- Cloudburst refers to particularly **heavy precipitation in a short period of time** over a **limited geographical area**. Rainfall of 10 cm or more in an hour over a roughly 10 km x 10-km area is classified as a cloudburst event.
- By this definition, 5 cm of rainfall in a half- hour period over the same area would also be categorized as a cloudburst.
- During a cloudburst event, a place receives about 10% of the annual rainfall within an hour.
- **Cloudburst incidence:**
 - **Uttarakhand floods and landslides, 2013** due to heavy rainfall and cloudburst that resulted in flash floods.
 - Cloudburst occurred at **Pahalgam en route to Amarnath cave shrine**.(2022)
 - Several people have been **killed in destruction caused by cloudbursts and flash floods** in different parts of Himachal Pradesh and Uttarakhand. (2022)

How does cloudburst occur?

- Cloudbursts occur when **saturated clouds ready to condense into rain cannot produce rain**, due to the upward movement of the very warm current of air. Instead of falling downwards, raindrops are carried upwards by the air current.
- New drops are formed and existing raindrops increase in size and after a point, the raindrops become too heavy for the cloud to hold on to, and they drop down together in a quick flash resulting in cloudburst.

How common are cloudbursts?

- Cloudbursts are common events, particularly during the **monsoon months**.
- Most of these happen in the orographically dominant regions like **Himalayan region, north-eastern states and Western Ghats** where the local topology, wind systems, and temperature gradients between the lower and upper atmosphere facilitate the occurrence of such events.



Impact of cloudbursts

- Triggers **landslides and flash floods**.

Challenges in cloudburst management

- Though the India Meteorological Department forecasts rainfall events well in advance, **it does not predict the quantum of rainfall and** it is difficult to predict when exactly a cloudburst will occur.
- There is **little definitive data** on the exact number of cloudbursts that occur in India.
- Due to their definition dealing with a very small area, it is **difficult to accurately predict and identify cloudbursts immediately**.
- Cloudburst is a sudden event that **hampers the capabilities of agencies** to manage the disaster.

Mitigation measures

- **Shifting people from the valleys to hills** or inhabiting the firm ground of slopes.
- **Raising infrastructure**, houses and businesses **above the floodplains** quite away from rivers and streams
- Indiscriminate and unscientific construction should be banned especially in landslide affected areas.
- Better **management of rainwater and floodwater** prevent and minimize disaster-induced losses.
 - **Drain pipes** could be provided on debris slopes.
- **Watershed management** that stabilizes the hill landscape and ensures better tackling of resultant landslides, flash floods, mudflows and land-caving needs to be adopted.
- Ensuring smooth flow and drainage of rainwater in the plains would prevent human, animal and infrastructural losses after cloudbursts and heavy rain.
- The **bioengineering technology** can be successfully implemented by using specific and local vegetation along with engineering measures to reduce instability and soil erosion.

- Although it is difficult to forecast cloudburst events, a **dense network of rain gauges** particularly in the areas identified as being vulnerable to cloudburst is required for better understanding of this phenomenon.
- The **capacity and capability of the human resources** of panchayati raj bodies, disaster management authorities, NGOs and communities involved in flash flood and cloudburst management need to be **continuously improved and strengthened**.
- The menace of infectious diseases surfacing after heavy rains and cloudbursts has to be tackled too.
- **Mainstreaming of disaster risk reduction of cloudbursts** involves incorporating risk reduction and mitigation measures into the developmental policy, planning and practices.
- Bracketing cloudbursts with floods, landslides and cyclones, their management projects should be planned and implemented in a time-bound manner.
- **Copenhagen model:** A useful model in cloudburst mitigation is Copenhagen, whose municipal department has organized a cloudburst master plan. It aims to decouple 30 to 40 percent of the excess storm water from the **combined sewer system**. The plan incorporates concretization as well as creation of canals and the greening of Copenhagen.

4) Drought

What is a Drought?

- **Variability of rainfall leading to rainfall deficiency** and water shortage causes drought.

Types of droughts

- **Meteorological Drought** – referring to lack of precipitation.
- **Agricultural drought** – referring to lack of moisture in the soil where crops grow.
- **Hydrological drought** – referring to low levels of water in reservoirs.
- **Socio-economic drought** – referring to water shortages affecting people in society, which impacts availability of foodgrains, fodder, etc.

Causes of drought

- In India, almost three-fourths of annual rainfall is received during the South West Monsoon Period (June-September) and the **erratic nature of the monsoon** (South West Monsoon), with long dry spells & high temperature, is mainly responsible for drought.
- **Unsustainable agricultural practices** leading to depletion of groundwater.
- **Abandonment of traditional water harvesting structures.**
- **El nino conditions** depriving monsoon results in drought.

Vulnerability to drought

- About **68% of cropped area in India is vulnerable to drought**, of which
 - 33% receives less than 750 mm of mean annual rainfall and is classified as “**chronically drought-prone**” while
 - 35% which receive mean annual rainfall of 750-1125 mm is classified as “**drought-prone**”.
- The drought-prone areas of the country are confined primarily to the arid, semi-arid, and sub-humid regions of peninsular and western India.
- Drought-prone districts account for **42 per cent of the country’s cultivable lands**.

Impact of drought

Economic impacts

- **Production losses** in agriculture and related sectors, especially animal husbandry, dairy, poultry, horticulture and fisheries.
- It **affects livelihoods** and quality of life for the majority of farmers, sharecroppers, farm laborers, artisans, small rural businesses and rural population in general that is dependent on agriculture.
- All industries dependent upon the primary sector for raw materials suffer on account of reduced supplies and hardening prices.
- Drought thus causes a dampening impact on the economy by
 - squeezing profit margins,
 - drying up income and revenue streams and
 - constricting employment avenues through disruption caused to supply chain managements,
 - slowing down flow of credit and tax collections,
 - depressing industrial and consumer demand,
 - increased dependence on imports

Environmental impacts

- Reduced stream flow and loss of wetlands may **affect levels of salinity**.
- Increased groundwater depletion rates, and reduced recharge may damage aquifers and adversely affect the quality of water (e.g., salt concentration, acidity, dissolved oxygen, turbidity) which in turn may lead to a **permanent loss of biological productivity of soils**.
- Loss of forest cover, migration of wildlife and sharpening man-animal conflicts and general stress on biodiversity are all the impacts of drought.

Social impacts

- Widespread disruption in rural society on account of
 - **Out-migration** of the population from drought affected areas
 - Rise in **school dropout rates**
 - Greater economic impoverishment and indebtedness
 - Alienation of land and livestock assets
 - Malnutrition, starvation and loss of social status among the most vulnerable sections.
 - May exacerbate **social tensions** and lead to **erosion of social capital**.

Measures to cope with Drought

- 1) **Suitable farming methods for arid areas:** By adopting the following methods it is possible to mitigate the intensity of drought. The methods are:
 - a) Production of coarse and hardy cereals
 - b) conservation of soil moisture by deep ploughing
 - c) storing water behind small dams
 - d) collecting water in ponds and tanks and use of sprinklers for irrigation.
- 2) **Sowing drought resistant crops:** By sowing drought resistant crops of cotton, Moong, pearl millet, wheat etc, the impact of drought could be mitigated to a certain extent.
- 3) **Rainwater harvesting:** Collection of each and every drop of rain could help in coping with the drought.

- 4) By making high bunds around the fields, adoption of terrace cultivation, planting trees on the bunds of fields, the use of rainwater can be maximized.
- 5) Water can also be conserved by taming the irrigation canals with mortar and bricks.
- 6) Small quantity of water can irrigate a comparatively larger area by using drip irrigation methods.

NDMA guidelines to drought management

- 1) **Assessment and early warning:** Need to establish automatic weather stations and rain gauges at appropriate places to enable microlevel analysis and forecasting.
- 2) **Separate Drought Monitoring Cells (DMCs)** should be created at the state level under the control of State Disaster Management Authorities which will prepare vulnerability maps in collaboration with the National Remote Sensing Centre.
- 3) A **control room** should be established for drought management and specific guidelines should be issued for the **use of Information and Communication Technology (ICT)** for real-time information related to droughts.
- 4) The Government of India should undertake the **watershed development approach** through various programs.
- 5) **Drought proofing measures** are taken before the crop is planted and drought management measures are taken during the crop growing period including in-situ conservation, reduction in plant population, supplemental irrigation etc.
- 6) The **nutritional aspects of food security** will be addressed by the Government through schemes like the Integrated Child Development Services (ICDS) and the Mid-Day Meal scheme.
- 7) Assessment of damage must be done in terms of agricultural production, depletion of water resources, livestock population, land degradation and deforestation as well as human health.
- 8) **Capacity Development:** The objective is to put in place a systematic functional mechanism with trained human resources whose capacities need to be enhanced at all levels, which calls for requisite financial, technical and infrastructural support.
- 9) A **national training and capacity building programme** for drought management will be formulated and implemented which would include: Strengthening the Administrative Training Institutes, preparation of District Drought Management Plans and documentation.
- 10) **Relief and Response:** Innovative, proactive, flexible, institutionally enabled and decentralized schemes should be put in place that can help quick and efficient drought management.
- 11) Interventions relating to agriculture and allied activities would include:
 - Preparation of a **contingency plan** in case of late onset of monsoon / dry spells during the season with appropriate cropping pattern.
 - Arranging availability of seeds with short duration varieties on subsidy.
 - Stocking of quality seeds, well in advance for immediate distribution
 - Creating awareness among the farmers on management practices like intercropping, mulching, weed control, intercultural operations.
 - Encouragement of afforestation with subabul, seemaruba, casuarina, and eucalyptus.
 - Promotion of biodiesel plantations like jatropha and pongamia.
 - Ensuring availability of quality fodder and cattle camps.

About Drought Prone Area Programme

This programme was initiated in 1973. The objectives of the programme are as follows:

- (i) To **minimize the adverse impact of drought** on crops, domestic animals, productivity of land, water and human resources. This could be done by integrated development by using appropriate technologies as it was done for the natural resources of Gujarat.
- (ii) By developing, conserving and suitably using the rainwater, the ecological balance could be maintained for a longer period.
- (iii) To improve the economic and social conditions of the section of society who do not have access to resources and facilities.

5) Glacial Lake Outburst Floods

What are GLOFs?

- A GLOF is created when **large amounts of water dammed by a glacier or a moraine is released suddenly**.
- Some of the glacial lakes are **unstable and particularly moraine dammed lakes** are potentially susceptible to sudden discharge of large volumes of water and debris which causes floods downstream i.e. GLOF.
- Eg: **2013 Kedarnath calamity**, the glacier break caused large-scale devastation in the upper reaches of the ecologically fragile Himalaya.

Causes of GLOF

- **Earthquakes**
- Continued scenario of **global warming**
- Unstable nature of moraine dams
- **Large lake volume** above the moraine dam
- **Large waves** caused from calving glaciers or ice or rock avalanches into the lake may overtop the moraine dam.
- **Melting of stagnant glacier ice** in the moraine dam may also reduce the freeboard or create passageways for piping to occur.
- **Catastrophic glacial drainage** may raise the lake level quickly and overtop the dam.

Mitigation measures

- There are several possible methods for mitigating the impacts of GLOFs, for monitoring and for early warning systems.

Structural measures

- The most important structural mitigation measure for reducing GLOF risk is to **reduce the volume of water in the lake** in order to reduce the peak surge discharge. It can be done through
 - Controlled breaching,
 - Construction of an outlet control structure,
 - Pumping or siphoning out the water from the lake, and
 - Making a tunnel through the moraine barrier or under an ice dam.
- **Careful evaluation** with detailed studies of the lake, mother glaciers, damming materials, and the surrounding conditions are essential in choosing an appropriate mitigation measure.

Non-structural measures

- **Non-structural and organizational mitigation measures can be complementary** to structural measures.
- **Monitoring systems** prior to, during, and after construction of infrastructure and settlements in the downstream area is needed.
- **Building bridges with appropriate flow capacities** and spans at elevations higher than those expected under GLOF events is needed.
- **GLOF risk zone:** Indian Himalayan Region (IHR)

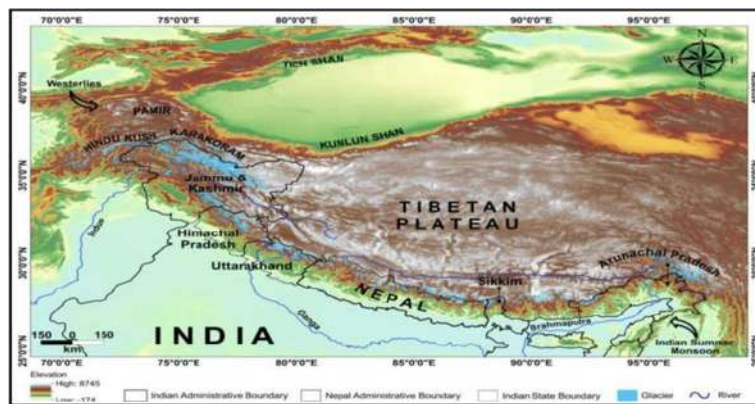


Figure 2.3: Glaciers cover and the major river systems (the Indus, the Ganga and the Brahmaputra) over the Indian Himalayan range.

NDMA Guidelines for GLOF management

- The main objective of the guidelines is to **generate awareness of various aspects of dam failure hazards** in India and to implement suitable actions to reduce both the risk and costs associated with these hazards.
- The Guidelines envision to **improve administrative response**, bringing together the relevant scientific capabilities of the nation to eliminate the losses from glacial and landslide hazards.
- The main aim and objectives of these Guidelines is to develop a **strategy that encourages the use of scientific information**, maps, methodology, guidance **for early warning systems**, response management, development and implementation of initiatives to reduce losses from glacial hazards.
 - Utilization of the **Synthetic-Aperture Radar imagery** that will automatically detect changes in water bodies, including new lake formations, during the monsoon months is recommended.
- These Guidelines also describe the **awareness, preparedness, capacity development, research and development**, regulations and enforcements and roles and responsibilities of the local, state and national ministries/ departments along with the various scientific organizations and institutions to reduce the potential risks.

6) Heat waves

What is a Heat Wave?

- A Heat Wave is a period of **abnormally high temperatures**, more than the normal maximum temperature that occurs during the summer season in the **North-Western parts of India**.

When does it occur?

- Heat Waves typically occur **between March and June**, and in some rare cases even extend till July.

Mechanism of heatwave formation


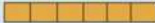

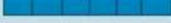
- A heat wave occurs when a system of **high atmospheric pressure moves into an area and lasts two or more days**. In such a high-pressure system, air from upper levels of our atmosphere is pulled toward the ground, where it becomes compressed and increases in temperature.

Causes

- Heatwaves are caused by large-scale atmospheric circulation anomalies like **high pressure areas, upper-tropospheric, jet streams, etc.**
- Global forcing like the **El Nino/Southern Oscillation (ENSO)** and the Indian Ocean modulate the frequency and duration of Indian heatwaves.
- Heatwave can be further accentuated by local effects like **depleted soil moisture and enhanced sensible heat flux**.

Criteria for heat waves

- The Indian Meteorological Department (IMD) has given the following criteria for Heat Waves:
 - Heat Wave need not be considered till maximum temperature of a station reaches at least **40°C for Plains and at least 30°C for Hilly regions**
 - When normal maximum temperature of a station is less than or equal to 40°C
 - Heat Wave Departure from normal is 5°C to 6°C
 - Severe Heat Wave Departure from normal is 7°C or more.
 - When normal maximum temperature of a station is more than 40°C
 - Heat Wave Departure from normal is 4°C to 5°C
 - Severe Heat Wave Departure from normal is 6°C or more.
 - When actual maximum temperature remains 45°C or more irrespective of normal maximum temperature, heat waves should be declared.

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



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