DISASTER MANAGEMENT

DM essentially deals with management of resources and information towards a disastrous event & is measured by how efficiently, effectively & seamlessly one coordinates these resources.

DM at the individual & organisational level deals with issues of planning, coordination, communication and risk assessment.

Disaster impact ⟶ nos. of dead & injured & loss of property & resources.

DM is a type of management and org. having resources and duties to deal with the entire human characteristics of the emergencies in a particular response, recovery & preparedness to reducing the effect of the disasters.

Phases of DM	Disaster effects
D. Preparedness	Deaths, Disability, Increase in
D. Impact	communicable diseases, Psychological problems
D. Response	food shortage, Socioeconomic losses,
Rehabilitation	Shortage of drugs & medical supplies,
D. Mitigation	Env. disruption

Risk reduction strategy includes —

1. the identification of areas that are safe for settlement and development.
2. the vulnerability mapping activity
3. the adoption of building codes based on disaster resilient eg engg. and on local hazard risk assessments
4. the proper enforcement of these plans & codes with the help of economic, market-based & other incentives.

Elements that must be incorporated in an effective national DM cycle:
prevention, mitigation, preparedness, awareness, response, recovery, rehabilitation & other misc. disaster related developments.

DISASTER → Serious disruption of the functioning of society, causing widespread human, material or env. losses which exceed the ability of affected society to cope on its own resources.

HAZARD → An agent which has the potential to cause harm to a vulnerable target.

RISK → the combination of the likelihood of the occurrence of a harm & the severity of that harm.

Risk assessment is the process where we:
→ Identify hazards & risk factors that have the potential to cause harm (hazard identification)
→ Analyze & evaluate the risk associated with that hazard (risk analysis & risk reduction)
→ Determine appropriate ways to eliminate the hazard, or control the risk when the hazard cannot be eliminated (risk control)

VULNERABILITY → the quality or state of being exposed to the possibility of being harmed.

Vulnerability → Disaster ← Hazard

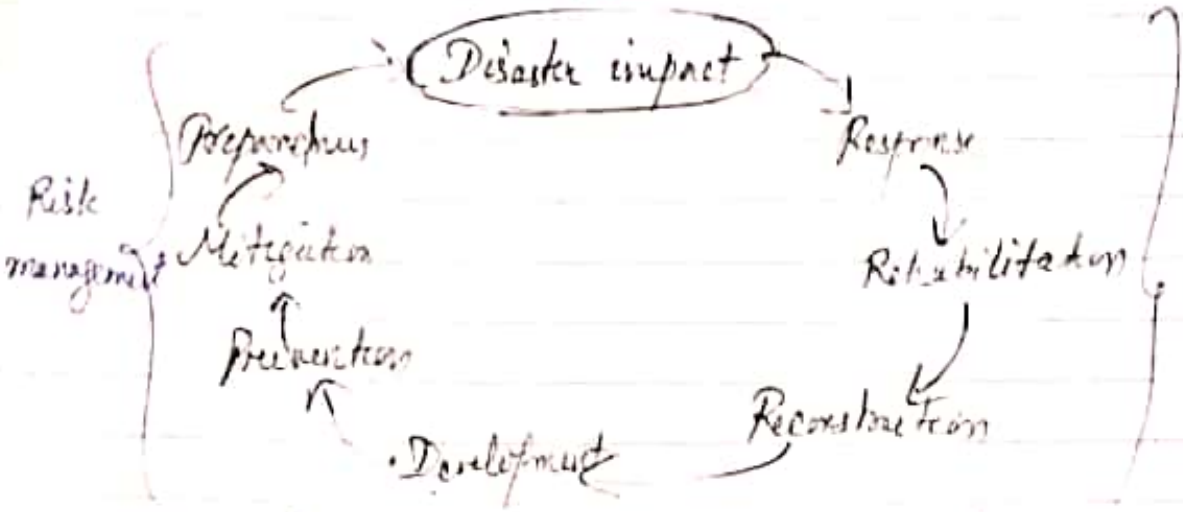
Vulnerability
- Underlying causes: limited access to resources, illness, disability, poverty
- Dynamic pressure: lack of institutional edu., skills, pop. explosion, env. degrad.
- Unsafe conditions: dangerous locations, buildings, low income level

Hazard
- Triggering events: Earthquake, Tsunamis, Volcano, Lava, Landslide, etc.

~~DRR~~ Disaster Risk Management Cycle → highlights the range of initiatives which normally occur during both the Emergency response & Recovery stages of a disaster.
eg: coordination & the provision of ongoing assistance, early warning & evacuation during emergency response, re construction & economic & social recovery.
It also highlight the role of media, where there is a strong relationship between this & funding opportunities
The DMC illustrates the ongoing process by which govt., business & civil society often for and reduce the impact of disaster, react during & immediately following a disaster & take steps to recover after a disaster has occurred.

* Mitigation: minimizing the effects of disaster.
eg. building codes & zoning, vulnerability analysis, public education.
* Preparedness: planning how to respond.
eg. emergency exercises / training, warning systems, etc.
* Response: efforts to minimize the hazards created by a disaster.
eg. search & rescue, emergency relief.

DM cycle



Disaster Management includes sum total of all activities, programmes and measures which can be taken up before, during and after a disaster with the purpose to avoid a disaster, reduce its impact or recover from its losses. The 3 key stages:—

① Pre-disaster: activities those which are taken to reduce human & property losses caused by a potential hazard. Eg: carrying out awareness campaigns, preparation of the DM plans at household & community level, strengthening the existing structures, etc. Such risk reduction measures taken under this stage are termed as mitigation* & preparedness activities.

② Disaster occurance: Include initiatives taken to ensure that the needs and provisions of victims are met & suffering is minimized. Activities taken under this stage are called emergency & response* activities

③ Post-disaster: Initiatives taken in response to a disaster with a purpose to achieve early recovery and rehabilitation of affected communities, immediately after a disaster strikes. These are called response & recovery activities

Quake - tremor

geophysical disaster

Shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves

EARTHQUAKE

While earthquakes accounted for 30% of estimated damage, they caused just 9% of all fatalities due to natural disasters

Earthquakes occur following the release of energy when tectonic plates move apart. Then plates move in currents in the Earth's lithosphere and the edges (which have been mapped to fault lines) sometimes collide. When the plates repel and become stuck, energy generated from the current is trapped until the plates move apart & (causing weak but very large) seismic waves are generated. These waves cause earthquakes, as they shake the earth as they radiate outward.

There is currently no way to predict an earthquake, & as such they strike with no warning).

Two ways to classify an earthquake

Magnitude

The approx. size or strength of the EQ, estimated based on the relative impact.

The Richter, log scale

Measure of the amplitude or size of seismic waves as specified by a seismograph reading

1-2.9 (micro) generally not felt, >1 per day

3-3.9 (minor) felt; no damage, 12,000 per year

4-4.9 (light) ↑ minor breakage, 2000-12,000

5-5.9 (mod.) large damage to weak struct., 200-2,000

6-6.9 (strong) mod. dam. in pop. areas, 20-200

7-7.9 (major) great dam. over large areas, loss of life, 3-20

8 & higher (great) serv. destr. & loss of life over large areas <3

Intensity

An estimate of the strength of the shaking at a particular location

Modified Mercalli scale (not for test)

I — XII (Total damage, large rock masses displaced, objects thrown into air)

II — felt by people at rest, on upper floors

III — felt indoors, hanging objects swing

IV — vibrating similar to those caused by the passing of heavy trucks

V — felt outdoors, liquids disturbed, doors swing

VI — felt by all, furnitures move, trees shake walk unsteadily

VII — diff. to stand, damage to weak masonry noticed by automobile drivers

VIII — damage to masonry, partial collapse, cracks in wet grounds & on steep slopes

IX — ordinary masonry damaged, reinforced masonry damaged, cracks in ground

X — mas. & framed structures destroyed with

62. EQ in India

8.7 (highest), 1897 Shillong XII

Vulnerability factors:

- Location of settlements in seismic areas & size of the population
- Inadequate building practices & regulations
- Dense concentration of building with high occupancy
- Absence of warning systems & lack of public awareness on EQ risks.

Worst EQ disaster in modern years → North Sumatra 26/12/2004 9.3 on Richter scale. Created Tsunami that killed 283,100 people. 1999, Chamoli 6.8, VIII, 100x

2001 – Bhuj 6.9, X 14000x

EQ hazards in India (about 65% of total area is vulnerable)

Most vulnerable areas are located in the Himalayan & sub Him. regions, Kutch, And. & Nic. Islands.

Seismic regions of India.

1. Kashmir & W. Him.
2. Central Him.
3. Peninsular India
4. N-E India
5. Indo-Gangetic basin & Raj.
6. And. & Nic. Islands.
7. Cambay & Rann of Kutch

EQ Hazard Zones in India: 4 seismic zones (II, III, IV, V) based on scientific inputs relating to seismicity, EQ occurred in the past & tectonic setup of the region. [BIS]

SZ II: Area with minor damage {V–VI MMIS}

SZ III: Moderate damage corresponding to VII MMIS. It comprises Kerala, Goa, Lakshadweep Islands, parts of UP, Guj., WB, Punjab, Raj, HP, Bihar, Jharkhand, Chhattisgarh, Maharashtra, Odisha, AP, TN & Kar.

SZ IV: Major damage corresponding to intensity, VII & IX in MMIS, Remaining parts of JK & HP, National Cap Terr. of Delhi, Sikkim, Northern parts of UP, Bihar & WB, parts of Guj. & small portions of Maha near the west coast & Raj.

3rd Jan, 2018 — Kashmir, Pak., Afg & Tajikistan,

SZ V: Seismically the most active region. NE India, Yamuna (J&K), HP, Uttaranchal, Rann of Kutch in Guj., parts of North Bihar & Andaman Nic. Islands. EQs with mag. 7 & 7 have occurred in these areas, Int. > IX.

Effects

1° → ground shaking, ground rupture, landslides, tsunamis & damages to bridges & highways.

2° → fire (EQs don't kill people, buildings do) i.e. faulty construction

Injuries & death
Structural damages to buildings
By Rupture of fuel pipelines & electrical wire. Water pipelines

Solid body of sediment is transformed into a liq-mass that can flow. When water saturated sediments are shaken, the grains become rearranged to the point where they are no longer supporting one another. Lose contact with one another.

Collapse of building & other structures. } Debris from collapsing structure.
Shattering glass windows & mirrors.
Damaged walls crack → floods

(Mitigation) Measures for EQ. Risk Reduction

pre-Eq. phase; preparedness, mitigation, prevention
the task of reducing vul. of stories & buildings will the key to}
post-EQ: immediate rescue and relief measures (temporary sheltering, soon after an EQ until about 3 months later)
re-construction & re-habilitation measures (6 months — 3 years)

Most effective measures of Risk reduction are (i) pre-disaster mit., (ii) preparedness & preventive measures to reduce vuln. (iii) effective rescue & relief actions immediately after the occurrence of an EQ.

Long term strat. → 5-15 yrs
Medium " " → 1-5 yrs
Short term " → immediately after in high risk areas

} depending upon the calamity & its consequences.

IS 1893-2002, 4928-1993, 13827-1993
13920-1993, 13935-1993.

Pre-Disaster preventive measures (Long-term)

→ Re-framing building codes, guidelines, manuals & bylaws. (Look after their strict implementation. Tougher legislation for highly seismic areas.
→ Incorporating EQ resistant features in all buildings at high-risk areas.
→ Making all public utilities like water supply systems, communication networks electricity lines etc. EQ-proof. ~~Creating alt. arr~~
→ Constructing EQ-resistant community building and buildings used to gather large groups during or after an EQ. (schools, hospitals, dharamshalas, prayer halls, etc)
→ Supporting R&D in various aspects of DMt, preparedness and prevention & post-DM.
→ Include disaster related topics in educational curricula viz. Arch., Engg. inst. & technical training in Polytechnics & Schools.

(Medium-term measures)

→ Retrofitting of weak structures in highly seismic zones
→ Preparation of disaster related literature in local languages with dos & don'ts for construction.
→ Getting communities involved in the process of DMt. through edu. & awareness.
→ Networking of local NGOs working in the area of DM.

"Tsunami" – Japanese word meaning "harbour wave"

72% of tsunamis are generated by EQ

Most frequently in the Pacific Ocean; Ring of fire – the Pacific Ocean basin

Introduction: A tsunami is a series of large waves created when either nearshore or undersea EQs occur causing sudden movement of the seafloor. The seafloor's movement generates a sudden impulse that causes the water column to displace vertically. The result is a large train of waves. As the wave approaches shallow water, it slows down, but the energy of the wave remains constant. This action causes the wave to increase in Ht., as high as 30.5 m (100 ft) (rare)

There is a very short time span for people to evacuate following an EQ or Tsunami warning.

Since 1990 most tsunamis have been generated in Japan, Peru, Chile, New Guinea & the Solomon Islands.

Dec. 26, 2004: trigger – massive undersea EQ of Sumatra in Indonesia 8.9

Killed over 150,000 people.

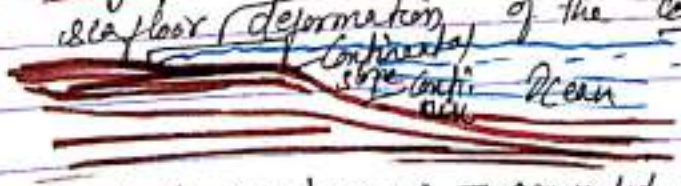
India, SL, Indonesia, Thailand, Malaysia, Myanmar, Maldives.

Waves ht. – 6 m

Tsunami is generated when a large mass of earth on the bottom of the ocean drops or rises, thereby displacing the column of water directly above it. Volcanoes have also generated significant tsunamis.

Under water & above water explosions (less efficient method of tsunami generation)

Long-period tsunamis – generated by large-magnitude EQs associated with seafloor deformation of the continental shelf (portion of a continent that's submerged under an ocean of relatively shallow water known as a shelf sea)



Shorter period tsunamis – generated by smaller magnitude EQs associated with seafloor deformation in deeper water beyond the conti. shelf.

When the trough of the wave arrives first, the water level drops rapidly. This phenomenon may be the only warning to residents that a large tsunami is approaching.

Sewage TP
fresh WSP

electrocuted
fires
explosions
= Deaths
wave falling instantly
drowning
building knocked down

Effects: Physical, Environmental, Casualties & health issues*
waves knock down infrastructure on the shore. They continue inland for many more miles destroying more buildings & homes. Sweeping up trees, gardens, animals, etc. Boats hurled into sky.
Entire towns & villages are destroyed within minutes.
*Tsunamis flood the areas closest to the coast. This can cause disease to spread in the stagnant water. eg: malaria.
Disease can also spread from the dead bodies that begin to rot on the ground once the water has subsided.
~~Financial~~ loss of economy, Psychological effect
Over the last 3500 years, there have been 279 fatal Tsunamis & more than 600,000 deaths. The Pacific Ocean is where 75% of the world's tsunamis occur. There is a history of severe Tsunami destruction in Alaska, Hawaiian island, Indonesia & S. America.
PREPAREDNESS: Hazard mapping, Early warning systems, Community preparedness.
Hazard maps indicate the extent of expected risk areas, and can be combined with DM info. such as evacuation routes, exc. routes, etc.
Tsunami Hazard mapping, is the 1st step in the development of effective evacuation plans for communities at risk. They maps also provide a base for land use planners in communities to reduce risk by locating critical facilities including schools, out of the potential tsunami flood plain.
Tsunamis travel approx. at a velocity of 700 km/hr in 4000 m depth of sea water. In 10 m depth of water, vel - 36 km/hr.

Key issue	THM	Target
① Immediate mit. effort	Protection → Planning	DMit. Plan
② Precise knowledge	Shortest reminder →	Appropriate Response (Tsunami awareness)
③ Immediate evacuation	Smooth evacuation →	Reduce human fatalities
④ Area protection	Land use planning →	Avoid development setback
⑤ Society participation	Communication tool →	Save society and economic losses

Self help + mutual support + Public assistance.

Each individual protects himself/herself

related to friends, neighbours, voluntary DM org. & communities

related to administrative bodies at the national to local levels.

Main mitigation strategies: Site planning, Land management, Engg. structures, Flood management. Chapter 5 NDM

→ INDIA: ① The early warning system for Tsunamis was finally commissioned in 2007-8 in Indian Ocean region at Indian National Centre for Ocean Information Services (INCOIS), Hyd. The system provides advance warnings of T likely to affect the coastal areas of the country.

② Developed various Tsunami code for coastal structures

③ Bio-shield for protection against Tsunami waves. ⑤ Mangrove plantation.

④ Identify & prepare risk maps.

CET-605 INTERNAL QUESTIONS Full marks: 20

① What is the difference between disaster and hazard? 2

② Explain briefly the Disaster Management Cycle. 4

③ State the pre disaster mitigation strategy in case of Earthquake. 5

④ What are the effects of an earthquake caused a Tsunami? 5

⑤ What are the structural measures undertaken as Tsunami mit. strategy? 5

⑥ What do you mean by magnitude of an earthquake? 2

~~Before the task Risk assessment.~~

→ A geological phenomenon that includes a wide range of ground movements, such as rock falls, deep failure of slopes and shallow debris flows.

LANDSLIDES (landslip).

The action of gravity is the P driving force

→ The downward movement of masses of rock and soil. ★

Causes: Heavy rains, EQs, Volcano eruptions, floods, Ground water changes, rapid snow melt, quarrying, mining, deforestation,

★ - The process of movement of mass may vary from slow soil creep to abrupt & sudden rockfall.

Types / Kinds: downslope viscous flow of fine grained materials that have been saturated with H_2O & moves under the pull of gravity

① Slump with earthflow

② Debris slide — loose natural material consisting of broken pieces of rock.

③ Debri fall

④ Rock slide

⑤ Rock fall

• More widespread in mountainous or hilly regions of the country.

[Landslide mit. & prevention]

→ by restricting or even removing populations from areas with a history of landslides.

→ by restricting certain types of land use where slope stability is in question.

→ by installing early warning systems based on the monitoring of ground conditions such as strain in rocks & soils, slope displacement & groundwater levels.

(direct methods)

→ modifying slope geometry → Vegetation cover

→ using chemical agent to reinforce slope material

→ installing structures such as piles & ~~RCC~~ retaining walls

→ grouting rock joints & fissures

→ diverting debris pathway.

→ rerouting surface & underground drainage. Hydrogeological methods in which attempt is made to lower the GW level or to reduce the water content of the material.

areas where the strength of the phy. env. is weak, less strong & more disturbed geological formations, rugged and high slope areas, low vegetation cover areas.

Elements at risk: human settlement on the mountainous slope.

Landslide Hazard assessment

Consider topography / lithology / vegetation cover / soil moisture factor, hourly, daily & monthly ppt. / seismicity / infrastructure / road & railway network in mount. regions. Local authorities must be aware of the landslide prone areas.

Effects: Severe casualties & property loss.
Economic loss . Loss of life

{ In India about 0.42 million km^2 or 12.6% of land area (excluding snow covered area) is prone to landslide hazard. Out of this, 0.18 million sq. km falls in NE Him.; 0.14 million sq. km falls in NW Him. (Uttarakhand, HP & JK); 0.09 million sq. kms in W. Ghats & Konkan hills (TN, Kerala, Karnataka, Goa & Mahe.) & 0.01 million sq. km in E. Ghat in AP. }

damage to infrastructure such as roads, railways, buildings, communication systems, etc.
affects the beauty of landscapes
Impacts river ecosystems — soil, debris & rock sliding downhill can find its way into rivers & block their natural flow. Fishes die. Communities depending ~~upon~~ river water for household activities and irrigation suffer.

Engg. Structures:— To increase the shear strength of the unstable mass
(metal) Anchors, rock or ground nailing — Active external forces
Piles, Retaining walls — Passive external forces.
Boulder catching net.

*Climate change & its resultant sea-level rises can significantly increase the vulnerability of the coastal pop.

Classification of TC by IMD as adopted by World Meteorological Org.

Type of disturbance	Associated wind speed
Super Cyclonic Storm	> 221 Km/h
Very severe " "	119 - 221 Km/h
Severe " "	89 - 118 Km/h
" "	62 - 88 Km/h
Deep depression	50 - 61 Km/h
Depression	31 - 49 Km/h
Less forms. area	< 31 Km/h

Effects: Strong winds, Flooding, Storm surges.
→ Destruction of life & property due to the strong winds.
→ Storm surges are strong winds that push water towards a shore. As a result water enters the low coastal areas and causes severe loss of life & property.
→ Prolonged heavy rains lead to floods. There is contamination of water which causes various water-borne diseases. Blockage of rail & road transport system as well as telephone & other communication systems. Disruption of agriculture.

Mitigation → ① Hazard mapping
② Land use control
③ Engg. structures
④ Flood management
⑤ Improving veg. cover
⑥ Community based init.

Initiated by GoI {National Cyclone Risk Mit. Project (NCRMP)}

Obj: to minimize vulnerability to cyclones & make people & infrastructure disaster resilient in harmony with the conservation of coastal eco system in the cyclone hazard prone areas of India.

① Hazard maps ~~are areas~~ is a map that highlights areas that are affected by or are vulnerable to a particular hazard.
To prepare a DM plan.

② Land use control are designed so that least critical activities are placed in vulnerable areas. Policies & Building Codes.

★ Habitual map & artificial Proper anchorage

(2). Improvement in materials & methods of construction to better withstand cyclone Construction of multipurpose cyclone shelters

(3) Mangroves & other coastal forests can reduce wind & storm wave impact as well as current velocities. Protect from coastal erosion. Planting trees in the direction of wind.

(4). Drainage system should be revamped so that cyclone water can exit easily.

Overflow of water into land that is normally dry.

FLOOD

Flood is a body of water which rises to overflow land that is normally dry or not submerged.

Causes: Climatological, Geomorphological, failure of Dams, etc.

Types: ① River floods (Fluvial flood) ② Pluvial floods (Flash floods & surface water) ③ Coastal flood (Storm surge)

Onset type: ① Flash floods → Occurs within a short interval (2–6 hrs sometimes within 2 days) due to heavy rain, dam breach or snow melt.
Most destructive in nature, as people are taken by surprise. No warning, so preparation & impact can be very swift & devastating.

② Rapid on-set floods → Takes slightly longer than ↑ to develop & can last for a day or two only. Very destructive but doesn't surprise people. People can escape before it gets bad.

③ Slow on-set floods → Usually as a result of water bodies overflowing their banks. Spread over many days & occur more in flood plains (low-lying areas).
Effect of this flood on people is more likely to be due to diseases, malnutrition or snakebites.

Warning:
IMD → trying a guidance system to detect & predict flash floods.
Community based ICT flood warning system.
ICT → (Info. & Comm. Tech.) enabled systems uses a flood sensor attached to the transmitter to detect rising water level. When the water reaches a critical level, a signal is wirelessly transmitted to the receiver. The flood warning is then disseminated via mobile phones to appropriate agencies & vulnerable communities offs.

(*) In coastal areas exposed to cyclones & storm surges, regulations mainly to deal for min. building ht., type of land-use according to the set-back for the shorelines & most vulnerable locations & density occupancy of buildings. Residential development must be away from coastlines

(**).

Flood Hazard Zones : India being a peninsular country & surrounded by the Arabian Sea, Indian Ocean & the Bay of Bengal is quite prone to floods. As per the GSI (Geological Survey of India), the major flood prone areas of India cover almost 12.5% area of the country. Flood is the most common disaster in India (Every year) The states falling within the periphery of "India Flood Prone Areas" (**) are WB, Odisha, AP, Kerala, Assam, Bihar, Guj., UP, Mah. & Punjab. The intense monsoon rains from SW causes rivers like Brahmaputra, Ganga, Yamuna, etc. to swell their banks, which in turn floods the adjacent areas.
Over the past few decades, Central India has become familiar with ppt. events like cloudburst & flash floods.
The major flood prone areas in India are the river banks & deltas of Ravi, Yamuna-Sahibi, Gandak, Sutlej, Ganga, Ghaggar, Kosi, Teesta, Brahmaputra, Mahanadi, Mahanda, Damodar, Godavari, Mayurakshi, Sabarmati & their tributaries & North Indian plains are prone to max. floods.

(**) 3 Div.
Ganga Basin Brahmaputra & Barak Basins Central India & Deccan Plateau

River basin: portion of land drained by a river & its tributaries.

Effects: → Loss of life & property
→ Destruction of crops; loss of livestock
→ Non functioning of infrastructure facilities
→ Deterioration of health condition owing to waterborne diseases. (typhoid fever, cholera, malaria, dengue, HA)
→ Death due to flash floods
→ Loss of livelihood. Its comm. links & infrastructure such as power plants, roads & bridges are damaged & disrupted
→ Loss of economy.
→ Mass migration
→ River bank erosion & sedimentation.
→ ~~Contamination of surface & GW.~~
→ Destruction of local habitat & landscape.
→ Loss of wildlife.
→ Dispersal of Nutrients & Pollution.

Mit. ①. Flood prone areas mapping ②. Flood control & management ③. Landuse control ④. Community based mit.

Paper-5 (2nd IA) DISASTER MANAGEMENT full marks: 20

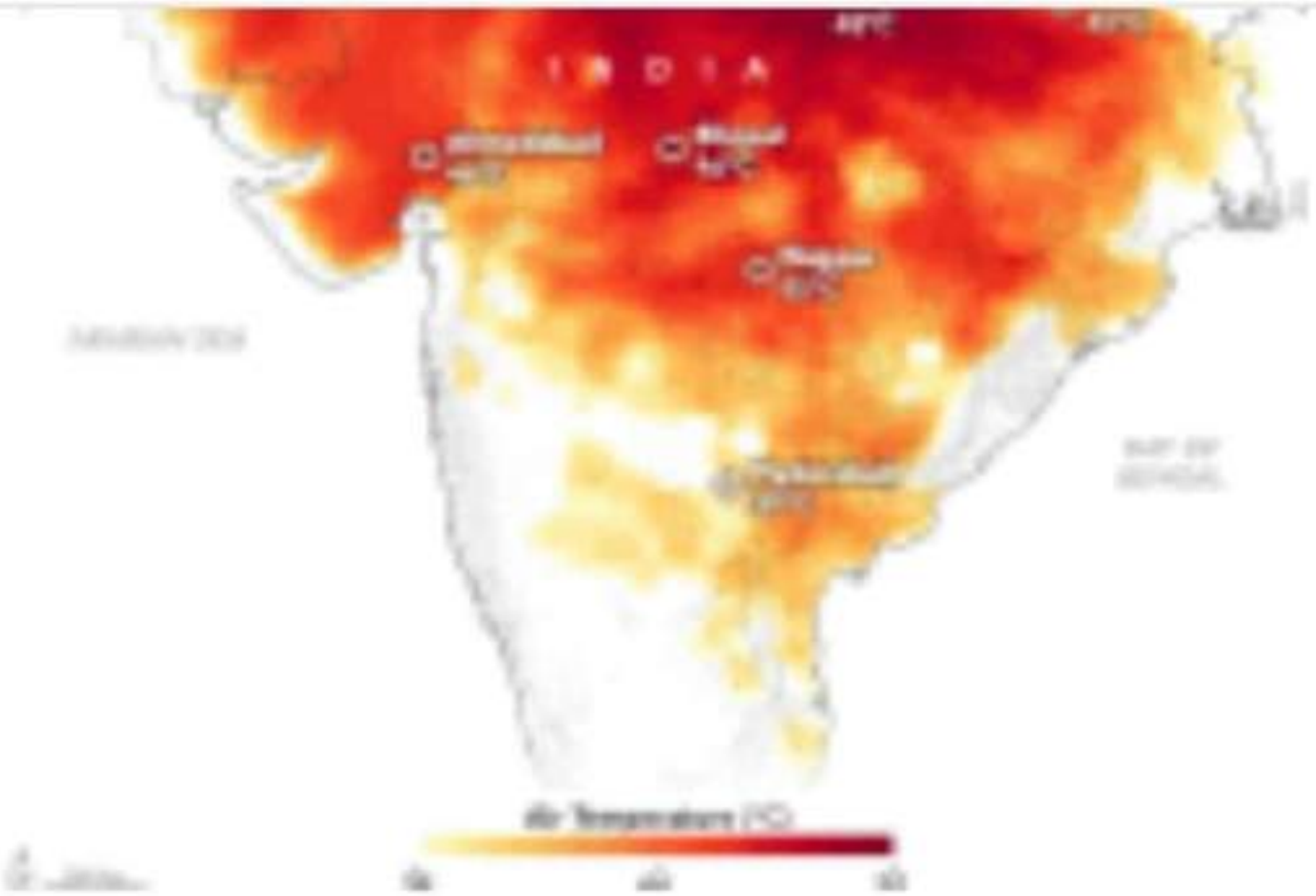
1. State the causes of a landslide. 3
2. What are the warning stages of a tropical cyclone? 4
3. How is flash flood different from slow onset flood? 3
4. Describe the DM strategy in case of a tropical cyclone. 5
5. What are the structural measures adopted to mitigate the effects of landslides? 5

What is a Heat Wave?

According to the World Meteorological Organization, a Heat Wave occurs when the daily maximum temperature of 5 consecutive days exceeds average maximum temperature by 5 degrees Celsius. During a heat wave, the weather is excessively hot and also highly humid. Heat Waves usually occur in oceanic countries.

How are Heat Waves formed?

Heat waves are formed when high pressure in the upper atmosphere strengthens and remains in a particular region for days together. They are common in summer as jet streams follow the sun. This high-pressure traps highly humid warm air under it. The air warms oceanic winds in the earth forming heat waves.



The Indian Meteorological Department has announced that months of March, April and May are to be warmer than normal. The heat waves are to prevail over the heat wave zones of India

Management Authority

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. Heat Waves typically occur between March and June, and in some rare cases even extend till July. The extreme temperatures and resultant atmospheric conditions adversely affect people living in these regions as they cause physiological stress, sometimes resulting in death.

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 atleast 40*C for Plains and atleast 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.

Higher daily peak temperatures and longer, more intense heat waves are becomingly increasingly frequent globally due to climate change. India too is feeling the impact of climate change in terms of increased instances of heat waves which are more intense in nature with each passing year, and have a devastating impact on human health thereby increasing the number of heat wave casualties.

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Health Impacts of Heat Waves

The health impacts of Heat Waves typically involve dehydration, heat cramps, heat exhaustion and/or heat stroke. The signs and symptoms are as follows:

- Heat Cramps: Edema (swelling) and Syncope (Fainting) generally accompanied by fever below 39*C i.e.102*F.
- Heat Exhaustion: Fatigue, weakness, dizziness, headache, nausea, vomiting, muscle cramps and sweating.
- Heat Stoke: Body temperatures of 40*C i.e. 104*F or more along with delirium, seizures or coma. This is a potential fatal condition

Purpose of Heat-wave Action Plan

The Heat-Wave Action plan aims to provide a framework for implementation, coordination and evaluation of extreme heat response activities in cities/town in India that reduces the negative impact of extreme heat. The Plan's primary objective is to alert those populations at risk of heat-related illness in places where extreme heat conditions either exist or are imminent, and to take appropriate precautions, which are at high risk.

All cities can learn from their experience and develop a plan to deal with Heat wave in their specific cities/town and thus reduce the negative health impacts of extreme Heat. In addition the State Governments should also prepare a comprehensive plan to combat Heat wave.

Key strategies

The heat-wave action plan is intended to mobilize individuals and communities to help protect their neighbours, friends, relatives, and themselves against avoidable health problems during spells of very hot weather. Broadcast media and alerting agencies may also find this plan useful. Severe and extended heat-waves can also cause disruption to general, social and economic services. For this reason, Government agencies will have a critical role to play in preparing and responding to heat- waves at a local level, working closely with health and other related departments on long term strategic plan.

- ***Establish Early Warning System and Inter-Agency Coordination*** to alert residents on predicted high and extreme temperatures. Who will do what, when, and how is made clear to individuals and units of key departments, especially for health.
- ***Capacity building / training programme for health care professionals*** at local level to recognize and respond to heat-related illnesses, particularly during extreme heat events. These training programmes should focus on medical officers, paramedical staff and community health staff so that they can effectively prevent and manage heat - related medical issues to [illegible] mortality and morbidity.
- ***[illegible] outreach*** - Disseminating public [illegible] wave

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Preparation of Heat Wave Action Plan	NDMA	Guideline on preparing a Heat Wave Action Plan	SDMA / DDMA/Municipal Corporation and Local Bodies	Preparing a Heat Wave Action Plan and implementing
Early Warning	IMD	Issue Heat wave alerts and weather forecasts on Short / Medium / Long range duration	State Governments/ District Administration	To disseminate the information received from IMD to the public at large
Mitigating Heat Wave	Ministry of Urban /Rural Development, Department of Drinking Water and Sanitation, Ministry of Surface Transport	To construct shelters/ sheds, bus stands and provide drinking water points at worksites.	Public Health and Engineering Department	To construct shelters/ sheds, bus stands and provide drinking water points in cities, worksites.

Media campaign and IEC activities	Ministry of Information and Broadcasting	Extensive IEC campaigns to create awareness through print, electronic and social media	Department of Information and Broadcasting/ SDMAs/ Commissioners of Relief/ State Govt/ Health Department	Extensive IEC campaigns to create awareness through print, electronic and social media