Introduction

Hazard & Disaster
- natural (earthquake, landslide etc)
- manmade (atomic bomb)

A hazard represents a source of potential damage or loss of life, health, property or environment.

→ A disaster is an event that causes great damage or loss of life.

→ A hazard is a potential & a disaster is the potential realized.

Ex

A cruise missile sitting in the hold of a ship is hazard, but when it demo detonates it creats a disaster.

→ Similarly other examples can be given.

Risk :-

Asset - An asset is what we are trying to protect. (i.e. people, property, information)

Vulnerability -

An vulnerability is a weakness/gap in our protection effort.

Ex - poor design & construction of building
- lack of public information & awareness
- inadequate protection of assets

Types

① physical vulnerability

wooden homes → earthquake collapse (↓)
→ catching fire ↑

② Social vulnerability

when flooding occurs some citizens (children, elderly & differently abled) may be unabled to protect themselves.

③ Economic vulnerability

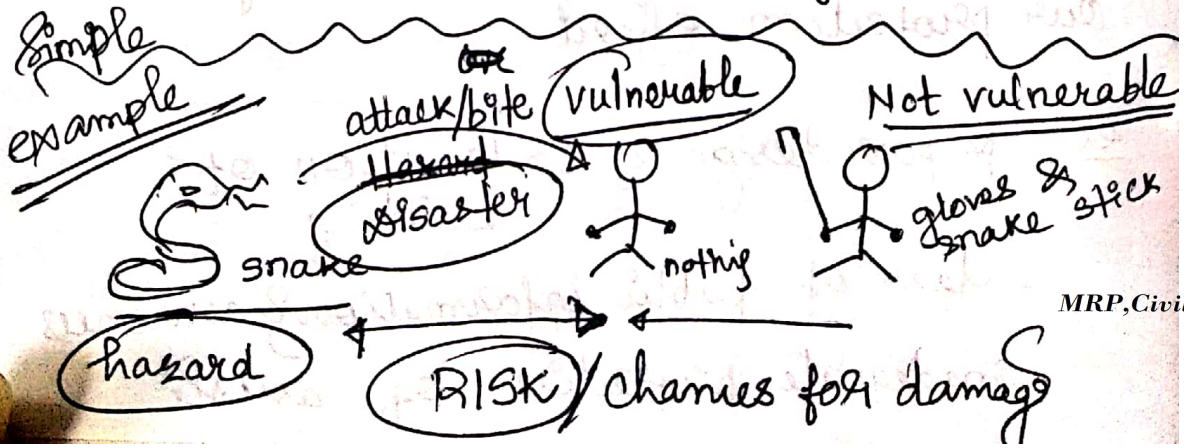
→ Depends upon economic status

④ Environmental vulnerability

→ Natural resource depletion & resource degradation.

ex — ozone layer hole
— polar ice melting issue
— rise in sea level

Risk - The potential for loss, damage, destruction of an asset as a result of threat exploiting a vulnerability.



Risk is potential disaster losses (life, health status, asset, service) which could occur to a particular community/ society over some specified future time period.

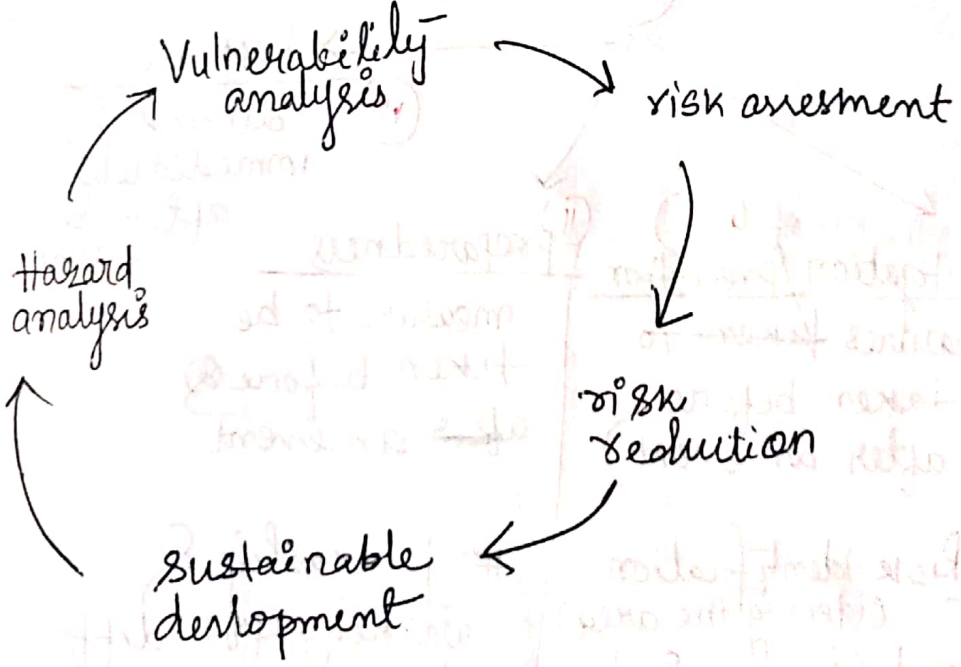
Risk = Hazard X Vulnerability

gap in protection effort

(probability of suffering damage from hazard for a given area and reference period.

Risk Reduction : Preparedness & Mitigation (DRR)

Risk Reduction Cycle.



What is preparedness

Pre disaster actions that result in persons knowing what to do & how to respond when disaster has occurs.

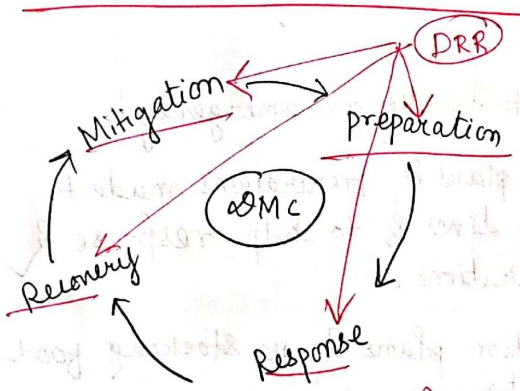
- It is long term.
- Part of a larger risk reduction programme.
- comprehensive application of sustainable development.
- All hazard planing.
- Multi sectoral.
- culturally sensitive & specific.

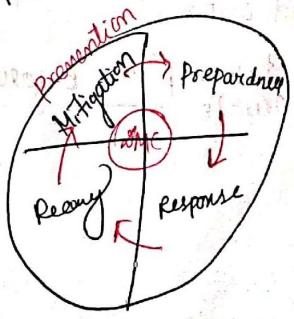
DRR
- (I) Mitigation / Prevention (Reducing the risk of loss)
  (measures taken to be taken before & after an event)
  * Risk identification (identify the area)
  * Land-use planning (Crop density, road network, population density)
  * structural & non-structural
  * disaster relief & rehabilitation
- (II) preparedness
  measure to be taken before & after an event
  # forecasting & warning for diff d hazard
  # emergency preparedness
  - personnel for monitoring, alert & evacuate
  - medical team
  - search & rescue team
  - food reserve
  - monetary fund & seed reserve
- (III) Response during & immediately after an event
- (IV) Recovery post disaster measures (Disas Rest)

* disaster management training & education
* Role of media in DRR
* Institutional capacity building
  (capacity building beyond the provision of education & training of professionals)
  → It aims to enhance the capacity.

- distribution of supplies & items
- ~~Organised personnel for monitoring~~
Education, training & public awareness

Disaster Management Cycle (DMC)
Disaster Risk Reduction (DRR)





Prevention (before) (after)

* preventing future emergencies / minimizing their effect.

ex: buying flood or fire insurance for home

* it takes place before and after activity.

* public education
  awareness
  ~~hard~~ hazard & vulnerability
  assesment
  improved infrastructure

Preparedness

* prepare to handle an emergency.
* includes plans & preparations made to save lives & to help response & rescue operations.
* evacuation plans & stocking food and water.
* It takes place before an emergency occurs.

Response

- Responding safely to an emergency.
- including action taken to save lives & preventing further property damage in an emergency situation.
- It takes place during an emergency.

ex - Seeking shelter from a tornado

Recovery

* Recovering from an emergency.

ex includes actions taken to return to a normal / an even safer situation following an emergency.

* It includes getting financial help to pay for repairs.
* It takes place place after an emergency.

personal & community awareness

It is a process of educating & empowering the population through sharing knowledge and information about the various types of disaster and their potential risks.

Steps

- Informal training / personal trainings
- Workshops
- Mock exercises
- the simple hazard map
- posters & videos
- Drama & TV shows, advt.
- mass campaigns
- Roles of role models in society for awareness

Types of disaster

- Earthquake (Tectonic plates movement)
- Tsunami
- Landslide
- cyclone
- flood
- drought
- forest fire
- Chemical & industrial accidents

EARTHQUAKES

Definition

An earthquake is the shaking of earth-surface resulting from sudden release of energy in the earth lithosphere that creates seismic waves.

concept

Eq. cluster → ~~If sequences form~~ EQs related to each other in terms of time & location
Aftershock → EQ after mainshock
EQ swarm → sequence of EQ hitting an area in short time

→ It is caused by tectonic movements in earth crust. When tectonic plates ride over one another, causing orogeny (mountain building) & earthquake.

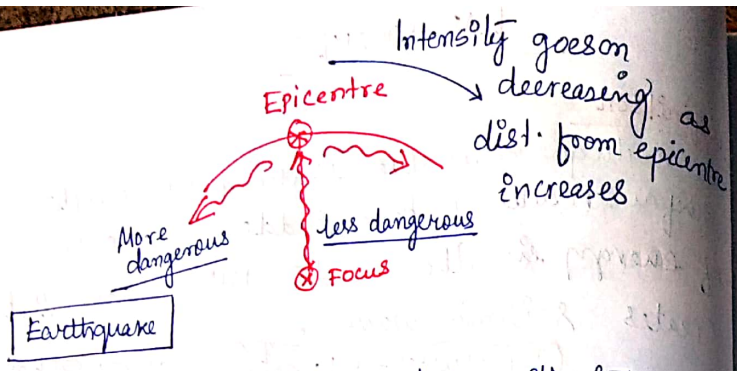
Tectonic plates → stick with each other/move away → relative motion → stress ↑ & breaks
→ sudden sliding over locked portion of fault → shock waves

Intensity

* It is a no. describing the severity of an equake in terms of its effect on surface / humans / structures.

* Assigned as Roman Capital No.

* Modified Mercalli scale & MSK scale (I to XII) Medvedev-Sponheuer-Karnik



→ structures are designed to withstand particulares levels of intensity of shaking and not so much the magnitude.

★ PGA → Peak Ground Acc^{n} → quantify the severity of ground shaking

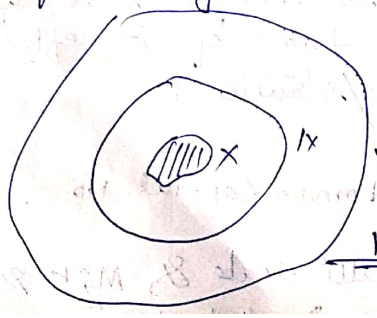
Magnitude

→ A numerical value on Richter scale.

→ Quantitative measure of actual earthquake.

→ Richter scale is used to measure the magnitude.

→ Seismographs (→ vibration is measured by drawing graph on paper) are used to record earthquake magnitude.



Intensity distribution

Group	Magnitude
Great	≥8
Major	7–7.9
Strong	6–6.9
Moderate	5–5.9
Light	4–4.9
Minor	3–3.9
Very Minor	< 3.0

★ Seismic wave — Surface wave, body wave (later than body wave) → P, S (late)

Element of Risk Assesment

→ The level of seismic hazard / identify the hazard

→ The no. of people and amount of property exposed to seismic hazards

→ How vulnerable these people & property are to the hazards. / Asses the risks & take action

→ Made a record of findings

→ Review the risk assesment.

Hazard Zones in India

(Refer PIB, Ministry of Earth Science)

Zone
- II → least active (V–VI MM scale)
- III → Kerala, Goa, ... (VII)
- IV (> VII MM)
- V → active region (NE, J&K, Himachal, Uttarakhand, Ran of Kutch, Gujrat, Bihar) (> VII & even IX also)

Typical Effects of Earthquake

- Structural damages
- people got killed & injured.
- loss of property
- loss of health and make weak emotionally
- Environmental effects (surface faulting, tectonic uplift & subsidence, tsunami, soil liquefaction, resonance, landslide)

Types of Earthquake

- Tectonic
- Volcanic (occurs in conjuction with volcanic activity)
- Explosion
- Collapse (mines → explosion of rock on surface)

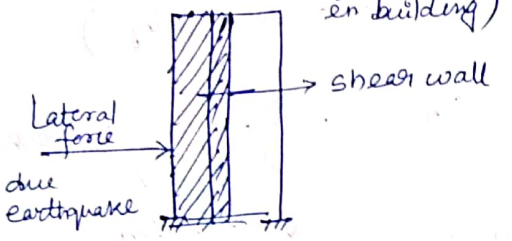
Mitigation Strategies

- structural
- non-structural (fix with any form structure)

- Building structures that comply with the building design codes of the area.
- Taking care about state of soil & its liquefaction potential.
- design flexible structures with regular ~~symmetric~~ symmetrical shapes.
- Tsunami alert system.
- Evacuation drills
- Earthquake alarm system
- knowledge about how & where to take shelters in equake.

Safe Engineering practice

→ using shear wall in building (Strength & stiffness in building)



→ braced frames / moment resisting frame

→ More rigid attachment of building to its foundation results less damage. (energy reaches other part of building)

→ Base isolation ( ) → decreasing the energy of earthquake that reaches to the building

→ Lateral strength & good str. configuration

→ location of building

→ No building near active fault

→ Reducing DL of building

→ Avoid soft storey (stiffness of one floor differ from other)

→ Making ductile building

→ Using modern technology (polymer RC, autoclave cement blocks)

→ Tie beam at plinth level

→ Strong column weak beam joint

global failure

local failure

Indian Standard Code & Enforcement by-Laws

(IIT Kanpur, Earthquake Tip)

IS 1893 → seismic zone map & specific design force.

IS 4326, 1993 → general principle of EQ resisting building

IS 13827, 13828 → design & construction for improving EQ resistance building of low strength masonary.

13827 → design & construction aspect for improving EQ resistance of earthen house

IS 13920 → ductile detailing & shear wall of monolithic str. (wall at last)

IS or 13935 → individual RC members strength

Tsunami

Definition

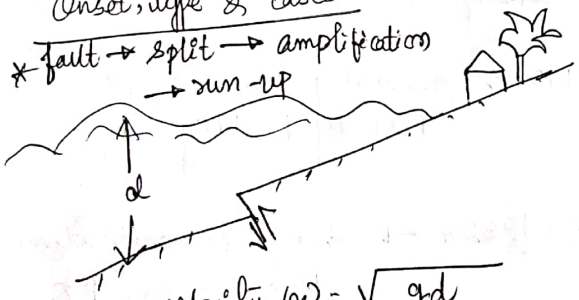
→ Tsunamis are giant waves caused by earthquakes / volcanic eruptions under the sea.

→ speed of tsunami waves depend upon the depth of ocean.

→ series of waves, with periods ranging from ~~se~~ minutes to hrs, so called "wave train".

Onset, type & cases

* fault → split → amplification → run-up



velocity (v) = $\sqrt{gd}$

d = depth of water

g = acceleration due to gravity

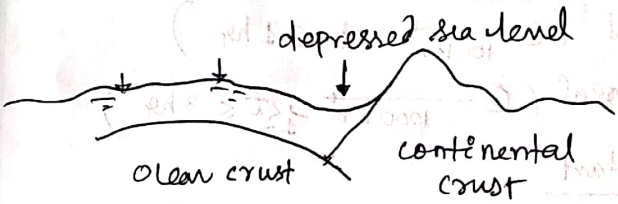
→ Tsunami = Tidal wave

* Tsunami is generated as the disturbed water level attempts to attain equilibrium

Reasons of tsunami

1. fault → It can lift a part of ocean floor vertically upward which in turn would ~~us~~ push up the column of water above it creating a local bulge over normal sea level.

→ Otherway if it causes down-slagging (relative to adjacent part) in ocean floor, a local depression in sea water is created causing ebbing tide.



Ex- Nagapattinam, Indian Ocean

→ As due to depression in the water column, imbalance is created. The process that follows in attaining the equilibrium creats ~~to~~ tsunami waves.

2. volcanic eruptions

3. Large meteorite impacts on ocean water (space object)

4. under water testing of nuclear bomb

5. Massive landslide

6. Earthquake & tsunami link

Type

1. local (source ⊙ ——100 km——, $t \leq 1$ hr)
2. Regional (⊙ ——1000 km—— $1 \leq t \leq 3$ hr)
3. distant tele-tsunami (> 1000 km, $t \geq 3$ hr)

Ocean wide tsunami

Cases — Cause

1. Sumatra, Indonesia (Earthquake)
2. North pacific coast, Japan (Eq.)
3. Lisbon, Portugal (Eq.)
4. Krakatau, Indonesia (volcano)
5. Enshunada Sea, Japan (Eq.)
6. Sanriku, Japan (Eq.)
7. Northen Chili (Eq.)
8. Ryuku Islands, Japan (Eq.)
9. Ise Bay, Japan (Eq.)
10. Nankaido, Japan (Eq.)

Warning

1. Earthquake
2. Ocean wave ~~receding~~ receding suddenly.
3. As waves are called 'wave train'/series of waves don't, stay out of danger unless declared 'SAFE'.
4. Stay away from rivers & streams that lead to ocean.
5. Keep store of emergency supplies
6. volcano
7. landslides
8. If any Nuke test, inform the costal people.

Element at risk

community vulnerability

(1) → coast prone area people
→ communities vulnerable to tsunami
→ preparedness of communities
} people

(2) → structural elements & the resulting economic loss

(3) social vulnerability which deals with damage to livelihoods and communities and their post event recovery.

Effect of Tsunami

→ Physical damage
→ Environmental damage
→ Casualties
→ Public health

Specific Preparedness

(1) → Hazard mapping (THM)
→ GIS
→ satellite images / satellite remote sensing data

(2) → Early warning system
RTSP - regional tsunami service provider

→ ~~Community preparedness~~

* detect, locate & determine the magnitude of potentially tsunamigenic eq.
* maintain the core observing system
* Real time tsunami modelling & inundation mapping
* R & D on probabilistics tsunami hazard assesment
* Development & implementation of multi-hazard forecasting system service
* Enhancement of ~~DSS~~ Decision Supp. System & other associated elements for RTSP.

(1) protection planing
(2) shortcut reminder (precise knowledge → appro. response)
(3) smooth evacuation
(4) land use plamg
(5) comm'n tools

(3) Community Preparedness

(Task for Students)

Main mitigation Strategies

- if you are on land
- if you are on boat

* tsunami knowledge (share among all)

* follow elders/ teachers advice if in school/institution

* if at home → make sure all are aware → ~~evacu~~ evacuation if house is in tsunami evacuation zone.

Follow advice of local emergency & law enforcement authorities

* if in a beach & feel earth shake move to higher ground & stay away from river & stream that leads to ocean.

* upper floors of high/ multi storeyed building in low lying castal area.

* staying away from low lying area.

* keep in contact with Harbour authority/ vessel traffic system.

* for smaller boat there may not be connection with H. Authority/ vessel traffic system. So owners should take immediate decision if they are aware of tsuni warnings.

* Damaging wave activity & unpredictable currents can effect harbours for a period of time following the initial tsunami impact on coast. Contacts harbour authority before returning to port for safe navigation & berthing.

Other strategies

* Site planing & land management
* Engineering structures
* Flood management (GIS → vulnerability mapping of costal region)

Community preparedness in Tsunami

↳ If you live/work/study in low laying ~~coa~~ coastal region know your evacuation route to high ground in case of tsunami.

↳ Emergency backpack should be ready. (medicines, key papers, fresh water, food, baby supplies if needed, survival blanket, ~~if needed~~ battery) for lighting purpose)

↳ If small quake is felt / any news regarding earthquake on TV then ~~be~~ head for higher ground.

↳ People visiting the coast if feel strong earthquake move to higher ground.

↳ If people at beach / harbor and see the ocean pull back and expose areas your, then people should run to higher ground.

↳ ~~People should find out~~

→ If you are at coast ~~x~~ area & feel earthquake then drop, cover & hold on. When shaking stops gather member of household and move quickly to higher grounds away from coast.

Site planning & land management

↳ find if your school/ workplace/home/ frequently visited locations are in tsunami hazard zones.

↳ know the height of your street above sea level and distance of street from coast/ high risk waters.

↳ plan evacuation routes routes from your home, school, workplace & other places you ~~could~~ could be where tsunami present a risk.

↳ ~~People should practice~~ Constructions or should be done at higher places if not then at distant places from tsunami prone zone.

↳ If you are in coastal area and feel an earthquake then when eqake stops gather members of household & move quickly to higher grounds. Avoid downed power lines, stay away from buildings & bridges from which heavy object might fall during an aftershock.

Engineering structures for tsunami

↳ build structures with RCC rather than wood or other material.

↳ design structures so that water can flow through the ground floor.

↳ construct deep foundations / braced at the footings. (resist the tsunami force)

↳ design with redundancy so that structure can experience partial failure without progressive collapse.

↳ ~~As much~~ Orient the building at an angle to the shore line.

↳ Use continuous steel frames strong enough to resist hurricane force winds.

↳ design structural connectors that ~~can also~~ absorb stress.

flood management

Landslide

Definition

A landslide is the movement of a mass of rock, earth, debris down a slope under gravity.

Concept

↳ ~~Landslip~~ landslide occurs in a variety of env. Charaiterized by either steep / gentle slope gradient from mountain range to coastal cliffs or even underwater (submarine landslide).

↳ Gravity is the primary driving force for landslide to occur but there are other factors affecting slope stability that produce specific condition that makes a slope prone to failure.

↳ That ~~spec~~ other factors are rainfall, earthquake a slope cut to built a road and others.

Onset type

↳ slide - movement parallel to planes of weakness & ~~o~~ occasionally parallel to slope.

↳ Creep - gradual movement of slope materials.

↳ Slump - complex movement of material on a slope, including rotational slump.

Topple → the end over end motion of rock down a slope.

fall → material free falls.

flow → fluid like motion of debris.

Torrent → a ~~sporadic~~ sporadic & sudden channelized discharge of water & debris.

Warning of landslide

→ springs, seeps on saturated ground in areas that are not usually wet.

→ new cracks/unusual bulges in the ground.

→ soil moving away from foundation/tilting or cracking of concrete floors and foundations.

→ sunken/~~downdrops~~ down-dropped ~~red~~ road beds.

→ rapid increase in stream water levels, with increased soil content.

→ sudden decrease in stream water level even though rain is ~~still~~ still falling

→ ~~unusual~~ unusual sound such as trees cracking/boulders knocking together might ~~increase~~ indicate moving debris.

Element at risk / area prone to landslide

↳ On existing old landslide
↳ On/at the base of slopes
↳ In or at the base of minor drainage hollows.
↳ at the base or top of an old fill slope
↳ at the base or top of a steep cut slope
↳ developed hillsides where leach field septic systems are used.

leach field → extension of septic system

Causes of landslide

↳ landslides occur due to failure of stability of slopes. The following factors cause failure of slopes.

* Groundwater & precipitation
* Insitu stresses
* Textures
* Weak planes
* weathering
* Structural features (bedding planes, fractures, joints faults, fissures)

* seismic activity
* excess rain/precipitation
* earthquake
* Volcanic activity
* shear strength of soil
* Anthropogenic factor (construction practice, deforestation, erosion, mining, drainage problem, continous horizontal vibration from heavy traffic/blasting)

* Geological factor

Hazard Zones & Indian landslide

Zones - (1) very very hazard
(2) high hazard
(3) Moderate hazard
(4) Low hazard
(5) Very low hazard

NB - follow ndma.gov.in/en/landslides-zone-map.html for more info.

Indian landslide → western ghats, eastern ghats
N.E. himalays, N.W. himalayas

Typical Effect

* Physical damage & loss casualties

↳ loss of lives (social)

↳ destruction of properties (Physical) ~~(Economical)~~
(highway bridges, buildings, roads)

↳ economic costs (economic) (communities & cities)

↳ destruction of natural environment. (environment)

* Any other effects can be added ~~by~~ if any left.

Main mitigation strategies

(1) Hazard mapping

→ It indicates the possibility of landslides ocuring throughout a given area.

→ An ideal hazard map shows not only the chances that a landslide might form at a particular place but also the chance that might travel downslope a given distance.

② Landslide practice (land use practice)

↳ afforestation
↳ Avoid blockage of natural drainage
↳ Total avoidance of settlement in risk zone
↳ No construction in areas beyond certain slope
↳ Relocate settlement/infrast. in landslide zone

③ Retaining wall

→ Retaining walls are designed to restrain the soil. They are normally used in areas with steep slopes / where the landscape needs to be shaped severly for construction/engg. projects. However retaining walls have been found very effective solution against landslide.

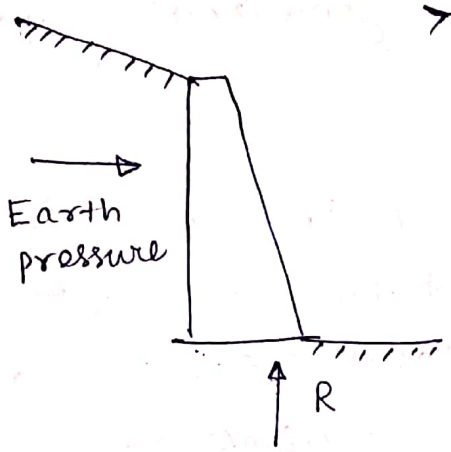
There are various ways of constructing a retaining wall —

* Gravity wall → they manage to resist pressure from behind due to their own mass

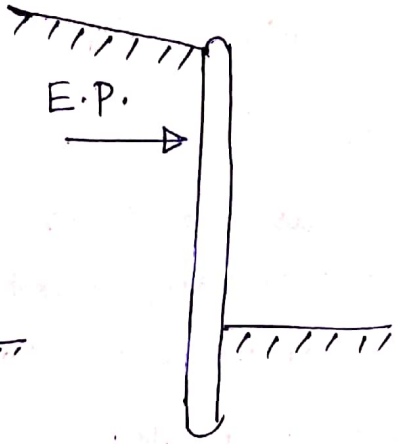
* Piling wall → made of steel, they are usually used in tight spaces with soft soil having $\frac{2}{3}$ of wall beneath the ground.

* Cantilever wall → they have large structural footing and convert horizontal pressure from behind the wall into vertical pressure on the ground below.

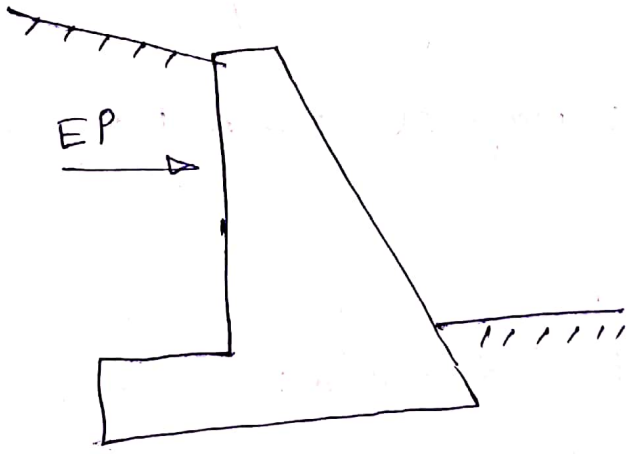
* Anchored walls → they use cables or other stays anchored in the rock or soil behind to increase resistance.



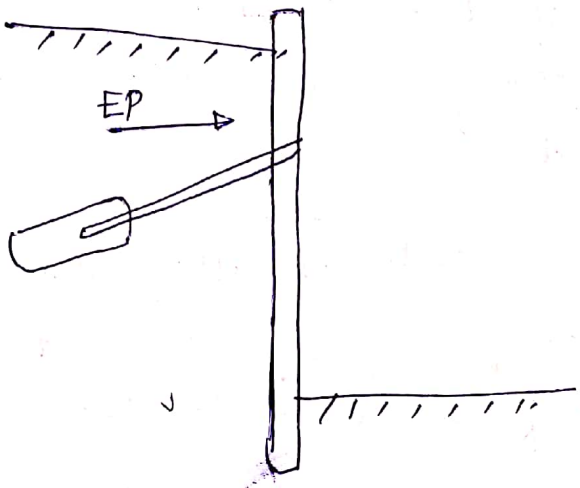
Gravity wall



Piling wall



Cantilever wall



Anchored wall

(4) Surface drainage control works

↳ The surface drainage control works are implemented to control the movements of landslide accompanied by infiltration of rain water & spring flows.

↳ Shallow drainage → trenches are cut in unbroken length & filled with highly permeable, granular & draining material.

Deep drainage → It modifies the filtration route in the ground. Deep drainage in earth slopes can be achived in several ways

(i) large diameter drainage wells with sub horizontal drains

(ii) isolated well fitted with horizontal pumps

(iii) deep drainage trenches

(iv) drainage galleries fitted with micro drains

(v) siphon drain

(vi) micro drain

(5) Engineering structures

↳ engineering structures with strong foundations can withstand/take the ground movement forces.

↳ Underground installations (pipes, cables) should be made flexible to move in order to withstand forces caused by landslide.

↳ Ex: Nets
Retaining walls
major civil works → to mitigate landslide

↳ if the property in the landslide prone zone, consultation with company specializing in earth movement for ~~a~~ opinions & advice on landslide problems and on corrective measures.

Community based mitigation

→ community knowledge

* aerial photo of community
* leaflets
* posters explaining the project

→ community slope feature mapping

→ produce landslide hazard map

→ community discussion

→ construction of new drains capture surface water

→ Agree plans with community

→ Community contractors building drains that capture surface water.

CYCLONE.

* Definition & Concept

→ A spinning storm that rotates around a low pressure centre.

→ Cyclone represents circular fluid motion rotating in the same direction as the earth. This means that the inward spiralling winds in a cyclone rotate anticlockwise in northern hemisphere and clockwise in southern hemisphere of earth.

* Types

1. Tropical cyclone - cyclone that occurs over tropical oceans regions.

ex- hurricane (Atlantic & NE Pacific)
typhoons (NW Pacific)

→ We can also describe tropical cyclone based on their wind speed.

Category	wind speed (mph)
1	74-95
2	↕
3	↕
4	↕
5	>155

2. Polar cyclone – cyclones that occur in polar region.

→ stronger in winter months.

→ Region: Greenland, Siberia, Antarctica

→ damage is less.

3. Meso cyclone → An area of vertically rotating air during a severe thunderstorm which can developе into tornado.

* How cyclone occurs

As cold front & warm front meet, warm air rises as lighter

⇒ When warm air rises the space is occupied by cold air as air moves from high pressure to low pressure zone. Because the earth is spinning the cold air drops in a spiral matter rather that straight line, creating the Coriolis Effect. When enough cold air drops quickly enought, it results in a cyclone.

Warning of cyclone

→ Regular observation from weather network of surface and upper air observing station.

→ Reports from ships

→ Satellites

→ Report from commercial aircraft

→ The IMD issues warning in 4 stages for Indian coast.

Stage-I : cyclone watch (issued 72 hrs in advance)

Stage-II : cyclone alert (issued 48 hrs in advance)

Stage-III : cyclone warning (issued 24 hrs in advance)

Stage-IV : landfall outlook (issued 12 hrs in advance).

Element at Risk

→ structures without proper anchorage to the foundations.

→ settlements located in the low lying coastal area.

→ Settlements in adjacent areas will be vulnerable to floods, mud-slides or landslides due to heavy rains.

→ Agricultural fields / big trees

→ other man made structures (telephone, electric poles, cables, roofs, signboards, hoardings, fishing boats..... etc)

Effect of Cyclone

→ strong wind in cyclone & flying debris also contribute to the effect of cyclone damage on populated areas.

→ A dangerous rain event that leads to flood.

→ Storm surges (caused by wind blowing across the open ocean) * cause beach erosion.

→ Tornado

→ water supplies got contaminated,

→ crops & food supplies got ruined.

→ communications got disrupted.

Hazard Zones

→ Very High damage risk zone-A ($v = 55$ m/s)
→ " B ($v = 50$ m/s)
→ High damage risk zone ($v = 47$ m/s)
→ Moderate damage risk zone - A ($v = 44$ m/s)
→ " - B ($v = 39$ m/s)
→ Low damage risk zone ($v = 33$ m/s)

Mitigation Strategies

* Hazard mapping

→ A cyclone hazard map will illustrate the areas vulnerable to cyclone in any given year and a disaster management plan can be prepared accordingly to face the disaster effectively.

* Land Use Control

→ Not permitting building of homes / businesses in areas ~~threat~~ threatened by ~~fo~~ flooding due to cyclone.

→ proper building codes for building construction.
Restriction to development

→ ~~Land use~~ is the most effective and least expensive mitigation strategy available ~~is~~ in areas at risk from tropical cyclone.
(transportation, sea ports, large complexes near ports tourism)

→ Proper construction practice

→ Reduce the population ~~centre~~ growth ~~near~~ in risky areas (proper urban planning)

→ drainage system should be revamped.

* ~~Engineering Structures~~

→ cyclone shelter house.

→ CRZ must be enforced.

* Engineering structures

→ Maintenance of embankments should be crafted with fine workmanship to mitigate flood risk during cyclone.

→ structural safety certificate is must for coast towns & cities.

→ Infrastructures i.e. public building, bridges communication systems, airports & hospitals must be resilient to cyclone.

→ Ageing test & retrofitting requirements should be mandatory for major city buildings.

→ Suitable gui Underground power cables and utility lines should also be planned.

→ Coastal mobile towers must be able to bear wind speed at 250 kmph for uninterrupted telecom service.

Flood Management

→ levees, floodwalls, sea walls and other appurtenant structure.

→ dams

→ floodways, spillways and channels

→ structural mitigation through improved levee design or modification

→ controlled overtopping and breaching of levees

→ ~~Leeve~~ levee armoring (less erosion)

→ floodwater diversion & storage

→ flood plain and stream reforation

→ Green Infrastructure (store water & reduce flood risk)

→ So mainly flood management based on two categories 1) structural 2) non-structural

→ Restructuring the landscape

→ less popular ~~as old~~ over time as old dams & flood gates have failed.

→ Remove people/property from flood zone

* Improving vegetation cover

→ Vegetation covers are required as they reduce cyclone intensity & they will also help in evapotranspiration and better precipitation in that area.

Community based mitigation

→ Don't go outside until officially advised.

↳ listen to local radio for official warnings and advice.

↳ if someone has evacuate ~~on~~ or did so earlier don't return until advised.

→ avoid areas prone to cyclone/storm surges and flooding.

→ shelter domestic animals.

→ avoid going outside.

→ Monitor closely the cyclone bulletins on Radio / Internet or any other medium.

→ Preparedness (making plans, identifying and procuring resources needed and testing the plans through exercises)

→ Education (community and rescue personnel also)

→ shelter in place

→ Refuge of last resort (not formal shelters. when people no longer have an opportunity to evacuate, refuges of last resorts are vital)

FLOOD

Definition & concept

A flood is an overflow of water that submerges land that is usually dry.

→ Flooding occurs due to following reasons —

* rain
* river overflow
* coastal flooding
* dam breakage
* melting of glaciers on mountain top
* clogged drainage

Types of flood

1. coastal flooding → occurs due to extreme weather and high tides
2. River flooding → occurs due to excess rainfall
3. Flash flooding → cause by heavy and sudden rainfall when ground can't absorb water quickly
4. Groundwater flood → due to excess rain ground becomes saturated with water and can't absorb it. So water rises above ground surface & flooding occurs.

5. Drain and sewer flooding → rainfall, blockage within the drainage system.

Warning

→ flash flood warning (Take action) → It is issued when a flash flood is imminent / ocuring. If you are in a flood prone area move immediately to high ground.

⇒ flood warning (Take action) → a flood warnig is issued when the hazardous weather event is imminent or already happening.

→ flood watch (be prepared) → a flood watch is issued when conditions are favourable for a specific hazardous weather event to ocur. It is issued when conditions are favourable for flooding.

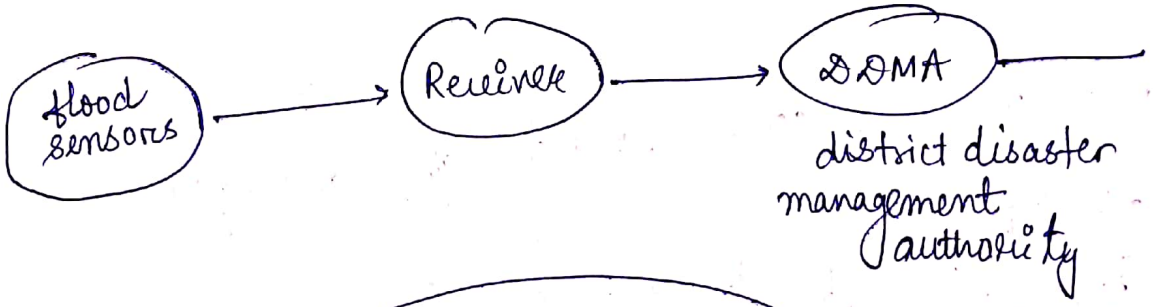
→ flood advisory (be aware) → It is issued when a specific weather event that is forecast to ocur may become a nuisance.

Early warning system

the warning system consists of sensors that wirelessly transmit information about river water levels to receiver.

Collect the data through water level flood sensors.

Community based early warning system



→ Distribution of warning through different channels to communities

- ↳ Mobile
- ↳ Internet
- ↳ local TV channels
- ↳ News paper

EWARN – early warning alert & response system

Element at Risk

- Community
- live stock
- industrial chemical mixing in water
- damage of plants
- damage of property
- petrol products from roads
- parking lots
- gas cans, gas tanks mixing with flood water and contaminating the waters and spreading.
- vegetation covers, plants got damaged.
- Infrastructures
- Spreading of diseases (human health)

~~Hazard Zones & Indian floods~~

Hazard Zones & Indian floods

- Punjab & Haryana
- Gangetic plains (UP, N. Bihar, W. Bengal)
- ~~Bhr~~ Brahmaputra Valley
- Coast A.P., Orissa & ~~South~~ Southern Gujrat
- Kerela, T.N., Uttarakhand, J&K portions

Indian floods

- Uttarakhand floods 2013
- Himalayan flash floods 2012
- Ladakh floods 2010
- India floods 2009
  (Odisha, Kerela, Karnataka, N.E)
- Bihar floods 2008
- Gujrat flood 2005
- Maharastra flood 2005
- Chennai flood 2005
- Bihar flood 2004
- J & K flood 2014

Effect of flood

* Physical damage

- damage. buildings & contents
- vehicles so that disrupt to transport
- livestocks so loss of value added in commerce & business Interruption
- crops
- infrastructure

→ damage to pipelines and appurtenances

→ damage to partially buried tanks

→ damage to pumping equipment and electrical installation

→ damage to intakes, dams, and other surface construction.

→ damage to dam and reservoir

Casualities & Public health

→ people die & some got separated due flood

→ Water borne diseases (typhoid, cholera, hepatitis A & E)

→ Vector borne diseases (malaria, dengue, West Nile fever)

→ Mental health (separation from family, disruption in family life and daily routine, loss of pets & possessions, moving to temporary accomodation)

→ Snake bites

→ Heath education (promote good hygienic practice, ensure boiling/chlorination of water, increase awareness)

Crops & flood

→ crops get submerged and got damaged
→ younger stage crops are more vulnerable
→ weather condition prior to flood situation & ~~ff~~ crop damage
→ mud disposition reduce photosynthesis
→ flooding can cause significant loss of soil nitrogen.
→ debris in fields can damage crops & damage machinary.
→ flood condition can increase disease incident in surving plant.
→ rain damage grains contain toxins, & it can be tested for ~~more~~ mycotoxins before use, it will be not be suitable for seed.
→ don't feed any type of flood damaged grains to livestock.

Main mitigation Strategies

Mapping of flood prone area

→ the map shows the region in the country that are regularly affected by flood so that people in that zone remain alert always and after getting ~~alert~~ alert ~~for~~ of any possibility of floods they take nessary steps or co-operate with local authority with their evacuation ~~so~~ & other works.

→ ~~Bec As~~ mapping of flood prone

Land Use Control

With the increase ~~in~~ human alteration and development of the catchment area, the run off process is changed (infiltration capacity of soil and change of soil cover) Hydrological responses to rainfall strongly depend on local characteristics of soil, water storage capacity and infiltration rate, alongwith that type and density of vegetation cover and land use characteristics are also important.

Thus appropriate planning and regulation of land use can limit the flood damage potential in the areas with flood risks. In that areas, flood proofings / relocation of existing developments can also be done.

Flood Control & Management

→ Education
→ dams
→ diversion canals
→ flood plains & groundwater replenishment
→ River defences (levees, bunds, reservoirs, weirs....)
→ coastal defences (sea walls, beach nourishment, barrier islands, tide gates)
→ Townplanning
→ self closing flood barriers (SCFB)
→ vegetation
→ strategic retreat
→ Resilience (city can recover quickly after flood)
→ flood clean-up safety
→ development of technology
→ temporary perimeter barrier (sandbags)

Community based mitigation

Before flood

→ know about local relief centre & evacuation route

→ keep emergency no. & imp. ~~for imfoval~~ info: along with emergency supplies

→ fold & roll up anything to higher ground

→ plant trees & shrubs in your compound if you are in low-lying area.

During flood

→ leave to higher ground as soon as flood start

→ turn off all electrical appliances

→ leave the area before it is too late

→ stay away from power lines / transmission cables

→ try to keep away from flood waters (chemical / hazard material)

After flood

→ Permission from official to return

→ Don't suddenly switch on electrical appliances

→ Keep sufficient proof of damages.

→ Clean the home (may be contaminated)

→ Wear gear (mask, glove) befor cleaning

Drought

Definition & Concept

→ A drought is an event of prolonged shortages in water supply, whether atmospheric, surface water or ground water.

Causes of drought

→ precipitation deficiency

→ erosion & human activities

↓ land not able to capture & hold water

↓ over farming, excessive irrigation deforestation

→ climate change.

Type of drought

→ Meteorological drought → prolonged time with less than average precipetation

→ Agricultural drought → it effects crop production / ecology of the range. It is caused by extended period of below average precipitation.

→ Hydrological drought → when water reserves (aquifiers, lakes, reservoirs) fall below a locally significant threshold.

Warning

→ Standardized Precipitation Index (SPI) which uses mean rainfall over a long term period of at least 30 yrs as a variable to develop an early warning scale.

→ A drought begins when SPI is continuously negative for a period of 2/3 weeks and ends when no. turns positive.

→ As drought is a slow onset disaster, its monitoring and early warning systems are central to drought management. The early warning system should function at 03 levels —

* ~~receiving fo~~ receiving forecasts/early warning and advisories from scientific institution (IMD)
* monitoring key drought indices at national & state level. (index) → measurement
* developing composite index for various drought indicators.

(% of normal precipitation, no. of days with no precipitation, soil moisture, hydrologic variables for water supply forecasting, vegetation, water availability)

Elements at Risk

→ dryness of harvesting soil → food production ↓ → mal-nutrition ↑
→ vaporization of rain filled rivers, ponds
→ due to lack of water in soil, plants die.
→ animals & birds die due to water thrst.
→ Production of electricity get hampered.
→ As electricity production gets hampered, it affected the growth rate.
→ Public health (stress, anxiety, depression)
→ economy will be affected.
→ decrease in water quantity & quality → water crisis
→ Earth climate (heat waves ↑, dust storm ↑)
→ disease pattern changes
→ other factors that depends upon water.

Effect of drought

→ Simply the effects are — ① environmental
② economic
③ social

↳ diminished crop or growth and carrying capacity of livestock

↳ Dust bowls (due erosion)

↳ Dust storms

↳ famine

↳ habitat damage

↳ hunger

↳ malnutrition, dehydration and related diseases

↳ mass migration

↳ Reduced electricity production

↳ Shortage of water for industrial uses

↳ Snake migration

↳ Social unrest

↳ war over natural resources (water/food)

↳ wildfires

↳ exposure and oxidation of acid sulfate soils due to falling surface and ground water levels

↳ cyanotoxin can accumulate within food and water supply which can cause cancer.

Mitigation Strategies

Drought monitoring →
- Meteorological data
- hydrological data
- agricultural data
- data from space
- socio-economic data
- data from GIS

→ The IMD monitors the ~~indices~~. incidence, spread, intensification and cessation of drought (ending process) based on

* **Aridity Index (AI)** {done on weekly timescale)

$$AI = \frac{PE - AE}{PE} \times 100$$

where PE = water need of plant (potential evapotranspiration)

AE = actual evapotranspiration

AI scale	drought intensity
1-25	mild
26-50	moderate
750	severe

* → Standardized Precipitation Index (SPI) is done at a monthly time scale. It is the no. of standard deviations that observed cumulative precipitation deviates from the climatological average.

Water Supply augmentation & Sup. conservation

Augmentation (increase)

→ Water Reuse → untreated wastewater reused at home.

→ treated wastewater delivered from a central treatment facility

suitable for → irrigation
→ cooling & industrial purpose

→ leak detection (faucets & toilets)

→ storage (from local lakes) → limited due small volume
→ can be treated in emergencies

→ groundwater (from wells) → irrigation & fire suppression
↓
(can supply limited quantities)

Conservation

→ domestic conservation

→ industrial ″

→ agricultural ″

Drought planning

Recommendation

→ set up a mission / task force for on drought mitigation

→ conduct drought risk & vulnerability assessment

→ identify programmes and measures for drought mitigation

→ develop a decision support system for drought mitigation

→ promote education & awareness of mitigation policies & measures.

→ encourage community level plans for drought mitigation

Implementation

→ water harvesting and conservation

→ artificial recharge of ground water (contour bunding, contour trenching, contour cultivation, bench terracing, graded bunding, gully plugging, check dam, stream bank protection farm ponds, percolation tank, anicuts, injection wells)

→ traditional water harvesting & conservation

→ drip & sprinkler irrigation system

→ Improved water saving farm practices

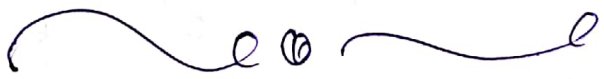
→ Long term irrigation management

→ Afforestation

→ Crop insurance

→ Community participation on drought mitigation

→ Climate variability & adoptation



Forest Fire

Definition & concept :-

→ It means a fire burning uncontrolled on lands covered wholly / in part by timbers, brush, grass, grain or other flammable vegetation.

→ Forest fire not only pose a threat to the forest wealth but also to the entire regime to fauna & flora etc seriously disturbing the bio-diversity, ecology and environment of a region & causes imbalance in nature.

⇒

→ Forest fire is caused due to two main reason ① - natural reason
② - man-made reason

OR

Forest fire can be described as any uncontrolled and non prescribed combustion of plants in a natural setting ~~and spreads based on environmental conditions~~ by human action or by natural reasons.

Forest fire damage in India

Types :- ① Surface fire : forest fire spreading along the ground ~~as the surface litter~~.

Crown fire → In this case the crown of trees and shrubs burn often sustained by a surface fire.

Vulnerability → The mountain range which grows in high rain density area is less vulnerable to forest fire.

Forest fire damages in India

↳ Precious forest resources including carbon locked in the biomass is lost due to forest fire every year.

↳ loss of ecosystem & biodiversity

↳ forest degradation

↳ air pollution

↳ soil degradation

↳ economic losses

↳ destruction of watersheds (as trees/vegetations act as watershed protectors)

↳ various impacts on human well being & damages

↳ pollution destruction of natural scenario

→ destruction do environmental chain

→ climate change of local area

→ extinction of certain animals

→ incomes / jobs are lost for certain workers

→ mud slides

→ global warming, ozone layer depletion

→ ~~damage the~~

Operational fire management system & organizations

* Good management is built on good knowledge :-

↳ using satellite data, SMS based alert system can be developed to inform field staff of active fire burning in their area.

→ Proper use of fire supression equipment.

→ Involve community in forest fire prevention

→ states can learn from each other experiences

* Investing to make service delivery more effective

↳ investing in modern technologies for detection, supression and safety equipment alongwith that fill vacancies in fire prone areas & make funding available.

* ~~partner~~ partnering in with communities and disaster management agencies :-

~~some~~ as communities continue to use forest fire, some fire is desirable so engaging them in decision making plays a vital role.

* Improving data and research

→ A national forest fire ~~in~~ information database, bringing together satellite based remote sensing data & field reported data are critical for planning fire prevention & response.

→ Alongwith that scientific researches are needed for fire management ~~at~~ with proper provisions for funding to satisfy the said purpose.

* fire risk zonation and mapping
* effective communication ~~with~~ for awareness generation
* capacity building of communities (mock drills, training, latest equipments)

* increasing resilience for forest fire

- moisture & water conservation
- forest floor biomass management
- weed management

* forest fire detection alert

- digitalization of forest boundaries
- promoting greater adoptation of forest fire alert system
- strengthening engagement with local communities
- dedicated phoneline
- monitoring & evaluation
- wireless network

* Digtize the location of critical resources & assets

* forest fire lines

* Control burning

* Fire supression

→ training of field staffs & fire fighters

→ equipments

→ development of adequate infrastructure for fire supression

→ arrangement of adequate man-power in fire prone areas.

* Post fire management

→ assesment of loss

→ proper investigation of causes

→ restoration

* Co-ordination with other agencies

* Centre of Excellance for forest fire

* Mobilization of financial resources

Organizations

NAPFF – National Action Plan on forest fire

MoEF&CC – Ministry of Env., forest & Climate Change

SFD – State Forest Dept.

DFO – Dist. forest Officer

FSI – forest Survey of India

Similarly search for

ICFRE, NDMA, SDMA, DDMA, NDRF, SDRF

DFE, CAMPA, JFMC, SOP, ICT, NTFP, EDC,

FRA, WPO, SHG etc....

Community Involvement

* land managers : They are encouraged to promote relationships between private & public land managers & work toward reducing ~~wildlife~~ wildland fire threats
  - private
  - public

* public → public must understand & prepare for the risk of wildlife fire. Homes that are

not properly prepared & maintained create a risk for the residents and the emergency services.

* Local officials & decision makers : Local officials work together to shape development in their communities & ensure an ideal quality of living. They promote the balance between the benefits of the env. in which they live & the risk posed by living there.

* Local fire service : → firefighters are the trusted source in the community. They can deliver the preparedness message to residents in an effective manner.

Public policies concerning fire :— Working Plan-1960
Social forestry-1976 Programme

* National Forest Policy (1988)

→ env stability
→ conserving national heritage
→ check soil erosion
→ check the extension of sand dunes
→ increase forest cover

→ increase the productivity of forest
→ efficient utilization of forest produce
→ creating people movement

* Participatory forest Management Programme (1990)

* Forest fire Management Planning (1995)

→ Review India's current forest fire problem, provide training in strategic fire planning to key forestry personnel at State & national level.

* Modern Forest fire Control Project

→ 1984–1990 → U.P. & Maharastra
(with the help of UNDP)
United Nations Development Plan

* Modern Forest Fire Control Method

1992–1993 → prevention, detection, supression

→ 2000, the scheme was extended to all states & UTs.

Modified National Forestry Policy

→ It aims to prepare a strong data base/ network on forest fires and evolve an appropriate strategy to deal the forest fire situation in more effective manner.

Parts
A
C

→ systematic strategic planning
→ forest fire monitoring (MODIS satellite, → sms based)

Incident Response System in India (IRS)

→ IRS provides a participatory, well structured, fail safe, multi disciplinary, systematic approach to guide administrative mechanisms at all levels of Govt.

→ It also provides scope for private sectors in response activities.

The needs for fire management

→ national focus & technical resources missing

→ Important forest fire mangement elements i.e. fire centres, co-ordination among ministries, funding, HR development, fire research, fire management and extension programmes are missing

→ Research, training & development are missing for fire management

→ So Ministry of Env. & Forest, GoI prepared a National Master plan for Forest fire Control which includes —

- * prevention of human caused fires
- * prompt detection of fire
- * fast initial attack measures.
- * vigorous follow up action
- * firefighting resources
- * introducing forest fuel modification system at strategic points

Other type hazards & disasters

Chemical Disaster

→ A chemical disaster is the unintentional release of one/more hazardous substances which could harm human health & environment.

ex — fires, explosions, leakages, ~~leakage~~ release of toxic materials that cause people illness, injury or disability

→ Bhopal Gas Tragedy (1984) → MIC gas.

Causes

- → human ~~effor~~ error
- → improper training
- → manufacturing defects
- → improper maintenance

→ induced effect of ~~chemical~~ natural calamities

→ hazardous waste processing/disposal

Effects

The effect is mainly categorized in 2 parts

① Env. effect ② Human effect

Env. effect

→ pollution (air, water, soil)

Human effect

→ Organ damage

→ weaking of immune system

→ development of allergies / asthma
→ birth defects
→ effect on the mental, intellectual and physical ~~dev~~ development of children
→ cancer

Preparedness

→ Don't smoke, lit fire in hazardous zone
→ sensitize the community living near industrial units
→ keep all emergencies contact no.
→ avoid housing near industries producing hazardous chemicals
→ participate in all capacity building programmes
→ prepare disaster management plan for the community & identify safe shelter alongwith safe and easy access route.
→ prepare family disaster management plan & explain to all members.
→ make family & community aware of the basic characteristics of various poisonous / hazardous chemicals & first aid require to treat them
→ adequate no. of personal protective equipments needs to be made available.
→ prepare an emergency kit of items & essentials

→ don't consume uncovered food / water

→ listen public adressal for advice from authority

→ Don't pay attention to rumours / spread rumours

→ provide correct info to Govt. if needed.

~~Industry~~

Industrial disaster → when disaster is caused by industrial companies.

Causes

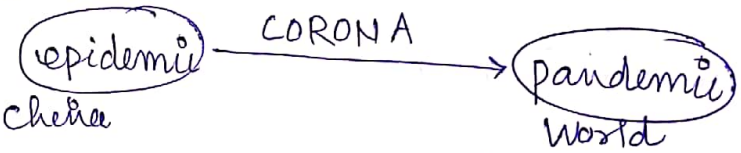
→ unsafe condition (work related)
→ unsafe acts (lack of skill)
→ unsafe situational & climate conditions & variations
→ machine & non machine factors
→ personal factors (eye sight, fear etc)
→ nature of job
→ slip slipping, tripping ~~and~~ / falling on the floor
→ collision & obstruction
→ equipments & machines
→ fire hazards

Preparedness

→ safety engineering
→ safety training & education
→ safety committee
→ Regular inspection

Epidemic (opposite Pandemic → disease spread throughout the world)

An epidemic is a disease that effects a large no. of people within a community, population or region.



Type

→ common-source outbreak (spread from common source)
→ propagated outbreak (person-to-person spread)

Warning → (self task for students)

Causes

There are several changes in infectious agent that trigger an epidemic.

→ increased virulence (pathogen ability to infect the host)
→ introduction ~~to~~ into a novel setting
→ Changes in host susceptibility to the infectious agent

→ infected food supplies & disease vectors (migration of population)

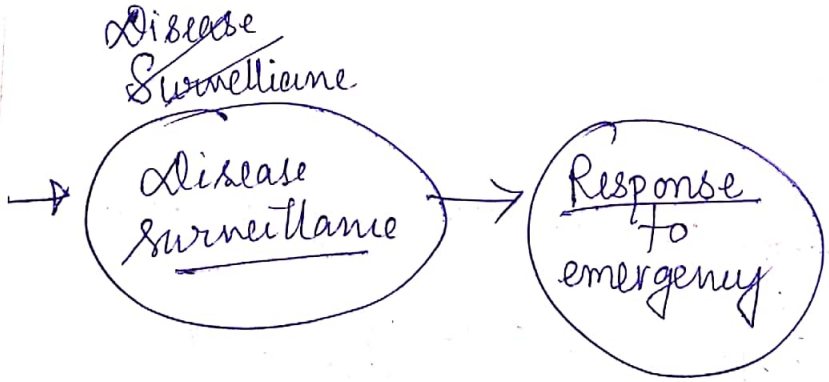
→ season change

Effect

→ economy
→ social
→ personal (health, depression) → people got confined in their houses e.g. – Corona (Lockdown)
→ growth rate decline
→ health sector got gets burden & neglect other issues

Risk reduction measure

→ disease surveillance system.
→ ability to dispatch emergency workers.
→ guarantee the safety and health of healthworkers.



Heat waves → It is a period of excessive hot weather, which may be accompanied by high humidity, especially in oceanic climate countries.

Effect

→ dehydration and loss of body salt
→ as the body cools, it taxes the heart may cause failure in people with heart conditions.
→ heat stroke in body
→ people sometimes drown in proces of cooling their body.
→ worker productivity declines in industry
→ forest fire
→ vegetation cover get effected
→ soil moisture gets reduced.
→ water level in ponds, lakes decreases
→ people and animals die
→ pshycological & sociological effects
→ power outages
→ harnessing effect
→ global warming

Forecast and warning

→ India Meteorological Department (IMD) issues warning on heatwaves when temp. crosses a certain range.

→ It also depends upon arrival of monsoon.

Awareness

→ stay hydrated by keeping water with you.

→ avoid excessive physical activities in hotter period.

→ stay in shade between 11 am to 3 pm when the sun's UV rays are intense.

→ cover up as much as possible with loose clothing & hat

→ take care of skin with sunscreen

→ wear sunglasses to save eyes from the UV light

→ Through advertisement on TV, paper & electronic media, social media

→ Make people aware about consequences

→ Social media Health dept. can also ask mobile companies to put caller tune on heatwave during that period.

Policy, Planning and Institutions for disaster Mitigation

Roles of policy makers in disaster risk reduction

Role of Govt.

→ identification (responsible for co-ordinating assistance and resources to the particular region.

→ National Response Framework:
(co-ordination among state, local & federal resources, rebuilding damaged areas and relief efforts)

→ Emergency Management:
(polluted water problems, damaged power lines, inadequate housing)

→ Emergency Response Team:- Trained teams with different speciality areas.

→ communications: maintain communication, so that the needy ones can be ~~touch~~ in touch with govt and public officials.

Role of NGOs

→ Most NGOs aim to provide relief materials, organize health camps, get involved in rescue operations, arrange temporary shelters and others things so that people are able to survive & recover from disasters.

Course of action

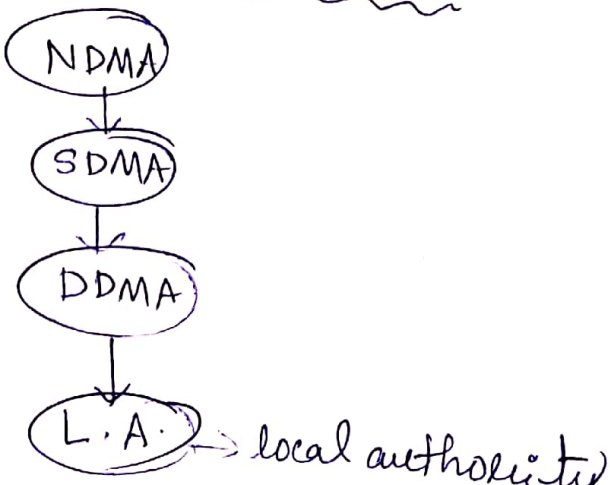
The NDMP is based on four priority themes —

↳ understanding disaster risk
↳ improving disaster risk governance
↳ investing in disaster reduction (through structural & non structural measures)
↳ disaster preparedness (~~early warning~~),

Institutional Arrangement in India

Major Institutions in National & State level

→ Google Search the above
↳ many articles are available.



NIDM → National Inst. of D.M.

NDRF → National Disaster Response Force

IDRN → Integrated Data Resource Network