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POLLACHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Approved by **AICTE** and Affiliated to **Anna University**)

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Department of Civil Engineering

Regulation 2021

III Year – V Semester

MX3084 DISASTER RISK REDUCTION AND MANAGEMENT

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UNIT I

HAZRADS, VULNERABILITY AND DISASTER RISKS

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced–Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR)

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- non structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies. - Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT

Components of Disaster Management –Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, –Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response–Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake

Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill

UNIT I

INTRODUCTION TO DISASTER

Disaster

A disaster is a seriousseries of events that leads to sudden disruption over a short or long period of time that causes widespread human, material, economic or environmental loss which exceeds the ability of the affected community or society to cope using its own resources and mechanisms.

Hazards

Hazards are potentially damaging physical events, phenomena, or human activities that causes loss of life, injury, property damage, social and economic disruption or environmental degradation. They are the external factors that affect the society or elements at risk , A hazard is a dangerous situation or event that carries a threat to humans. A disaster is an event that actually harms humans and disrupts the operations of society. Hazards will be considered disasters once they affect humans, but if they occur in an unpopulated area, they will remain hazards.

Vulnerability

Vulnerability can be defined as the diminished capacity of an individual or group to anticipate, cope with, resist and recover from the impact of a natural or man-made

hazard. The concept is relative and dynamic. Vulnerability is most often associated with poverty, but it can also arise when people are isolated, insecure and defenceless in the face of risk, shock or stress. Vulnerabilities are the internal factors that transform the hazards into disaster. Vulnerabilities determine the hazards impact on the society or elements at risk.

Resilence

Disaster resilience is the ability of individuals, communities, organisations and states to adapt to and recover from hazards, shocks or stresses without compromising long-term prospects for development.

Or

'the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure'.

Risk

Disaster risk is defined as "the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time. That can be determined as a function of hazard and it can also be defined through the combination of three terms: hazard, exposure and vulnerability.

$$\text{Risk} = \frac{\text{Hazard} \times \text{Vulnerability}}{\text{Capacity}}$$

For example, when a settlement is established on the shores of a river, hydrologists can identify and characterise flood hazard by carrying out a hydraulic analysis. According to the UNDRR definition, a hazard is characterised by its "location, intensity or magnitude, frequency and probability". In some countries, such hazard areas outline the geographic extent of floods that have a 100 year period of possible return. Any people, assets, infrastructure, and ecosystems located inside the area are all exposed to potential damage from floods. The degree of potential damage is then characterized by the area's vulnerability. For example, this can be defined by the physical structure of a building, as well as by the social and economic characteristics of a system. Additionally, hazard vulnerability can be characterized by the capacities of a society to cope with a hazard.

Classification of Disaster or Hazards

Disasters are routinely divided into natural (Geological- earthquake, tsunami, volcanic eruptions, landslides. Hydro meteorological-avalanches , floods, cyclones, storm. Climatological – extreme variation in temperature, drought, wildfires and biological-disease epidemic, insect/animal plagues) or human induced (environmental degradation and technological hazards).Hazards and disaster varyineveryregionintheworld,dependingongeographicalcharacteristics.

Natural disasters

A natural disaster is a natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Earthquakes, landslides, volcanic

eruptions, floods, hurricanes, tornadoes, blizzards, tsunamis, cyclones and pandemics are all natural hazards that kill thousands of people and destroy billions of dollars of habitat and property each year. The rapid growth of the world's population and its increased concentration in hazardous environments has elevated the frequency and severity of disasters. Climatic conditions and unstableland conditions, along with deforestation, unplanned growth proliferation, non-engineered constructions are the reasons for disaster-prone areas becoming more vulnerable.

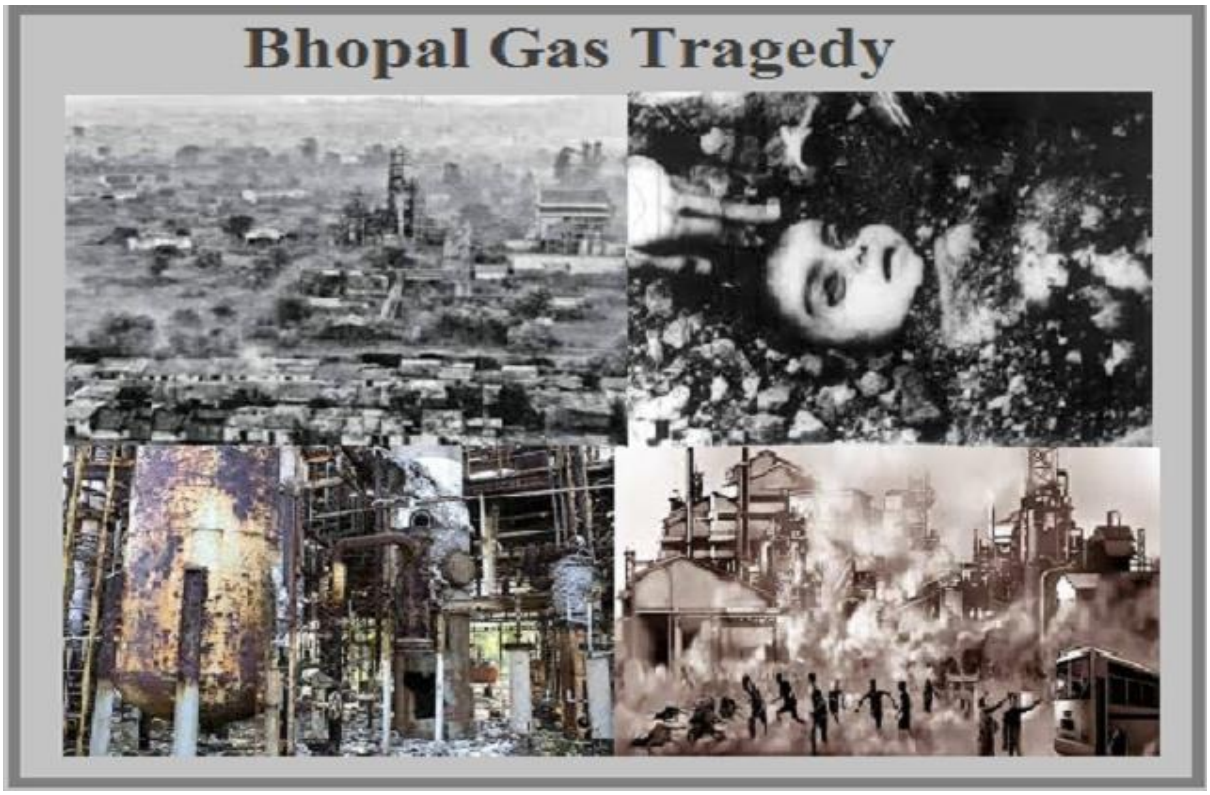
1906 San Francisco earthquake one of the worst natural disasters

Earthquake and Tsunami at Indian Ocean during 2004

Human Induced disasters

Human induced disasters are the results of technological or human hazards. Examples include stampedes, fires, transport accidents, industrial accidents, oil spills, terrorist attacks, nuclear explosions/nuclear radiation. War and deliberate attacks may also be put in this category. Other types of induced disasters include the more cosmic scenarios of catastrophic global warming, nuclear war, and bioterrorism. Sociological disasters are more human induced such as workforce violence, criminal acts, stampedes, and war.

Terrorist attacks by the Islamic terrorist group al-Qaeda against the United States on the morning of Tuesday, September 11, 2001.



Bhopal gas tragedy due to the leakage of methyl isocyanate

Earthquakes

Earthquakes are inevitable, unstoppable, and unpredictable geophysical natural events that occur on the earth's surfaceresulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves. They have highly destructive effects and causes remarkable impacts on lives and people. There is more chance for casualties, injuries and enormous physical damages if it occurs close proximity to the urban areas. The primary threats due to earthquakes are ground shaking, surface faulting and ground failure. Ground shaking may cause building to collapse if it is not built to withstand the motion of quake. Surface faulting is the appearance of cracks on the earth surface which is relatively less dangerous and largely avoidable threat if buildings, utilities and other facilities are built

away from the faulting lines the risk associated with it can be minimised however it is not always possible to predict the surface faulting lines. Ground failure leads the subsidence of land due to plate movement and may cause the buildings to collapse or tilt and induce landslides. The earthquake causes low number of causalities but the impact due to it is high. Tsunamis. Landslides, dam failures, hazardous material spills and fire etc are the secondary hazards that can cause from earthquake. These secondary hazards due to earthquake may cause more causalities.

Globally, earthquakes result in a loss of about 50,000 lives every year. Earthquakes over 5.5 magnitudes on the Richter scale are progressively damaging to property and human life. However, there are many other factors that influences the damage pattern. Massive earthquakes generally occur near the junction of two tectonic plates, e.g., along the Himalayan range, where the Indian plate goes below Eurasian plate. The Indian sub- continent situated on the boundaries of two continental plates is very prone to earthquakes. Some of the most intense earthquakes of the world have occurred in India. Fortunately, none of these have occurred in any of the major cities. According to latest seismic zoning map brought out by the Bureau of Indian Standard (BIS), over 65 percent of the country is prone to earthquake of intensity Modified Mercalli Intensity Scale (MSK) VII or more.

Causes of earthquake:

The earthquake may be caused due to various reasons, depending upon it intensity. Following causes of earthquake are important:

1. Earthquakes due to superficial movements:

The feeble earthquakes are caused due to superficial movements.i.e, dynamic agencies, and operation upon surface of the earth.

The dashing waves cause vibrations along the seashore.

Water descending along high water falls, impinges the valley floor and causes vibrations along the neighboring areas.

At high altitudes the snow falling down is an avalanche also causes vibrations along the neighboring areas.

2. Earthquake due to volcanic eruptions:

Most of the volcanoes erupt quietly and as consequence, initiate no vibration on the adjoining area. But a few of them when erupt, cause feeble tremors in the surface of the earth. But there may be still a volcanic eruption may cause a severe vibration on the adjoining area and have really disastrous effects.

3. Earthquake due to folding or faulting:

The earthquakes are also caused due to folding of the layers of the earth's crust. If the earthquakes are caused due to folding or faulting then such earthquakes are more disastrous and are known as tectonic earthquakes and directly or indirectly change the structural features of the earth crust.

Classification of earthquakes:

Earthquakes are classified on a no. of basis. Of these the depth of focus, the cause of origin and intensity are important.

a) Depth of focus:

Three classes of earthquakes are recognized on this basis, shallow, intermediate and deep seated. In the shallow earthquakes the depth of focus lies anywhere up to 70 km below the surface. The intermediate earthquakes originate between 70 and 300 km depth below the surface and deep seated earthquake the depth of focus lies between 300-700 km.

b) Cause of origin:

Tectonic earthquake- These are originated when the plates move against to one another. This movement can create stress that causes the earth exterior shell, the lithosphere to shift or break. This is caused by faulting or folding of the crust.

i) **Non tectonic earthquakes**: These are of three reasons, surface causes, volcanic causes and collapse of cavity roofs.

Surface Causes – Perceptable variation may set up by

i. The dashing waves and crashing breakers along the sea shore
ii. Rock fall and avalanches mountain, large land slides etc
iii. These are also due to man made reasons e.g, nuclear testing, blasts, construction of large dams, deforestation etc

Volcanic Causes

Volcanic earthquakes occur around active volcanoes mainly due to explosive eruption and also due to hydraulic shock of magma that forcefully fills the underground chambers and channels.

collapse of cavity roofs

These are small earth quakes originated in underground caverns and mines

C) Intensity as basis:

Based on the magnitude or intensity of earthquake it is divided into the following categories

1 Based on Rossi- Forrels Scale

2 Mercalli Scale

3 Richter Scale

Out of which Richter scale is important. It measures the total amount of energy released by an earthquake independent of intensity. Amplitude of the largest wave in an event is corrected for distance and assigned a value on an open ended logarithmic scale.

Class	Magnitude
Great	8 or more
Major	7 – 7.9
Strong	6 – 6.9
Moderate	5 – 5.9
Light	4 – 4.9
Minor	3 -3.9

Landslides

A landslide is the movement of rock, earth, or debris down a sloped section of land. Landslides are caused by rain, earthquakes, volcanoes, or other factors that make the slope unstable.

Geologists, scientists who study the physical formations of the Earth, sometimes describe landslides as one type of mass wasting. A mass wasting is any downward movement in which the Earth's surface is worn away. Other types of mass wasting include rockfalls and the flow of shore deposits called alluvium.

Near populated areas, landslides present major hazards to people and property. Landslides cause an estimated 25 to 50 deaths and $3.5 billion in damage each year in the United States.

Causes of landslides

Landslides have three major causes: geology, morphology, and human activity.

Geology refers to characteristics of the material itself. The earth or rock might be weak or fractured, or different layers may have different strengths and stiffness.

Morphology refers to the structure of the land. For example, slopes that lose their vegetation to fire or drought are more vulnerable to landslides. Vegetation holds soil in place, and without the root systems of trees, bushes, and other plants, the land is more likely to slide away.

A classic morphological cause of landslides is erosion, or weakening of earth due to water. In April 1983, the town of Thistle, Utah, experienced a devastating landslide brought on by heavy rains and rapidly melting snow. A mass of earth eventually totaling 305 meters wide, 61 meters thick, and 1.6 kilometers long (1,000 feet wide, 200 feet thick, and one mile long) slid across the nearby Spanish Fork River, damming it and severing railroad and highway lines.

Human activity, such as agriculture and construction, can increase the risk of a landslide. Irrigation, deforestation, excavation, and water leakage are some of the common activities that can help destabilize, or weaken, a slope.

Types of landslides

There are many ways to describe a landslide. The nature of a landslide's movement and the type of material involved are two of the most common.

Landslide Movement

There are several ways of describing how a landslide moves. These include falls, topples, translational slides, lateral spreads, and flows.

In falls and topples, heavy blocks of material fall after separating from a very steep slope or cliff. Boulders tumbling down a slope would be a fall or topple.

In translational slides, surface material is separated from the more stable underlying layer of a slope. An earthquake may shake the loosen top layer of soil from the harder earth beneath in this type of landslide.

A lateral spread or flow is the movement of material sideways, or laterally. This happens when a powerful force, such as an earthquake, makes the ground move quickly, like a liquid.

Landslide Material

A landslide can involve rock, soil, vegetation, water, or some combination of all these. A landslide caused by a volcano can also contain hot volcanic ash and lava from the eruption. A landslide high in the mountains may have snow and snowmelt.

Volcanic landslides, also called lahars, are among the most devastating type of landslides. The largest landslide in recorded history took place after the 1980 eruption of Mount St. Helens in the U.S. state of Washington. The resulting flow of ash, rock, soil, vegetation and water, with a volume of about 2.9 cubic kilometers (0.7 cubic miles), covered an area of 62 square kilometers (24 square miles).

Other Factors

Another factor that might be important for describing landslides is the speed of the movement. Some landslides move at many meters per second, while others creep along at

an centimeter or two a year. The amount of water, ice, or air in the earth should also be considered. Some landslides include emission of toxic gases from deep in the Earth expelled by volcanoes. Some landslides, called mudslides, contain a high amount of water and move very quickly. Complex landslides consist of a combination of different material or movement types.

Flood

A flood is an overflow of water on normally dry ground. This is most commonly due to an overflowing river, a dam break, snowmelt, or heavy rainfall. Less commonly happening are tsunamis, storm surge, or coastal flooding. It causes areas submerged with water for prolonged or short period of time.

The Ganga and Brahmaputra rivers causes the largest floods in India.There are a number of reasons why Assam experiences dangerous levels of flooding year-on-year, but at the heart of the issue is the unpredictable Brahmaputra River that cuts across the state. The most deadly flooding was in 1931 in China and killed between 2,000,000 and 4,000,000 people. The Kerala flood in India (August 2018) was another one has destroyed people's houses. During a flood, people try to move themselves and their most precious belongings to higher ground quickly. The process of leaving homes in search of a safe place is called flood evacuation.

Causes of flood

1. **Heavy rains**

   The simplest explanation for flooding is heavy rains. No matter where we live we are surrounded by infrastructure and systems designed to move rainwater

into appropriate basins and reservoirs. In most of the cases the infrastructure does its job. But when it rains heavily those systems are overwhelmed and the water doesn't drain quickly as it needs, the drainage systems get blocked and water rises.

2. **Overflowing rivers**

   River flooding can happen when there is debris in the river or dams that block the flow of the water.

3. **Broken dams**

   This is another cause of flooding. Older infrastructure can fail when heavy rains come and water levels rise. When dams break, they unleash torrents of water on unsuspecting households. This is part of what happened when Hurricane Katrina hit New Orleans in 2005.

4. **Storm surge and tsunamis**

   This also cause flooding. Storm surges from hurricanes and other tropical systems can cause sea levels to rise and cover normally dry coastal areas in several feet of water. Tsunamis on the other hand are giant waves caused by earthquakes or underwater volcanic eruptions. As these waves move inland, they build height and can push a lot of water inland in coastal areas.

5. **Channels with steep banks**

   Flooding often occurs when there is fast runoff into lakes, rivers, and other basins. This is often the case with rivers and other channels that feature steep sides.

6. **A lack of vegetation**

   Vegetation can help slow runoff and prevent flooding. When there is a lack of vegetation, there is little to stop water from running off and overflowing river banks and streams.

7. **Melting snow and ice**

   It is another common reason for flooding. When a large amount of snow and/or ice melts quickly, it often doesn't have somewhere to go except low-lying areas.

Classification of flood

Fluvial floods (river floods)

A fluvial, or river flood, occurs when the water level in a river, lake or stream rises and overflows onto the surrounding banks, shores and neighboring land. The water level rise could be due to excessive rain or snowmelt.

The damage from a river flood can be widespread as the overflow affects smaller rivers downstream, which can cause dams and dikes to break and swamp nearby areas..

The severity of a river flood is determined by the duration and intensity (volume) of rainfall in the catchment area of the river. Other factors include soil water saturation due to previous rainfall, and the terrain surrounding the river system. In flatter areas, floodwater tends to rise more slowly and be shallower, and it often remains for days. In hilly or mountainous areas, floods can occur within minutes after a heavy rain, drain very quickly, and cause damage due to debris flow.

To determine the probability of river flooding, we should consider past precipitation, forecasted precipitation, current river levels, and well as soil and terrain conditions.

Pluvial floods (flash floods and surface water)

A pluvial flood occurs when an extreme rainfall event creates a flood independent of an overflowing water body. Yet pluvial flooding can happen in any location, urban or rural; even in areas with no water bodies in the vicinity. There are two common types of pluvial flooding:

- **Surface water floods** occur when an urban drainage system is overwhelmed and water flows out into streets and nearby structures. It occurs gradually, which provides people time to move to safe locations, and the level of water is usually shallow (rarely more than 1 meter deep). It creates no immediate threat to lives but may cause significant economic damage.
- **Flash floods** are characterized by an intense, high velocity torrent of water triggered by torrential rain falling within a short amount of time within the vicinity or on nearby elevated terrain. They can also occur via sudden release of water from an upstream levee or a dam. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurtling debris that is often swept up in the flow.

Coastal flood (storm surge)

Coastal flooding is the inundation of land areas along the coast by seawater. Common causes of coastal flooding are intense windstorm events occurring at the same time as high tide (storm surge), and tsunamis.

Storm surge is created when high winds from a windstorm force water onshore — this is the leading cause of coastal flooding and often the greatest threat associated with a windstorm. The effects increase depending on the tide - windstorms that occur during high tide result in devastating storm surge floods. In this type of flood, water overwhelms low-lying land and often causes devastating loss of life and property.

The severity of a coastal flood is determined by several other factors, including the strength, size, speed, and direction of the windstorm. The onshore and offshore topography also plays an important role. To determine the probability and magnitude of a storm surge, coastal flood models consider this information in addition to data from historical storms that have affected the area.

Drought

It is a natural event of prolonged shortages in the water supply, whether atmospheric (below-average precipitation), surface water or ground water. A drought can last for months or years, or may be declared after as few as 15 days. It can have a substantial impact on the ecosystem and agriculture of the affected region and harm the local economy. It usually happens when an area receives lesser rainfall than expected or in comparison to the normal rainfall level for that area. Hot temperatures can make a drought worse by evaporating moisture from the soil. But droughts don't just happen in hot and dry places.

One way to monitor droughts is from weather satellites in space. For example, satellite data was used to develop a tool that alerts farmers about upcoming flash droughts.

The National Oceanic and Atmospheric Administration, or NOAA, GOES-R (Geostationary Operational Environmental Satellites-R Series) and JPSS (Joint Polar Satellite System) series satellites can capture thermal infrared images of Earth. These images provide information about the amount of heat on Earth's surface. This information can be used to estimate evapotranspiration, which is a measure of how much water is being transferred from the land to the atmosphere through the soil and plants.

By comparing the weekly evapotranspiration data from satellites with the average for the region, scientists can predict whether or not a region is at risk for flash droughts — and give warnings to farmers.

Causes of Drought

1. Land and water temperatures cause drought. As overall temperatures increase more water evaporates and turns to severe weather conditions . Landscapes and crops need more water to survive and overall the demand for water increases.
2. Soil moisture levels also contribute to drought. When soil moisture is depleted there is less evaporation of water to create clouds. Surface temperatures rise, more water is needed and less is available which contributes to a more severe drought.
3. Excessive irrigation is an excellent of people contributing to a drought.
4. If the timing of water doesn't match the agricultural season you may have too much water when you don't need it and too little when you do need it. Proper storage and collection of water is key to counter balancing this cycle and clearly in the scope of human management.

Classification of drought

The climatological community has defined four types of drought:

1) meteorological drought, 2) hydrological drought, 3) agricultural drought, and 4) socioeconomic drought.

Meteorological drought– It happens when dry weather patterns dominate an area. It is the situation when there is a 25% decrease in average rainfall for a given period of time (IMD Pune). This can begin and end rapidly.

Hydrological drought– It occurs when low water supply becomes evident, especially in streams, reservoirs, and groundwater levels, usually after many months of meteorological drought due to depletion of surface water Hydrological drought takes much longer to develop and then recover.

Agricultural drought- Happens when crops become affected. It is the result of soil moisture stress due to imbalance between available soil moisture and evapotranspiration demand of crops.

Socioeconomic drought– It relates the supply and demand of various commodities to drought.

Standardized Precipitation Index (**SPI**) is a widely used index to characterize meteorological drought on a range of timescales. On short timescales, the **SPI** is closely related to soil moisture, while at longer timescales, the **SPI** can be related to groundwater and

reservoir storage.

SPI	SPI category
≥2.00	Extremely wet
1.50–1.99	Severely wet
1.00–1.49	Moderately wet
0–0.99	Mildly wet
–0.99–0	Mild drought
–1.49– –1.00	Moderate drought
–1.99– –1.50	Severe drought
≤–2.00	Extreme drought

Fire

Wildfires occur when vegetated areas are set alight and are particularly common during hot and dry periods. They can occur in forests, grasslands, brush and deserts, and with sufficient wind can rapidly spread.Such fires can cause devastation to forests and other areas of vegetation. If fires approach or occur near towns or cities it often prompts a precautionary evacuation, as the direction fires may take are unpredictable.

The most common causes of fires are lightning strikes, sparks during arid conditions, the eruption of volcanoes, and man-made fires arising from deliberate arson or accidents.

A side-effect of wildfires that also threatens inhabited areas is smoke. Fires create large quantities of smoke, which can be spread far by wind and poses a respiratory hazard.

Satellites can be used to map the extent of a fire by observing the smoke plumes and identifying burn scars. Thermal infrared sensors can detect heat, thereby pinpointing

the exact locations of fires and data acquired through the Charter may be passed on to firefighters on the ground within a matter of hours, providing helpful assistance for their efforts in locating and combating fires.

Causes

Natural- dry climate, volcanic eruptions, lightning

Human activity- open burning, the use of engines or vehicles, dropping burning substances such as cigarettes, or any other human-related activities that can create a spark or a heat source sufficient to ignite a wildfire.

Classification of Fire

- **Surface Fire** - A forest fire may burn primarily as a surface fire, spreading along the ground as the surface litter (senescent leaves and twigs and dry grasses etc) on the forest floor and is engulfed by the spreading flames.
- **Underground Fire** - The fires of low intensity, consuming the organic matter beneath and the surface litter of forest floor are sub-grouped as underground fire. In most of the dense forests a thick mantle of organic matter is find on top of the mineral soil. This fire spreads in by consuming such materials. These fires usually spread entirely underground and burn for some meters below the surface. This fire spreads very slowly and in most of the cases it becomes very hard to detect and control such type of fires. They may continue to burn for months and destroy vegetative cover of the soil. The other terminology for this type of fire is Muck fires.

- **Crown Fire** - A crown fire is one in which the crown of trees and shrubs burn, often sustained by a surface fire. A crown fire is particularly very dangerous in a coniferous forest because resinous material given off burning logs burn furiously. On hill slopes, if the fire starts downhill, it spreads up fast as heated air adjacent to a slope tends to flow up the slope spreading flames along with it. If the fire starts uphill, there is less likelihood of it spreading downwards.
- **Firestorms** - Among the forest fires, the fire spreading most rapidly is the firestorm, which is an intense fire over a large area. As the fire burns, heat rises and air rushes in, causing the fire to grow. More air makes the fire spin violently like a storm. Flames fly out from the base and burning ember spew out the top of the fiery twister, starting smaller fires around it. Temperatures inside these storms can reach around 2,000 degrees Fahrenheit.

Tsunami

It is a series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions (including detonations, landslides, meteorite impacts and other disturbances) above or below water all have the potential to generate a tsunami.Tsunami waves do not resemble normal undersea currents or sea wavesbecause their wavelength is far longer. Rather than appearing as breaking wave, a tsunami may initially resemble a rapidly rising tide. For this reason, it is often referred to as a tidal wave. Tsunamis generally consist of a series of waves, with periods ranging from minutes to hours, arriving in a so-

called wave train". The 2004 Indian Ocean Tsunami was among the deadliest natural disasters in human history, with at least 230,000 people killed or missing in 14 countries bordering the Indian Ocean.

Classification

There are two types of tsunami generation: Local tsunami and Far Field or distant tsunami

Local tsunamis are confined to coasts within a hundred kilometers of the source usually earthquakes and a landslide or a pyroclastics flow. It can reach the shoreline within 2 to 5 minutes.

Far field or distant tsunamis can travel from 1 to 24 hours before reaching the coast. These tsunamis mainly coming from the countries bordering Pacific Ocean like Chile, Alaska in USA and Japan.

In the current scenario of tsunami forecast, India uses the earthquake information (location and magnitude) to provide coastal forecast of expected tsunami arrival times and expected wave amplitudes at beachalong with threat status (warning/alert/watch/no threat) using tsunami scenario database,.

Cyclone

A cyclone is a system of winds rotating counterclockwise in the Northern Hemisphere around a low pressure center. The swirling air rises and cools, creating clouds and precipitation. There are two types of cyclones: middle latitude (mid-latitude) **c**yclones and tropical cyclones. Mid-latitude cyclones are the main cause of winter storms in the middle latitudes. Tropical cyclones are also known as hurricanes.

Middle latitude cyclones- sometimes called extratropical cyclones, form at the polar front when the temperature difference between two air masses is large.

Tropical cyclones have many names. They are called hurricanes in the North Atlantic and eastern Pacific oceans, typhoons in the western Pacific Ocean, tropical cyclones in the Indian Ocean, and willi-willi's in the waters near Australia. By any name, they are the most damaging storms on Earth.

Environmental effects

The effects caused by an earthquake, including surface faulting, tsunamis, soil liquefactions, ground resonance, landslides and ground failure, either directly linked to the earthquake source or provoked by the ground shaking. These are common features produced both in the near and far periods, routinely recorded in recent events and remembered in historical accounts and preserved in the stratigraphic record (paleoearthquakes). Both surface deformation and faulting and shaking-related geological effects (e.g., soil liquefaction, landslides) not only leave permanent imprints in the environment, but also dramatically affect human structures. Moreover, underwater fault ruptures and seismically-triggered landslides can generate tsunami waves.

Earthquake environmental effects are divided into two main types:

Primary effects: Which are the surface expression of the seismogenic source (e.g., surface faulting), normally observed for crustal earthquakes above a given magnitude

Secondary effects: mostly this is the intensity of the ground shaking (e.g., landslides, liquefaction, etc.).

Tsunamis cause the destruction of houses, buildings and other structures. Loss of power, land erosion and contamination of water also arise due to tsunami.

Volcanic eruption also causes the destruction of houses, buildings and other structures, loss of power, land erosion etc. It also causes fire and atmospheric pollution caused due to liberation of toxic gases. Carbon dioxide liberated into the atmosphere causes greenhouse effect.

Flood causes loss of habitat, spreading of diseases, destruction of houses, buildings and other constructions, power loss and household wastes get mixed with fresh water systems and water get contaminate and there will be shortage for drinking water.

Hurricanes and tornadoes could hit hazardous toxic gases which could carried by a thunder storm and destroys top soil and crops.

Psychological Aspects

Disasters can cause a wide range of negative psychological responses. These include psychophysiological effects such as fatigue, gastrointestinal upset, and tics, as well as cognitive signs such as confusion, impaired concentration, and attention deficits. Psychological impacts include emotional signs such as anxiety, depression, and grief. They also include behavioural effects such as sleep and appetite changes, ritualistic behavior, and substance abuse. In most cases, the observed effects are mild and transitory. Few disaster victims require psychiatric diagnosis and most benefit more from a crisis counseling orientation than from a mental health treatment orientation, especially

if their normal social support networks of friends, relatives, neighbors, and coworkers remain largely intact. However, there are population segments requiring special attention and active outreach. These include children, frail elderly, people with pre-existing mental illness, racial and ethnic minorities, and families of those who have died in the disaster. Emergency workers also need attention because they often work long hours without rest, have witnessed horrific sights, and are members of organizations in which discussion of emotional issues may be regarded as a sign of weakness. , the majority of disaster victims engage in adaptive problem focused coping activities to save their own lives and those of their closest associates. In some cases, people even engage in altruistic behaviors that risk their own lives to save the lives of others. There also psychological impacts with long-term adaptive consequences, such as changes in risk perception (beliefs in the likelihood of the occurrence a disaster and its personal consequences for the individual) and increased hazard intrusiveness (frequency of thought and discussion about a hazard). In turn, these beliefs can affect risk area residents' adoption of household hazard adjustments that reduce their vulnerability to future disasters. However, these cognitive impacts of disaster experience do not appear to be large in aggregate, resulting in modest effects on household hazard adjustment.

Economic Impacts of earthquake

The property damage caused by disaster impact creates losses in asset values that can be measured by the cost of repair or replacement . The ultimate economic impact of a disaster depends upon the disposition of the damaged assets. Some of these assets are not replaced, so their loss causes a reduction in consumption (and, thus, a decrease in the

quality of life) or a reduction in investment (and, thus, a decrease in economic productivity). Other assets are replaced—either through in-kind donations (e.g., food and clothing) or commercial purchases.Past and recent earthquake-damages have well established the severity of economic losses and consequences of this event. Earthquakes generate a variety of economic impacts and these impacts adversely affect the economy of the country or state. The economic impact of an earthquake or any natural disaster can be classified as:

(i) losses to immovable assets, (ii) losses to movable assets (iii) economic losses due to business interruption, (iv) public sector economic costs, and (v) household income losses due to death, injury, and job disruption.

The first impact consists of the direct economic losses due to destroyed or severely damaged buildings and other structures (such as power substations). Losses to movable assets consist of economic losses due to damaged or destroyed contents of buildings and other private property. Public sector economic costs accrue because of loss of revenues and increases in expenses for the public sector. Further, economical losses broadly categorized into direct economical-loss and indirect economical loss. The first two impacts, i.e., losses to immovable assets and losses to movable assets are considered as direct loss and the rest three impacts, i.e., economic losses due to business interruption, public sector economic cost and household income losses are considered as indirect economic loss. A natural disaster like an earthquake has an impact on the Government's revenues. Income loss in the affected region can lead to a slump in sales and hence, loss

of revenue from sales tax, the major source of tax revenue of the Government. But, apart from this direct effect, the total impact on revenues depends on how soon the recovery starts as well as the policy stance of the government. A natural disaster is followed by recovery and reconstruction. While income loss in the region because of the direct impact of the earthquake can lead to a loss of revenues in the short run, the construction boom following the disaster can be a source of additional inflows. The amount of property loss from a natural disaster depends critically on the development stage of the affected country. To make comparisons across time and space, researchers measure the size of loss relative to the size of the economy, rather than the absolute amount in the local currency.

It also is important to recognize the financial impacts of recovery on local government. Costs must be incurred for tasks such as damage assessment, emergency demolition, debris removal, infrastructure restoration, and re-planning stricken areas. In addition to these costs, there are decreased revenues due to loss or deferral of sales taxes, business taxes, property taxes, personal income taxes, and user fees.

Political impacts

There is substantial evidence that disaster impacts can cause social activism resulting in political disruption, especially during the seemingly interminable period of disaster recovery. The disaster recovery period is a source of many victim grievances and this creates many opportunities for community conflict. Victims usually attempt to recreate preimpact housing patterns, but it can be problematic for their neighbors if victims attempt to site mobile homes on their own lots while awaiting the reconstruction

of permanent housing. Conflicts arise because such housing usually is considered to be a blight on the neighbourhood and neighbors are afraid the “temporary” housing will become permanent. Neighbours also are pitted against each other when developers attempt to buy up damaged or destroyed properties and build multifamily units on lots previously zoned for single family dwellings. Such rezoning attempts are a major threat to the market value of owner-occupied homes but tend to have less impact on renters because they have less incentive to remain in the neighborhood. There are exceptions to this generalization because some ethnic groups have very close ties to their neighbourhoods, even if they rent rather than own. Attempts to change prevailing patterns of civil governance can arise when individuals sharing a grievance about the handling of the recovery process seek to redress that grievance through collective action.

Existing community groups with an explicit political agenda can expand their membership to increase their strength, whereas community groups without an explicit political agenda can extend their domains to include disaster-related grievances. Alternatively, new groups can emerge to influence local, state, or federal government agencies and legislators to take actions that they support and to terminate actions that they disapprove. Usually, community action groups pressure government to provide additional resources for recovering from disaster impact, but may oppose candidates’ re-elections or even seek to recall some politicians from office.

Health impacts

Natural and man made disasters have the direct and indirect impact on the health of the population, resulting in physical trauma, acute disease and emotional trauma along

with increase in the morbidity and mortality associated with chronic diseases. A public health sector which conducts routine surveillance, good immunization coverage, maintains adequate environmental control is recommended to withstand the increased need following a disaster, while also expecting the health system to be prepared to resist the disaster.

Each year million so people are affected by natural and man made disasters around the world.l999 was an example of the devastation that natural hazards can have on humanity. Tornados, hurricanes, heavy rains, and earth quakes resulted in tens of thousands of deaths and many more affected. Close to a million people have found themselves homeless, economically impacted, or injured because of these disasters.

Different types of disasters result in different patterns of injury and these, in turn, produce variable levels of morbidity and mortality. Generally it is believed that earthquakes and rapid flooding (i.e. tsunamis and flash floods) are capable of producing large numbers of deaths. Earthquakes and high wind events (such as tornados) are capable of producing large numbers of severe injuries requiring intensive care. Every disaster scenario is unique in its own way and presents new and unusual challenges to victims and rescue emergency personnel alike. On one hand, each disaster must be evaluated independently of past events in order to recognise the special features of the situation at hand. In this manner, one avoids the common mistake of preparing for the last disaster situation as opposed to anticipating the next one. On the other hand, certain disaster situations do follow general patterns and develop along similar paths. It is vital to appreciate these subtle patterns in order to provide community planners and allied health professionals with a foundation to design a

comprehensive emergency response plan. Certain disasters lead to certain types of injuries more than others. This can be an important fact to bear in mind when planning an emergency response, taking stock of available medical supplies, or estimating the needs of a community or geographical area.

Social impacts

For anyone who has experienced an earthquake, the experience can be frightening and traumatic. In addition to the movement of the ground, people need to be concerned with collapsing buildings and falling debris, such as flying glass. The majority of the injuries and deaths that occur from earthquakes are due to falling objects and structures. The effects of an earthquake can also cause dangerous landslides, fires, gas line and electric explosions, and floodwaters from collapsing dams. The goal of seismologists is to understand why earthquakes and other seismic activity occur on Earth. This information, when shared with people in earthquake-prone areas, can help decrease the number of deaths and injuries that may occur.

One of the most destructive effects of earthquakes are tsunamis. Tsunamis, giant ocean waves, form after an earthquake has occurred on the ocean floor. If the tsunami crashes into land, it may cause serious destruction. The difficulty with protecting people from tsunamis is that it may come without warning and at an extremely high speed. Once undersea earthquakes occur, the ocean floor rises or sinks. This is when tsunamis may begin to form. Along with this shifting of the ocean floor, there is also a large mass of seawater that may drop or rise. To adjust to the sudden change in sea level, the mass of water moves upward or downward. As it is moving, a series of long, low waves begin to

moves from the point of the epicenter outward. These waves will increase in height as they come closer to the shore. Underwater landslides caused by earthquakes may also form tsunamis.

On land, the focus of an earthquake's destruction is usually buildings and property. Most of the buildings today are built using strict building codes. These codes require that the buildings can withstand the swaying motion of the ground during an earthquake. However, there are buildings with weak walls that may collapse completely during a quake. Extremely tall buildings, like skyscrapers, may sway so violently that they may tip over and cause damage to lower structures nearby. One factor that affects the intensity of an earthquake is the local geology. The type of land that is beneath buildings can determine the way the buildings respond to an earthquake. Buildings on solid ground are more likely to withstand an earthquake than buildings that are constructed on loose soil and rock. Loose rock and soil vibrate as if they were jelly. When buildings are constructed on this type of land, they tend to have an exaggerated motion and to sway violently.

Differential impacts of disaster

Impacts in terms of age

The increasing size of the ageing population worldwide represents an achievement of development and improvements in healthcare, but the combination of more extreme climate events and an ageing population may increase older people’s vulnerability to disasters, especially in low- and middle-income countries. Disasters result in avoidable and disproportionate loss of life and impoverishment among older people, whose

vulnerabilities and capacities are overlooked, even though they have the same rights as other age groups to protection from physical and psychological harm. When Hurricane Katrina struck New Orleans in 2005, 75% of those who died were aged over 60, even though this age group comprised only 16 per cent of the local population. Similarly, in the Japanese tsunami of 2011, 56% of those who died were aged 65 and over, despite this age group comprising just 23% of the population.

Four key factors explain older people's heightened vulnerability in the face of shocks:

• Physical decline that comes with ageing, which can include poor health, mobility, sight and hearing

• Lack of adequate service provision, support and information for older people, both on a daily basis and in emergencies

• Age discrimination, which serves to exclude and isolate older people, and often violates their rights

• High poverty levels among older people, often increased by lack of social protection mechanisms and livelihood opportunities.

This leaves them vulnerable to disaster – for example by increasing their physical decline as they are unable to access services and education, protect their homes and businesses or reduce their exposure, save or access financial services. Older people's physical and social challenges can reduce their capacity to prepare for disasters – for example, they may struggle to stockpile food and water, bring livestock to safety quickly, or travel long distances. Frail and poor older people who live alone, isolated from family

and community support, are more likely to live in poorly constructed houses, which can put them at greater risk. In addition, many frail or housebound older people may be less able or willing to flee their homes (for example, to move to higher ground or evacuation centres when cyclones or floods threaten), due to connection to land and place. Lack of developmental services, and the absence of resilient service systems that can function in the face of disaster and poverty in old age across the world, often leave older people highly vulnerable to disaster.

Older people's contributions

Older people have a lifetime of experience, knowledge and skills that can be useful in understanding local environmental hazards and their impacts and supporting disaster preparedness in their communities. It is therefore vital to recognise older men and women's capacities, and support them to make contributions to all stages of disaster management activities, from risk assessment to operational response and recovery. Older people can also make other important contributions:

• As community elders and traditional knowledge-holders, they may be a valuable source of information on local hazard and risk profiles, and sustainable communitybased mitigation strategies which can be combined with other information sources, such as scientific data to better understand local hazard. For example, older people may recall details about the impact of previous local disasters (and the response effort), highlighting what could be improved. They also have experienced how the community has adapted to climate variability and climate change over time.

• Older people may not be as intensively engaged in day-to-day economic activities as younger people, and so may be able to spend more time on disaster risk reduction activities, while encouraging other community members to get involved. They will also have acquired significant knowledge and skills over their working life which they may wish to contribute.

• Older women in particular can play an important role in supporting family members and grandchildren. In addition to their own protection needs during a crisis, their role as carers of other vulnerable groups also needs to be considered.

Disasters can damage children's physical health. Children may be injured or killed, but they may also suffer from such things as malnutrition caused by disruptions in food supply or diarrheal illness caused by contaminated water. Disasters can cut off access to medical care, even for non-disaster-related illnesses and disasters can cause mental health problems. Not only are disasters themselves stressful and frightening, but children can suffer psychological harm from the damage to their homes and possessions; from migration; from the grief of losing loved ones; from seeing parents or caregivers undergo stress; from neglect and abuse; and from breakdowns in social networks, neighbourhoods, and local economies. Third, disasters can interrupt children's education by displacing families, destroying schools, and pushing children into the labour force to help their families make ends meet in straitened times.

Impacts in terms of gender

Women, girls, boys and men belonging to different age and socio-economic strata have distinct vulnerabilities, and this shapes the way they experience disaster, and also

their ability to recover from it. In countries where gender discrimination is high, women and girls are particularly vulnerable to natural hazards. Not only is the percentage of women and girls who die higher in these countries, but the incidence of gender-based violence—including rape, human trafficking and domestic abuse—is also known to increase exponentially during and after disasters. Most disasters place an undue burden on women and girls who are responsible for unpaid work such as providing care, water and food for households. Women are less likely to know how to swim; they are often restricted from running fast by their clothing; their role as caretakers of children and older people as well as cultural rules restrict them from leaving their homes without the accompaniment of a male relative.

Agricultural work, often performed by women, is especially subject to many types of hazards .Natural disasters affect women more adversely than men in terms of the effect of disasters on the life expectancy at birth. What this means is that natural disasters on average kill more women than men or kill women at a younger age than men, and the more so the stronger the disaster. Yet the extent to which women are more likely to die than men or to die at a younger age from the immediate disaster impact or from postdisaster events depends not only on disaster strength itself but also on the socioeconomic status of women in the affected country. The higher women's status, the smaller is the differential negative effect of natural disasters on female relative to male life expectancy. What this means is that where the socioeconomic status of women is high, men and women will die in roughly equal numbers during and after natural

disasters, whereas when the socioeconomic status of women is low, more women than men die.

Gender-specific capacities of women deriving from their social roles proved to be beneficial for their whole communities during every stage of the disaster cycle. Women's high level of risk awareness, social networking practices, extensive knowledge of their communities, task in managing natural environmental resources and caring abilities makes of them important players of effective risk assessment, early warning, disaster response and recovery actions.

The same destructive forces of disasters also create opportunities for women as agents of change. Disasters can also provide an opportunity to reduce gender disparities. For example, during the recovery period following a disaster, longstanding biases against women can be challenged by programmes that are sensitive to their needs and that involve them as equal partners in recovery work. However, if women and girls are left out of planning for disaster response or risk reduction measures, the special talents, skills and knowledge of 50 percent of the population are not capitalized upon and the needs of the most affected are unlikely to be met.

Impact in terms of caste

The caste system is vital to understand the way it might manifest before, during and after a disaster. In rural India, the geography of a village and the caste system go hand in hand, sometimes intensifying the experience of caste. Upper and middle castes in coastal villages live in elevated areas and own concrete houses and this helps them deal better with disasters. Lower-caste day labourers who live on the edges of villages, in low-

lying areas, have a tougher time recovering from disasters. The way in which different castes inhabit a particular location exacerbates the impact or minimises the impact of the disaster. Scarcity of resources during natural disasters exacerbated the caste fault lines particularly with respect to access to relief. Almost 88% of the Scheduled Castes are poor and face multidimensional vulnerability, according to the 2007 Arjuna sengupta Committee report. Stranded at the bottom of India's agricultural economy, labourers like Sethi are economically the most vulnerable and unable to secure even the minimum standard of living. Unlike any other social group, nearly 63% of Scheduled Castes are wage labourers, according to the National Sample Survey Office's 68th round for 2011-12.

Impacts in terms of class

Research findings reflect a world in which people of low SES are more vulnerable in the face of disasters and are more likely to suffer more serious consequences during impact, from property damage to homelessness to physical and financial impacts. Disasters can contribute to more adversity for people of low SES than for others. People of low SES are more likely to live in homes that are more vulnerable to the impact of disasters than those of people of higher SES. As a result, their experience of a disaster may involve more material losses, less protection from disasters, and perhaps greater damage to or destruction of their homes. Disasters in some cases have been more likely to make low-income people homeless. We need to reduce the risks for poor people by strengthening their capabilities to cope with recurring disasters. The poor are physically vulnerable because they tend to live in hazardous areas, such as gullies or coastal areas

that are predisposed to disaster; and economically vulnerable because disasters devastate their households' natural, physical, and social assets. They are more likely to experience stress, anxiety, isolation, disruption, displacement, depression, and feelings of powerlessness. As the poor being the most affected, there is a strong correlation between disaster and poverty due to the exposure to physical and economic vulnerability. They face greater restrictions in physical abilities, have fewer social contacts, experience more fear about area hazards, and possess inadequate resources for response actions.

In Terms of Disability

Natural and human-induced disasters tend to have a disproportionate impact on people with disabilities. Individuals with disabilities may be greatly affected by natural disasters. Those with physical disabilities can be at risk when evacuating if assistance is not available. Individuals with cognitive impairments may struggle with understanding instructions that must be followed in the event a disaster occurs. Those who are blind, hearing impaired, etc. may have difficulty communicating during the emergency. They are unable to hear danger signals alrms etc. All of these factors can increase the degree of variation of risk in disaster situations with disabled individuals. The most common limitation is that people cannot physically access buildings or transport, as well as access disaster-related services. The exclusion of these individuals is caused in part by the lack of disability-related training provided to emergency planners and disaster relief personnel.

In terms of location

World statistics indicate present and future trends of increasing impacts from natural and human made hazards on life and livelihoods. Hazards events such as earthquake, drought, floods, storms, fires and volcanic eruptions have caused major loss of human life and livelihoods, destruction of economic and social infrastructure and significant environmental damage. Natural disasters such as earthquake , floods and hurricane can wipe out years of urban development by destroying infrastructure and housing by injury or by killing thousands of people. The 2011 Tsunami in Japan is an example for a disaster characterized by an immense loss of lives and property.

Social and economic structure of a society is a major determinant of the vulnerability of the population to the impact of disasters. This explains the variation in the impact of disasters and environmental emergencies all over the world. Most of the economic losses occurred in industrially developed parts of the worlds developing countries in Africa and Asia suffer greater burden of the relative impact of these disasters. Developing nations experience increased risk of devastation , humn and property loss resulting from human and natural disasters.

Areas that do not adapt to natural disaster risk will become poorer over time, as well-to-do residents move away.

If we are considering Indias present situation

- Landslides are very common in the Lower Himalayas.
- The young age of the region's hills result in rock formations, which are susceptible to slippages.

- Rising population and development pressures, particularly from logging and tourism, cause deforestation. The result is denuded hillsides which exacerbate the severity of landslides.
- Parts of the Western Ghats also suffer from low-intensity landslides.
- Extreme precipitation events, such as flash floods and torrential rains, have become increasingly common in central India over the past several decades, coinciding with rising temperatures.
- During summer, the Bay of Bengal is subject to intense heating, giving rise to humid and unstable air masses that produce cyclones.
- Many powerful cyclones, including the 1737 culcutta cyclone the 1970 Bhola Cyclone, the 1991 Bangladesh Cyclone the 1999 Odisha Cyclone, and 2019s Fani in Odisha and Vayu in Gujarat, have led to widespread devastation along parts of the eastern coast of India and neighboring Bangladesh. Widespread death and property destruction are reported every year in exposed Tamil Nadu, and West Bengal.
- India's western coast, bordering the Arabian Sea, experiences cyclones only rarely; these mainly strike Gujarath and, less frequently, Kerala and sometimes Odisha.
- Western Ghats coveringTamilnadu, Karnataka, Kerala , Goa, Maharashtra and Gujarath.The developmental activities taking place in the upper reaches leads to 41% decline in evergreen forests
- **Global trends in disasters**
- **Urban disaster**

- Disasters are the result of the interaction of hazards and vulnerable conditions. When disasters affect cities or urban areas (nonrural contexts) they are referred to as urban disasters.
- The urbanisation of the world's population is accelerating. By 2008 more than 50% of the global population was already became urban. The megatrend of urbanisation will continue with estimates suggesting that by 2050 more than 67% of the world's population will be city dwellers. With the climatic change and conflict posing significant threat to the urban poor, urban population are particularly vulnerable to risks, especially children. In the 21stcentury there is increasing number of people affected by the disasters. The urban poor people who are living in areas more prone to natural hazards. Globally tow third of the world cties with population over five million are partially located in coastal zones that are susceptible for coastal flooding and to the effects of climate change induced sea level rise. Poor people moving into cities are also likely to live in poor neighbourhood located on marginal land in urban areas. From the Indian Ocean tsunami of 2004 to the Pakistan floods of 2010, disasters are affecting significantly more people now than they did 50 years ago. The Center for Research on the Epidemology of Disasters (CRED) maintains an emergency disaster database called EM DAT. An event is categorised as natural disasterif it kills 10 or more people or leaves at least 100 people injured, homeless, displaced or evacuated. According to EMDAT the natural disaster reported each year has been steadily increasing in recent decades from 78 in 1970 to 348 in 2004. These disasters

include droughts, tsunamis, hurricanes, typhoons and floods and have been increasing over the past 25 years. In 1980 there were only about 100 such disasters reported per year but that number has risen to over 300 per year since 2000. The growing population concentrating in the urban areas at the same time the number of disasters is increasing and the number of people affected by the disaster also increasing.

- In the 19th and 20th centuries , disasters disproportionally affected more people in rural areas than urban. Characterised by sparse population living in close proximity to their food sources. Rural areas presented unique challenges which led to the creation of a standard way of providing help to families in need. By handing out food, distributing tents and water to families, providing healthcthe basic needs of families affected and creating sanitation infrastructure, aid organisations were able to meet the impact.
- In some respects living in urban area is easier than in rural. Related to job opportunities, communication, and transportation are generally more developed in urban areas. The physical concentration of population is greater so that the logistics delivery of assistance is often easier. Services and human resources are usually available. Cities have more hospitals and trained staffs. Because of the concentration of both media and political power there is more attention and generally political addressing to the communities will be more in urban areas.
- But the same time the experiencegot from many earthquakes taught us, an urban environment is often complex than rural and brings its own set of challenges. In

particular it is more difficult to identify the beneficiaries within large urban area. Questions around shelter, housing are as much about legal tenure and prevention evictions as about architectural design and construction. Finally the humanitarian response is very difficult in urban areas.

- The 21st century urban disaster will present unique challenges to the traditional approaches to disaster response. The challenge can be categorised into three primary areas:
- 1. From household to neighbourhood— the focus of assistance:
- In the past, aid organizations identified the individual household as the primary unit of intervention based on sparse populations living on discrete land in rural areas. Because each household was mostly self-sufficient in terms of livelihood pattern, food production, housing and sanitation, aid organizations could design their interventions around individual households. In an urban context, there is significantly more integration and interconnectedness of households. Targeting at the household level is rarely possible because few urban households own the land on which they live and fewer still produce enough food for the family. In most urban areas, households do not maintain individual water sources and sanitation outlets but are connected by common water and sewer infrastructure. The 21st century urban disaster presents difficulties in designing aid programs around the individual household. A different neighborhood based approach becomes necessary.

- 2. Urban livelihoods: Urban livelihoods can take on many forms but the primary objective of that livelihood is to earn money to enable the family to purchase those household items most urgently needed. This approach differs significantly from the rural livelihood which revolves around producing sufficient food for the family and selling whatever surplus remains. In an urban context, where families rely on purchasing those items the family needs most, any interruption to a family's ability to earn income can be disastrous. Urban disasters lead to loss of employment and frequently result in price increases for food, water, and essential commodities. The urban family is hit disproportionately hard by disaster because those items the family most needs are increasing in price at the same time when the family has less money to spend on them. The urban poor, particularly migrants, often lack financial social and physical assets (i.e. money, connections and property) to rely upon when there is a reduction of or interruption in income or when a price shock reduces the purchasing power of that income.
- The 21st century challenge will be to better understand and address urban livelihoods with their unique vulnerabilities (to price shocks, supply failures, for instance) and complexities.
- The importance of markets: Urban populations rely almost exclusively on buying whatever goods they need from the market. In an urban setting, markets are integral to survival. Small businesses and shop owners are the drivers of the economy in many cities in developing countries. Aid organizations are increasingly recognizing the significance of supporting markets in the wake of

disaster. In rural contexts following a disaster, many aid organizations distribute food and goods (blankets, water containers, plastic sheeting, etc.) directly to vulnerable families bypassing area markets. In urban contexts markets are more robust and proximate. The 21st century challenge for aid organizations will be how to best utilize area markets in relief programs so that the drivers of economic recovery, small businesses, are supported during the administering of relief and not bypassed. The quicker markets can be restored, the more effective they can become in meeting the recovery needs of disaster-affected families.

- **Pandemics**
- A **pandemic** is an epidemic of an infectious disease that has spread across a large region, for instance multiple continents or worldwide, affecting a substantial number of people. A widespread endemic disease with a stable number of infected people is not a pandemic. Widespread endemic diseases with a stable number of infected people such as recurrences of seasonal influenza are generally excluded as they occur simultaneously in large regions of the globe rather than being spread worldwide.
- Throughout human history, there have been a number of pandemics of diseases such as smallpox and tuberculosis. The most fatal pandemic in recorded history was the Black Death (also known as The Plague), which killed an estimated 75–200 million people in the 14th century. The term was not used yet but was for later pandemics including the 1918 influenza pandemic (Spanish flu).Current pandemics include COVID-19 and HIV/AIDS.

- The WHO previously applied a six-stage classification to describe the process by which a novel influenza virus moves from the first few infections in humans through to a pandemic. It starts when mostly animals are infected with a virus and a few cases where animals infect people, then moves to the stage where the virus begins to be transmitted directly between people and ends with the stage when infections in humans from the virus have spread worldwide.

- **HIV/AIDS**
- HIV is believed to have originated in Africa. AIDS is currently a pandemic in Africa, with infection rates as high as 25% in southern and eastern Africa. In 2006, the HIV prevalence rate among pregnant women in South Africa was 29%. Effective education about safer sexual practices and bloodborne infection precautions training have helped to slow down infection rates in several African countries sponsoring national education programs.

- **COVID-19**

Which was first identified in Wuhan, Hubei province, China, in late December 2019, has caused a cluster of cases of an acute respiratory disease, which is referred to as coronavirus disease 2019 (COVID-19). More than 200 countries and territories have been affected by COVID-19, with major outbreaks occurring in central China, Iran,Western Europe and the United States. On 11 March 2020, the World Health Organization characterized the spread of COVID-19 as a pandemic. As of 22 July 2020, the number of people infected with COVID-19 has reached 15,404,722 worldwide, of whom 9,381,890 have recovered. The death toll is 631,009. It is believed that these

figures are understated as testing did not commence in the initial stages of the outbreak and many people infected by the virus have no or only mild symptoms and may not have been tested. Similarly, the number of recoveries may also be understated as tests are required before cases are officially recognised as recovered, and fatalities are sometimes attributed to other conditions. This was especially the case in large urban areas where a non-trivial number of patients died while in their private residences. It was later discovered that asymptomatic hypoxia due to COVID-19 pulmonary disease may be responsible for many such cases. **Black death**

The Black Death was a devastating global epidemic of bubonic plague that struck Europe and Asia. It was the deadliest pandemic recorded in human history. The Black Death resulted in the deaths of up to 75–200 millionpeople in Eurasia and North Africa. The plague arrived in Europe in October 1347, when 12 ships from the Black Sea docked at the Sicilian port of Messina. Arguably the most infamous plague outbreak was the so-called Black Death, a multi-century pandemic that swept through Asia and Europe. It was believed to start in China in 1334, spreading along trade routes and reaching Europe via Sicilian ports in the late 1340s. The Black Death lingered on for centuries, particularly in cities. Outbreaks included the Great Plague of London (1665-66), in which 70,000 residents died.

The cause of plague wasn't discovered until the most recent global outbreak, which started in China in 1860 and didn't officially end until 1959. The pandemic caused roughly 10 million deaths. The plague was brought to North America in the early 1900s by ships, and thereafter spread to small mammals throughout the United

States.The third plague pandemic was a major bubonic plague pandemic that began in Yunnan, China, in 1855 during the fifth year of the Xianfeng Emperor of the Qing dynasty. This episode of bubonic plague spread to all inhabited continents, and ultimately led to more than 12 million deaths in India and China, with about 10 million killed in India alone. According to the World Health Organization, the pandemic was considered active until 1960, when worldwide casualties dropped to 200 per year.

The 1994 plague in India was an outbreak of bubonic and pneumonic plague in south-central and western India from 26 August to 18 October 1994.[1] 693 suspected cases and 56 deaths were reported from the five affected Indian states as well as the Union Territory of Delhi.

Plague vaccine is a vaccine used against Yersinia Pestis. Dead bacteria have been used since 1890 but are less effective against pneumonic plague so that recently live vaccines of an attenuated type and recombination protein vaccines have been developed to prevent the disease.

Small pox

Smallpox ranks among the most devastating illnesses ever suffered by humankind. After a final outbreak in the United States in 1949, the virus was declared eradicated in 1980 following a successful vaccination program regarded as one of the greatest triumphs of modern medicine.

Smallpox is an acute contagious disease caused by the variola virus. It gets its name from the Latin word for "spotted," referring to the raised, pustular bumps that break out over the face and body of those affected. Historically the virus killed around

30 percent of people who caught it. Those who survived were often left blind, sterile, and with deep pitted scars, or pockmarks, on the skin.

Spread through direct contact with infected people, body fluids, or contaminated objects such as bedding, the disease had two main types. Variola major was the most common form–and most lethal. Variola minor produced a milder disease, which was fatal in less than one percent of cases. Two other, rarer forms also existed: hemorrhagic and malignant. Both invariably resulted in death.

Smallpox is have originated in India or Egypt at least 3,000 years ago. In Europe, smallpox is estimated to have claimed 60 million lives in the 18th century alone. In the 20th century, it killed some 300 million people globally.

- 6th Century – Increased trade with China and Korea introduces smallpox into Japan.
    - 7th Century – Arab expansion spreads smallpox into northern Africa, Spain, and Portugal.
    - 11th Century – Crusades further spread smallpox in Europe.
    - 15th Century – Portuguese occupation introduces smallpox into part of western Africa.
    - 16th Century – European colonization and the African slave trade import smallpox into the Caribbean and Central and South America.
    - 17th Century – European colonization imports smallpox into North America.
    - 18th Century – Exploration by Great Britain introduces smallpox into Australia.

Spanish flu

The Spanish flu pandemic of 1918, the deadliest in history, infected an estimated 500 million people worldwide—about one-third of the planet's population—and killed an estimated 20 million to 50 million victims, including some 675,000 Americans. The 1918 flu was first observed in Europe, the

United States and parts of Asia before swiftly spreading around the world. At the time, there were no effective drugs or vaccines to treat this killer flu strain. Citizens were ordered to wear masks, schools, theaters and businesses were shuttered and bodies piled up in makeshift morgues before the virus ended its deadly global march. The flu virus is highly contagious: When an infected person coughs, sneezes or talks, respiratory droplets are generated and transmitted into the air, and can then can be inhaled by anyone nearby. Additionally, a person who touches something with the virus on it and then touches his or her mouth, eyes or nose can become infected. The Spanish Flu did not originate in spain, though news coverage of it did. During World War I, Spain was a neutral country with a free media that covered the outbreak from the start, first reporting on it in Madrid in late May of 1918. Meanwhile, Allied countries and the Central Powers had wartime censors who covered up news of the flu to keep morale high. Because Spanish news sources were the only ones reporting on the flu, many believed it originated there (the Spanish, meanwhile, believed the virus came from France and called it the “French Flu.”)

was reported at Camp Funston in Fort Riley, Kansas, on March 11, 1918. Some believe infected soldiers spread the disease to other military camps across the country, then brought it overseas. In March 1918, 84,000 American soldiers headed across the Atlantic and were followed by 118,000 more the following month. When the 1918 flu hit, doctors and scientists were unsure what caused it or how to treat it. Unlike today, there were no effective vaccines or antivirals,

drugs that treat the flu. (The first licensed flu vaccine appeared in America in the 1940s. By the following decade, vaccine manufacturers could routinely produce vaccines that would help control and prevent future pandemics.) hospitals in some areas were so overloaded with flu patients that schools, private homes and other buildings had to be converted into makeshift hospitals, some of which were staffed by medical students. Citizens in San Francisco were fined $5—a significant sum at the time—if they were caught in public without masks and charged with disturbing the peace. Citizens in San Francisco were fined $5—a significant sum at the time—if they were caught in public without masks and charged with disturbing the peace. By the summer of 1919, the flu pandemic came to an end, as those that were infected either died or developed immunity.

Officials in some communities imposed quarantines, ordered citizens to wear masks and shut down public places, including schools, churches and theaters. People were advised to avoid shaking hands and to stay indoors, libraries put a halt on lending books and regulations were passed banning. today, influenza vaccines – as well as H. influenzae type b vaccines—are widely available to prevent illness.

Climatic Change

Climate change describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time. It is the change in the pattern of weather, and related changes in oceans, land surfaces and ice sheets, occurring over time scales of decades or longer.

NASA scientists have observed Earth's surface is warming, and many of the warmest years on record have happened in the past 20 years. For example, 20,000 years ago, much of the United States was covered in glaciers. In the United States today, we have a warmer climate and fewer glaciers.

Global climate change refers to the average long-term changes over the entire Earth. These include warming temperatures and changes in precipitation, as well as the effects of Earth's warming, such as:

- Rising sea levels
- Shrinking mountain glaciers
- Ice melting at a faster rate than usual in Greenland, Antarctica and the Arctic
- Changes in flower and plant blooming times.

Earth's climate has constantly been changing — even long before humans came into the picture. However, scientists have observed unusual changes recently. For example, Earth's average temperature has been increasing much more quickly than they would expect over the past 150 years.


Alaska's Muir glacier in August 1941 and August 2004. Significant changes occurred in the 63 years between these two photos.

Some parts of Earth are warming faster than others. But on average, global air temperatures near Earth's surface have gone up about 2 degrees Fahrenheit in the past 100 years. In fact, the past five years have been the warmest five years in centuries.

Many people, including scientists, are concerned about this warming. As Earth's climate continues to warm, the intensity and amount of rainfall during storms such as hurricanes is expected to increase. Droughts and heat waves are also expected to become more intense as the climate warms.

When the whole Earth's temperature changes by one or two degrees, that change can have big impacts on the health of Earth's plants and animals.

Causes of climatic change

There are lots of factors that contribute to Earth's climate. However, scientists agree that Earth has been getting warmer in the past 50 to 100 years due to human activities.

Certain gases in Earth's atmosphere block heat from escaping. Energy from the Sun is the ultimate driver of climate on Earth. The solar energy received by Earth depends on how much the Sun emits and the distance between Earth and the Sun. Part of this sunlight is

reflected directly back to space by the atmosphere, clouds, and land, ice and water surfaces. Aerosols (tiny particles in the atmosphere, some coming from human activities) can increase the reflection of sunlight.

Eventually the solar energy absorbed by Earth is returned to space as infrared (heat) radiation. In the process it interacts with the whole climate system—atmosphere, oceans, land surfaces and ice sheets. The flows of radiation in the atmosphere are very important in determining climate. The main gases that make up the atmosphere, nitrogen and oxygen, do not interact with infrared radiation. However, certain gases present in smaller quantities absorb infrared radiation flowing upwards from Earth's surface and re-radiate it in all directions, including back downwards. By doing this they impede the outward flow of infrared energy from Earth to space. This is called the 'greenhouse effect', and the gases that cause it by interacting with infrared radiation are called greenhouse gases. The most important are water vapour, carbon dioxide (CO_2) and methane.

These gases keep Earth warm like the glass in a greenhouse keeps plants warm.

Global climate varies naturally over time scales from decades to thousands of years and longer. These natural variations can originate in two ways: from internal fluctuations that exchange energy, water and carbon between the atmosphere, oceans, land and ice, and from external influences on the climate system, including variations in the energy received from the sun and the effects of volcanic eruptions.

Human activities — such as burning fuel to power factories, cars and buses — are changing the natural greenhouse. These changes cause the atmosphere to trap more heat than it used to, leading to a warmer Earth.

The combined effects of all these things give us our **global climate**. NASA's Earth observing satellites collect information about how our planet's atmosphere, water and land are changing.

Consequence of climatic variability

Vegetation

A change in the type, distribution and coverage of vegetation may leads to change in the climate. Some changes in climate may result in increased precipitation and warmth, resulting in improved plant growth and the subsequent removal of airborne CO_2. A gradual increase in warmth in a region will lead to earlier flowering and fruiting times, driving a change in the timing of life cycles of dependent organisms. Conversely, cold will cause plant bio-cycles to lag.

Larger, faster or more radical changes, however, may result in vegetation stress, rapid plant loss and desertification in certain circumstances.An example of this occurred during the carboniferous rain forest collpse (CRC), an extinction event 300 million years ago. At this time vast rainforests covered the equatorial region of Europe and America. Climate change devastated these tropical rainforests, abruptly fragmenting the habitat into isolated 'islands' and causing the extinction of many plant and animal species.

Wildlife

One of the most important ways animals can deal with climatic change is migration to warmer or colder regions. On a longer timescale, evolution makes ecosystems including animals better adapted to a new climate. Rapid or large climate change can cause mass extinctions when creatures are stretched too far to be able to adapt.

Humanity

Collapses of past civilizations such as the Mayamay be related to cycles of precipitation, especially drought.Around 70000 years ago the Toba supervolcano eruption created an especially cold period during the ice age, leading to a possible genetic bottle neck in human populations.

Changes in the cryosphere

Glaciers and ice sheets

Glacieries are considered among the most sensitive indicators of a changing climate.Their size is determined by a mass balance between snow input and melt output. As temperatures increase, glaciers retreat unless snow precipitation increases to make up for the additional melt. Glaciers grow and shrink due both to natural variability and external response. Variability in temperature, precipitation and hydrology can strongly determine the evolution of a glacier in a particular season.

Sea level change

25,000 years ago, sea levels were roughly 130 m lower than today. The deglaciation afterwards was characterized by rapid sea level change.

Sea ice

Sea ice plays an important role in Earth's climate as it affects the total amount of sunlight that is reflected away from the Earth.In the past, the Earth's oceans have been almost entirely covered by sea ice on a number of occasions, when the Earth was in a so-called snowball earth state,and completely ice-free in periods of warm climate.When

there is a lot of sea ice present globally, especially in the tropics and subtropics, the climate is sensitive to as the response as ice albedo feedback is very strong.

During the snowball earth period, large glacial ice sheets spanned to Earth's equator, covering nearly its entire surface, and very high albedo created extremely low temperatures, while the accumulation of snow and ice likely removed carbon dioxide through atmospheric decomposition. However, the absence of plant coverto absorb atmospheric CO_2 emitted by volcanoes meant that the greenhouse gas could accumulate in the atmosphere. There was also an absence of exposed silicate rocks, which use CO_2 when they undergo weathering. This created a warming that later melted the ice.

Do's and Don'ts during different disasters

Do's Don'ts for prevention of life and property due to earthquake

Before an Earthquake occurs make sure that you have made the following activities finished

. Train ourselves in basic rescue and first aid functions. For this we can take help from nearest Red Cross Office or PHC.

.All new buildings must be made earthquake resistant by following correct design and construction practices

. All existing buildings must be strengthened by retrofitting of buildings

.Laws must be followed during the construction of buildings

.Follow BIS codes relevant to your area for building standards

If living in seismic zone-

- Place large or heavy objects on lower shelves.
- Store breakable items such as bottled foods, glass etc in low, closed cabinets.
- Hang heavy items such as pictures and mirrors away from beds, settees, and anywhere that people sit.
- Repair defective electrical wiring and leaky gas connections. These are potential fire risks.
- Secure water heaters, LPG cylinders etc., by strapping them to the walls or bolting to the floor.
- Store weed killers, pesticides, and flammable products securely in closed cabinets and on bottom shelves.
- Identify safe places indoors and outdoors
- Know emergency telephone numbers (such as those of doctors, hospitals, the police, etc)

If indoor during earthquake

- DROP to the ground; take COVER by getting under a study table or other piece of furniture; and HOLD ON until the shaking stops. If there is no a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.

- Protect yourself by staying under the lintel of an inner door, in the corner of a room, under a table or even under a bed.
- Stay away from glass, windows, outside doors and walls, and anything that could fall, (such as lighting objects or furniture).
- Stay in bed if you are there when the earthquake strikes. Hold on and protect your head with a pillow, if you are under a heavy lighting object that could fall. In that case, move to the nearest safe place.
- Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported, load bearing doorway.
- Stay inside until the shaking stops and it is safe to go outside. Research has shown that most injuries occur when people inside buildings attempt to move to a different location inside the building or try to leave.

If outdoor

- Do not move from where you are. However, move away from buildings, trees, streetlights, and utility wires.
- If you are in open space, stay there until the shaking stops. The greatest danger exists directly outside buildings; at exits; and alongside exterior walls. Most earthquake-related casualties result from collapsing walls, flying glass, and falling objects.

If in a moving vehicle

- Stop as quickly as safety permits and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and utility wires.
- Proceed once the earthquake has stopped. Avoid roads, bridges, or ramps that might have been damaged by the earthquake.
- **If trapped under debris**
- Do not light a match.
- Do not move or kick up dust.
- Cover your mouth with a handkerchief or clothing.
- Tap on a pipe or wall so rescuers can locate you. Use a whistle if one is available. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust.

Do's & Don'ts during landslides

Do's

- Prepare tour to hilly region according to information given by weather department or news channel.
- Move away from landslide path or downstream valleys quickly without wasting time.
- Keep drains clean
- Inspect drains for - litter, leaves, plastic bags, rubble etc.
- Keep the weep holes open.

- Grow more trees that can hold the soil through roots.
- Identify areas of rock fall and subsidence of buildings, cracks that indicate landslides and move to safer areas. Even muddy river waters indicate landslides.
- Notice such signals and contact the nearest District Head Quarters.
- Listen for unusual sounds such as trees cracking or boulders knocking together.
- Stay alert, awake and active (3A's) during the impact or probability of impact.
- Locate and go to shelters,
- Try to stay with your family and companions.
- Check for injured and trapped persons.
- Mark path of tracking so that you can't be lost in middle of the forest.
- Know how to give signs or how to communicate during emergency time to flying helicopters and rescue team.
- **Don'ts**
- Try to avoid construction and staying in vulnerable areas.
- Do not panic and loose energy by crying.
- Do not touch or walk over loose material and electrical wiring or pole.
- Do not built houses near steep slopes and near drainage path.
- Do not drink contaminated water directly from rivers, springs, wells but rain water if collected directly without is fine.
- Do not move an injured person without rendering first aid unless the casualty is in immediate danger.

Do's & Don'ts during Drought

Do’s:

- Listen to radio, watch TV and read newspapers for warnings, updates and instructions.
- Practice rainwater harvesting.
- Repair and rejuvenate local water bodies before the rainy season.
- Excavate deep pits to help increase groundwater table.
- Participate in water conservation programs.
- Put used domestic water to use by watering grasses and plants.
- Use a bucket instead of a shower for bathing.
- Use wet clothes to clean and scrub floors instead of using running water.
- Construct toilets that need less water for flushing.
- Regularly check tanks, taps, etc. to prevent leakage.
- Reuse water as much as possible.
- Adapt water conservation practices in lifestyle. Follow all state and local restrictions on water use, even if you have a private well (groundwater levels are affected by drought too).
- Encouragement of afforestation with subabul, seemaruba, casurina, and eucalyptus.
- Promotion of bio diesel plantations like jetropha and pongomia.
- **Don’ts**

- Do not waste water at all.
- Do not cut trees and forests.
- Do not waste rainwater collected on rooftops, etc.
- Do not mess with traditional water sources such as ponds, anicuts, well, tanks, etc.

Do's & Don'ts during Fire

- Know your building’s evacuation plan.
- Evacuate calmly and quickly whenever a fire alarm or carbon monoxide alarm sounds.
- Keep important items such as medications and medical equipment handy for quick access in the event of a building evacuation.
- Know two ways out of any building.
- Before opening a door, feel it with the back of your hand. If the door is hot, do not open it.
- If you encounter smoke during your evacuation, stay low to the floor.
- Know the outside rally point for your building.
- Ensure that smoke and carbon monoxide alarms have batteries. Change the batteries when you set your clocks back or forward.
- Test smoke and carbon monoxide alarms regularly.
- Make sure that hallways and stairway doors close tightly.
- Know the locations of fire extinguishers, fire alarm pull stations, and exits.

- Learn to use a fire extinguisher.
- Extinguish barbecue coals completely.
- Leave candles, incense, barbecue grills or other open flames unattended.
- Use halogen lamps near curtains or other combustibles.
- Leave cooking appliances unattended.
- Avoid tampering with smoke detectors, carbon monoxide alarms, fire alarms or sprinkler systems.
- Do not Ignore any building alarm.
- Don’t Hang anything from sprinkler heads or pipes.
- Avoid using elevators during an evacuation.

Do's & Don'ts during Tsunami

Before and During Tsunami

- Turn on your radio to learn if there is tsunami warning if an earthquake occurs and you are in a coastal area. Be alert for early warning.
- If you are in dangerous area, immediately turn all the water gas and electricity and quickly move to a higher ground.
- Remember once tsunami warning is issued, it could be a matter of minutes, or even seconds, before the wave’s hits.
- If tsunami warning is issued, never go down to the beach to watch the waves come in.

- Listen to the portable radio to learn when its safe to return home.
- Stay away from the beach.
- Learn to understand and notice the sea. If there is noticeable recession in water away from the shore time become caution and move away immediately..
- Move inland to higher ground immediately and stay there.
- What to do after Tsunami
- After the Tsunami has hit, all food and water should be tested for contamination before they are eaten.
- All buildings should be checked for gas leaks and electricity shorts before anyone enters.
- Stay away from flooded and damaged areas until official say it is safe to returns.
- Stay away from debris in the water, it may be safety hazards to boats and people.
- Save yourself not you’re passionate**.**

Do's & Don'ts during Flood

Do’s

- Turn off gas valves fed to appliances, water valves and the electricity on the main fuse box. Be aware that surges of electricity during gas leaks can cause violent ignitions.
- Unplug all electrical items and store them away from floodwaters.
- Move all inhabitants and pets to safe locations, ideally in pet carriers.

- If safely possible, move rugs, furniture and any sentimental or valuable possessions to a drier location. Big appliances may be raised with bricks.
- Enhance airflows to enhance drying.
- Wearing mosquito nets can combat the heightened threat of mosquito-borne diseases.
- Sop up and extract intruding waters when possible.
- To prevent sewage backups, put sandbags in the toilet and obstructions on drain holes.
- Look out for snakes, which often go inside flooded homes.
- Help neighbors when possible but otherwise avoid walking through floodwaters, as something like a manhole opened due to water pressure could make a situation worse.
- Sturdy work boots and gloves can help with submerged and dangerous debris. The most common injury during a flood is cut feet.
- Use a radio and local media for news updates.
- Beware of and watch for structural damages, such as falling walls and ceilings. Piercing small holes in sagging ceilings can strategically drain them and prevent collapses.
- Strong ropes and a well equipped First Aid Kit can greatly enhance rescue efforts.
- **Bathe and wash items with clean, preferably safely contained water. Drink only clean water, preferably bottled water. If left without options, boil water for ten minutes before using and drinking.**

Don’ts

- **Don’t eat or drink anything exposed to the likely contaminated floodwaters.**
- **Don’t use potentially contaminated water for washing or food preparations.**
- **Don’t let wet dyes from clothes, books, etc. damage other items and carpets.**
- **Watch out for and don’t approach downed power lines.**
- **Don’t drive through floodwaters. If stuck, exit the car and move to higher ground.**
- **Don’t use open flames in the presence of gas, propane or natural gas. Use flashlights.**
- **Both floating and sinking littered debris and refuse can both complicate rescue efforts and plug outgoing flows.**
- **Don’t be careless in a flooded area at night when it’s much harder to see standing and flowing water. Two feet of moving water is deep enough to sweep away a vehicle and six inches can sweep away an adult.**
- **Touching or approaching wet, plugged-in electronics can lead to electrocution.**
- **Don’t leave doors and windows unlocked when leaving your property due to high incidences of looting.**

Unit 2

Approaches to disaster risk reduction (DRR)

Disaster risk reduction (**DRR**) is a systematic approach to identifying, assessing and reducing the risks of disaster. It aims to reduce socio-economic vulnerabilities to disaster as well as dealing with the environmental and other hazards that trigger them.

Disaster Cycle

The disaster cycle or the disaster life cycle consists of the steps that emergency managers take in planning for and responding to disasters. Each step in the disaster cycle correlates to part of the ongoing cycle. This disaster cycle is used throughout the emergency management community, from the local to the national and international levels.

Phase

The disaster life cycle consists of the steps that emergency managers take in planning for and responding to disasters are known as disaster phases. The National Governor's Association designed a phase of disaster model to help emergency managers prepare for and respond to a disaster known as the 'life cycle' of comprehensive emergency management. The model helps frame issues related to disaster preparedness as well as economic and business recovery after a disaster. Each phase has particular needs, requires distinct tools, strategies, and resources and faces different challenges.

Phases of disaster management cycle

1. Prevention: Activities aimed at trying to prevent future disasters occurring, such as building dykes or a dam to control flood and drought.
2. Mitigation: Mitigation involves steps to reduce vulnerability to disaster impacts such as injuries and loss of life and property. This might involve changes in local building codes to srengthen buildings, revised zoning and land use management; strengthening of public infrastructure; and other efforts to make the community more resilient to disaster event.
3. Preparedness: Activities aimed at trying to prepare communities for a disaster, such as emergency drills or pre-stocking relief items in logistic hubs. Preparedness focuses on

understanding how a disaster might impact the community and how education, outreach and training can build capacity to respond to and recover from a disaster. This may include engaging the busuness community, pre disaster strategic planning and other logistical readiness activities. The disaster preparedness activities guide provides more information on how to better prepare an organization and the business community for a disaster.

4. Response: Activities aimed at understanding needs and responding to them, including rapid assessments, provision of food and non-food items, provision of water, sanitation and hygiene services, and health and shelter interventions. In the immediate hours and days after a disaster, when search-and-rescue activities are critical, it is most often local actors who are first to respond. Information is often patchy and confused, there can be significant damage to infrastructure, and large movements of people.
5. Recovery: Activities aimed at trying to return communities to normal life, such as livelihoods development or formal education. Recovery activities can start when the disaster has stabilised, and the affected population has access to food and water and some form of transitional shelter. This stage is sometimes divided into two: early recovery and medium-term recovery.
6. **Reconstruction**: Activities aimed at rebuilding infrastructure and housing. This can often take years and many activities may also blend back into mitigation, such as retrofitting schools to make them more earthquake resistant.

Culture of safety (Safety culture)

Safety culture is the collection of the beliefs, perceptions and values that employees share in relation to risks within an organisation such as a workplace or community. Safety culture is a part of organizational culture. Studies have found that workplace related disasters are a result of a breakdown in an organization's policies and procedures that were established to deal with safety, and that the breakdown flows from inadequate attention being paid to safety issues. A good safety culture can be promoted by senior management commitment to safety, realistic practices for handling hazards, continuous organisational learning, and care and concern for hazards shared across the workforce.

The Chernobyl disaster highlighted the importance of safety culture and the effect of managerial and human factors on safety performance. The term ‘safety culture’ was first used in INSAG's (1986) ‘Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident’ where safety culture was described as:

"That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

The U.K. Health and Safety Commission developed one of the most commonly used definitions of safety culture: "The product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation’s health and safety management".

The concept of 'safety culture' originally arose in connection with major organisational accidents, where it provides a crucial insight into how multiple organisational barriers against such accidents can be simultaneously ineffective: "With each disaster that

occurs our knowledge of the factors which make organisations vulnerable to failures. It has become clear that such vulnerability does not originate from just ‘human error’, chance environmental factors or technological failures alone may also be a reason. It is the ingrained organisational policies and standards which have repeatedly been shown to reduce the catastrophic impact.

The safety culture of an organization cannot be created or changed overnight. It develops over time as a result of history, work environment, the workforce, health and safety practices, and management leadership.An organization's safety culture is ultimately reflected in the way safety is addressed in its workplaces. In reality an organization's safety management system is not a set of policies and procedures on a bookshelf, but how those policies and procedures are implemented into the workplace, which will be influenced by the safety culture of the organization or workplace.

Community based disaster risk reduction

Communities are the first responders in case of a disaster. Therefore, community-based disaster risk reduction (CBDRR) should be the core of any risk reduction approach. Disaster risk reduction focuses more on reducing underlying risk, encouraging preventive action before a disaster. Disaster risk management, in contrast, focuses on broader aspects of disaster issues, from prevention and mitigation to relief, response, and recovery.

Reasons for Community at the heart of disaster management

Community is at the site of disaster.

Community has a better up to date information about the people and resources available in the area.

There is a traditional established coping mechanism in the areas of recurrent disasters.

Community is to respond quickly in the case of emergency.

Disaster management by rural community

- In rural community a meeting is to be arranged for discussing the disaster management with all the representatives of the neighbouring villages.
- Children are very helpful as young volunteers to inspire their parents to attend such meetings.
- Block development officer and other gov functionaries doctors, nurses, postmen,Talathi, sarpanch, priests etc also should attend.
- All these are made aware about the vulnerable aspects of the some of the hazards like earthquake and cyclone.
- They discuss the issues relating to disaster preparedness, response and prevention and mitigation measures.
- The discussion causes concern in the meeting as the geographical location of some areas carry high risk.
- Against this background the villagers try to get prepared to respond to hazardous situations as and when they occur.
- They then will form village disaster management committee.
- The group discuss a set of names for handling the following activities and responsibilities

- Early warning and communication system to be activated.
- Evacuation and temporary shelter management.
- Search and rescue operation
- Health and first aid operation
- Relief coordination
- Water and sanitation arrangement
- Other activities

The composition of a Village Disaster management committee(VMDC) and Role

The sarpanch, Village representative, school principal, PHC doctor, The gram Sewak, Two ladies of the self help group, One NSS volunteer

Responsibilities of each of the member in VMDC

Early warning and communication- Army base of the dist H. quarters

Evacuation and shelter management- Dsit. Police dpt.

Search and rescue- Fire brigade

Health and first aid- village doctor

Relief coordination- Local NSS

Water and sanitation- Engineer of dist pancahayat

Disaster management team(DMT)

Its role is to provide experts to respond to an emergency

Its members are volunteers who are trained in the basic functional areas that are vital for efficient response**.**

Role and responsibilities of community in Disaster risk reduction

In case of any disaster or emergency, before any government machinery and support reaches or outside help gets, it is the Community which has to respond immediately. As the Community plays the role of First Responder, it is critical that there is adequate awareness and preparedness at the community level especially amongst the most vulnerable set of communities residing in the most vulnerable areas. Therefore, it is important to strengthen community. Community connections are the relationships necessary to develop, implement, and maintain an effective end-to-end early warning system. A multi-hazard warning center can only be successful if the warnings it produces reach individuals at risk and are easy to understand, resulting in appropriate responses. To assure warnings are most effective, the staffs at a center must establish trusted partnerships among international organizations, governmental agencies, community leaders and organizations, businesses, and local citizens prior to issuing a warning. The impacts of the disasters are deeply related with the socio economic conditions, tradition, culture, and climate of the communities. To minimize the damages caused by disasters, various efforts have been taken by government, international communities including donor agencies. Disaster preparedness provides a platform to design effective, realistic and coordinated planning, reduces duplication of efforts and increase the overall effectiveness of National Societies, household and community members disaster preparedness and response efforts. Disaster preparedness activities embedded with risk reduction measures can prevent disaster situations and also result in saving maximum lives and livelihoods during any disaster situation. Enabling the affected population to get back to normalcy within a short time period. Community

preparedness can be thought of as the advance capacity of a community to respond to the consequences of an adverse event by having plans in place so that people know what to do and where to go if a warning is issued or a hazard is observed. This result can be achieved through the development of programs, in which communities establish plans, enhance communications, and heighten awareness among their citizens. Key components of a community preparedness program include

- Raising public awareness and effecting behavioural change in the areas of mitigation and preparedness .
- Devlopment of stable, reliable, and effective warning systems.
- Development of effective messaging for inducing favourable community.
- Response to mitigation, preparedness, and warning communications

Role and responsibilities of Panchayati Raj Institutions in disaster risk management

Disasters like Floods, Cyclones, Droughts and Earthquakes are increasing in India due to environmental degradation, deforestation, increasing population, nuclear explosions and air pollutions, etc. There is also worldwide concern to mitigate the growing incidence of disaster and their toll on human life, property and environment. While the Government has the role to help its people in distress, the people themselves have greater responsibility to withstand together to face such eventualities and help the Government to help themselves in this process, rather fully depending on it. No state-

level administration will be able to meet the requirements of communities, unless communities come forward to solve their own problems.

The PRI is a statutory body elected by the local people through a well defined democratic process with specific responsibilities and duties. The elected members are accountable to the people of the ward, rural community, block and the district.

The PRI, the representative body of the people, is the most appropriate institution from village to the district level in view of its proximity, universal coverage and enlisting people's participation on an institutionalized basis. Their close involvement will go a long way in getting people prepared for countering natural disasters as well as involve them in all possible preventive and protective activities so that the impact of the disasters are mitigated and the people are able to save their lives and property. The PRIs can act as catalysts to social mobilization process and tap the traditional wisdom of the local communities to complement the modern practices in disaster mitigation efforts. The disaster management cycle requires massive efforts in all its aspects like prevention, mitigation, preparedness, response, restoration, rehabilitation reconstruction work. These include addressing situations like lack of coordination at all levels in the restoration and relief work, non-involvement of the people, over dependency on government, inadequate relief and restoration work, lack of awareness among people regarding potential danger of cyclones and other disasters, lack of knowledge on availability of funds and resources etc,. Thus, the entire preparedness with regard to meeting emergencies like cyclone, flood and drought etc., calls for a constructive role and greater commitment on the part of the PRIs.

How PRI bodies can lead

PRI has played a crucial role in mobilizing people in various situations of crisis. It is a fact that it is difficult to pre empty disasters and also to predict their magnitude. But the impact of disasters on people living in vulnerable areas and losses to their property can be minimized by role played by PRIs at the grassroots level. Apart from great organizing skills, it may call for courage and leading from the front.

The PRI members can play a role of leadership in Disaster Management at all stages. Right from the preparatory stage up to the handling of the long term development activities for risk reduction, PRI can lead in several ways. The activities of PRI include:

Pre-Disaster

- Organising awareness campaign and promoting community education on disaster preparedness
- Articulation of community need for developing preparedness plan through community involvement and Panchayat ownership
- Identifying the resource gaps both physical and manpower and replenish the same through capacity building
- Establishing synergy with local agencies including NGOs/ CBOs
- Encouraging people to insure assets and livestock.
- Establishing convergence with local institutional structures created for implementing education, health, livelihood, social justice and so on.
- Activating the DM Plans with the participation of the community

- Formation of Task forces and their capacity building During Disaster

During disaster

- Arranging emergency communication through available resources
- Evacuation to temporary shelter and running relief camps
- Supplementing rescue and relief efforts in coordinating different agencies
- Monitoring of Relief distribution
- Safe disposal of carcass and arranging safe drinking water and sanitation

Post Disaster

- Damage assessment particularly assisting in identifying victims for compensation and its distribution
- Formulating rehabilitation and reconstruction plan of houses and other local infrastructures
- Enforce minimum specification for safe reconstruction
- Supervise and monitor long term reconstruction and mitigation projects
- Mobilising special funds to use disaster resistant construction technology in vulnerable areas.

MODES OF DISASTER MANAGEMENT by PRI

Disaster Management in a broad framework covers all aspects of preventive and protective measures, preparedness and systematic organization of rescue, relief and rehabilitation operations to mitigate the impact of disasters on the human beings and all socio-economic aspects of the disaster-prone areas. The whole process of disaster

management can be divided into three broad phases and each phase has a number of inter-related activities:

I. PreparednesII. Response III. Rehabilitation and reconstruction

I. Preparedness for an eventuality of the occurrence of a disaster helps its mitigation to a large extent. Therefore this is a continuous phase, when a number of activities are in place. These could include awareness generation, identification of vulnerable groups, identification of resources and assets, household preparation, formation of various task forces and their capacity building and developing a disaster management plan etc. This needs a sustained effort on the part of the community.

II. Response Phase - This has two sub-phases; Early-warning and Post-warning.

Early- warning: This phase begins with Early Warning System. In cases where the disasters are predictable, such as Drought, Floods and Cyclone, as soon as there is indication of the on-set of a disaster, early warning is issued to keep people alert. The warnings continue till the actual impact. The interval at which warnings are issued depends on the type of the disaster. In the case of drought, the intervals for warning could be a week to a month but for Floods and Cyclones, it could be just every half-an-hour. Other activities at this phase include preparation for evacuation, arrangements for food and drinking water, medical support and other basic needs and operationalising all communication and warning systems.

Post- warning: This is perhaps the most crucial phase and needs high alertness. The earlier preparedness helps a lot during this phase in reducing risk and damage and taking mitigation actions. This includes activities like Control room management, shelter management, inter-agency coordination, search, rescue and medical aid, public health measures, sanitation and hygiene, damage assessment, relief distribution, disposal of carcass and mobilization of resources and their optimal utilization.

III. Rehabilitation and Reconstruction Phase- After the impact of a natural disaster, particularly those which are devastating in nature leave behind a large scale destruction such as loss of lives, damage to houses and properties, crops, livestock and the physical infrastructure. Thus the activities to be attended in this phase are as follows: Provision of temporary shelters for those who have lost their houses completely, till construction of permanent housing is completed. Providing minimum household utility goods for all those who lost everything. Provision of food and clothing. Making alternate arrangements for drinking water if the existing facility has been completely damaged. Restoration of road, transport, electricity and communication. Salvaging the losses incurred due to damage to the crops and plantations. Arrangements for distribution of seeds, fertilizers and other inputs in initiating the process of agricultural activities. Removing sediments from agricultural fields, irrigation tanks, canals etc. Restoration of health and educational facilities, if the damage is repairable or

making temporary alternative arrangements. Distribution of payments for the dead and compensation for the losses.

Roles and responsibilities of ULBs

The representatives of Urban Local Bodies (ULBs) have to initiate disaster management tasks in the urban areas in the jurisdiction of municipal bodies. Their tasks include: Maintaining of vehicles, sanitary facilities, food, shelter and rest facilities, relief and replacement, personnel and emergency message, contact arrangement and logistic support; Keeping unauthorized persons out of the disaster area in order to prevent looting and decreasing congestion in rescue efforts, and preventing persons from being injured in the wreckage; Handling the dead, as mass disposal poses many problems in disasters; Warning and communicating with the public; Evacuating neighbourhoods; Coordinating with volunteers; Acquiring and allocating unusual resources; Dealing with livestock or family pets that had to be left behind; pay out large amounts of donations;

Controlling emergency vehicle traffic in order to avoid blockage of routes by emergency vehicles; Maintaining hospital wards for emergencies; Checking the hospitals, nursing homes and day care centers that may need assistance; Prioritising utility sources delivery; Enhancing communication that is a recurring challenge in disaster response; Sharing and collecting information on what agencies have responded to and what resources have they dispatched; Determining the resources needed to undertake the counter disaster measures; Sharing information about the location, scope, and character of the disaster and damage; Locating and specifying procedures for obtaining special disaster resources; Sharing information about the state of transportation route facilities,; Generating and sharing

predictions about weather conditions; and Obtaining information on how to deal with specific hazardous chemicals. Thus, ULBs have many specific disaster management tasks to do.

Roles and responsibilities of state and centre stalk holders

Disaster management authorities

1.National management authority-

- **Develop guidelines for community based disaster risk management approaches**
- **Advocate for community based disaster risk management approaches.**
- **Demonstrating innovative strategies for CBDRR by undertaking schemes.**
- **Ensure that disaster management plan prepared for state department provide for community invoiment .**

2.State disaster management authority

- **Issue office order/amend state acts to make provisions for proposed institutional mechanisms.**
- **Develop action plan and templates for CBDRR**
- **Recommends funds to be provided for disaster mitigation and preparedness measures VDMC/LADMC/ULBDMC**
- **Advocate for disaster risk reduction**

3.3.District disaster management authority-

- **Issue office order to panchayat for formation of VDMC**

- **Facilitate the preparation of VDMPs**
- **Advocate for and implement CBDRR measures**
- **Set up community facilitation centers to provide support to the VDMCs for preparation and implementation of VDMPs and the necessarry capacity enhancement**

Government departments

1.State and district level line departments-

- **Work with VDMCs /ULBDMCs to develop standard operating procedures for before , during and after scenarios with respect to disasters**
- **Integrate disaster risk concerns into all activities and ensure that they are implemented in a participatory manner**
- **Support, engage with and provide resources to VDMC/ULBDMC/LADMC to carry out disaster management activities**

2. Training institutions

State DM training institute, state institute of rural development, Red Cross and department training programs-

- **Announce and conduct training programmes for VDMC and DM members at the community level**
- **Develop SATCOM based training programme to reach out to large number of community members**
- **Develop popular training material to be used by local resource persons**

Private Sector

- **Industries and business establishments-**
- **Include DM activities in their CSR plans in consultation with VDMCs**
- **Proactively reduce disaater risks wrt business actvities**

People's representatives/ community level institutions

1.Members of parliament, members of legislative assembly and other elected members-

- **Advocate and provide policy support for CBDRR initiatives**
- **Manage political and administrative issues to ensure the smooth operation**
- **Coordinate with block and district authorities**

2.Schools and management committees-

- **Generate awareness of school communities role in DRR through education programmes.**
- **School level task forces could be issued for rescue, first aid and relief support**
- **Teaching staff can be useful for coordinating work and documentation**
- **School premises could be used for emergency and temporary shelter. Kitchen can also be used to run community kitchens and provide storage for cooking utensils and food items**

3.Public distribution centre

- **Setup special mechanism to ensure that food supplies are not disrupted and discontinues**

4.Pani/Jal Samiti(water committee)

- **Generate awareness about water use and management**
- **Promote equitable distribution of water**
- **Provide water and sanitation support in emergencies**
- **Promote personal hygiene and cleanliness**

5.Primary healthcare and sub centers including ASHA

- **Develop measures for continuity of health services**
- **Provide first aid care and follow-up medical support, establish health camps and prevent epidemics**

6.Anganvadi

- **Provide special care to pregnant and lacting woman**
- **Provide nutrition and health care services to children.**
- **Religious group**
- **Gain skills in emergency rescue**
- **Crowd management in events of mass gathering**
- **Provide premises as relief centers and storage facilities**

7.Woman representative from panchayat

- **Assistant and advise panchayat members on matters related to woman needs , gender justice etc**

8.Media

- **used to give early warnings, evacuation plans and help post-disaster activities.**
- **The media can play a leadership role in changing the mindset of society for making it more proactive rather than reactive.**

- **It also has the responsibility to make the message more valuable and credible for the general public.**

Structural and nonstructural measures of DRR

Structural measures are any physical construction to reduce or avoid possible impacts of hazards, or the application of engineering techniques or technology to achieve hazard resistance and resilience in structures or systems. Non-structural measures are measures not involving physical construction which use knowledge, practice or agreement to reduce disaster risks and impacts, in particular through policies and laws, public awareness raising, training and education.

Common structural measures for disaster risk reduction include dams, flood levies, ocean wave barriers, earthquake-resistant construction and evacuation shelters. Common non-structural measures include building codes, land-use planning laws and their enforcement, research and assessment, information resources and public awareness programmes.

Structural mitigation

Struc**c**tures comprise of engineering and non engineering structures.

Engineering structures

It involves architects, engineers and masons during the planning , designing and construction phases and helps to ensure disaster resistant buildings like

- Locating building in a safe place
- Assessment of forces created by natural hazards
- Planning and analysis of structural measures to resist such forces

- Designing and proper detailing of structural components
- Construction with suitable materials
- Good workmanship under adequate supervision and inspections

Non- engineering structures

Non-engineering structures are buildings which the owners have got constructed by local masons and carpenters. They do not have formal training**.**

Non- structural mitigation techniques

It include the following techniques

- Legal frame work- it provides building codes for built structures to withstand impact of cyclone or earthquakes, cloud bursts, storm surge etc
- Land use planning- it refers to controlling of human activities in hazard prone areas to avoid fatalities and loss. This involves relocation of communities to safer location. This work can be done by passing laws and enforcing them.
- Incentives and and financial frame work-
    1. Gov grants and subsidies helps to persuade commercial and other institutions to include mitigation measures in their building and reconstruction.
    2. Insurance companies offer reduced premiums for buildings that incorporate hazard resistant measures.

3. Banks insist on disaster resistance in new construction , They also help in repair and extension of old buildings

- Training and education- Provides awareness and know how to the government officials who are involved in disaster management. Engineers, architects, masons, supervisors, craftsman, land use planers helps in mitigation
- Public awareness- Prevention technique is more effective in disaster impacts

1. The gov departments and municipalities can prevent disaster impact by conducting selected mitigation activities before a disaster strikes.
2. A dam could control flood water
3. Controlled burning of fire belts could prevents the spread of wild fire
4. Stringent building code imposition can reduce collapse of buildings during an earthquake
5. Proper socio-economic development and active ownership and participation of communities in the disaster management continuation.
6. The development of adequate warning systems where applicable, can also bring positive results in mitigation programs.

Structural and non-structural measures of different types of disasters

SL NO	Type of disaster	Structural measures	Non-structural measures
1	Drought	• Construct irrigation channels • Clean existing ponds and more ponds to be dug • Link sluice gate with ponds • Construct and maintain grain banks on safer places	• Promote and support rain water harvesting • Awareness on judicious use of water resources • Take livestock protection measures • Promote drought resistant crops
2	Earthquake	• Building must conform to earthquake resilient features • Construct buildings by following the laws and standards	Awareness about the laws especially in the earthquake prone areas Policy decision about the construction of structures with due approval from specified authorities Formulate and amend building codes.
3	Fire	• Establish fire stations as per fire safety by laws • Maintain proper fire exits • Compliance with electrical codes to prevent from over heating and ignition from electrical faults • Place and maintain the correct type of fire extinguisher in easily accessible places	Promote usage of fuel blocks during summers to minimise cases of fire Awareness campaign on fire hazards and strategies Maintain fire alarms for detection and warning Obtain and maintain a complete inventory of fire stops Conduct regular fire drills for preparedness
4	flood	• Construct, maintain and protect flood control structures like embankments and ring bunds etc. • Construct dams and levees to be used as temporary storing place to	Well maintained boats to be available at all times Harvest flood friendly crops before the onset of monsoon season Awareness on flood proof habitual planning with long term goal of flood plain zoning and

		reduce the changes of lower plains getting flooded • Construct seed banks and higher ground	rehabilitating all to safer zone
5	Cyclone and high wind speed	• Design and maintenance considerations to be addressed to improve the cyclone preparedness • Improve the existing road network and provide at least one link road in all weather conditions for each village that is accessible during cyclone and flooding time.	Ensure the availability of adequate number of shelters like community centres, schools, places of worship etc which can be used for moving people from vulnerable areas to safer places. Ensure that cyclone resistant features are incorporated in the government housing projects Awareness on various aspects of cyclone Prepare checklist of elements that can be prepared for and learning to mitigate the risks

Institutional process and framework for disaster management

National Institutional Arrangements for Disaster Management

Major national level agencies / committees designated to play a critical role in managing disaster are elaborated in the following section.

Name	Composition	Role
Cabinet Committee on Security. (CCS)	Prime Minister. Minister of Defence. Minister of Finance. Minister of Home Affairs. Minister of	CCS considers issues relating to a disaster when it bears implications from a security point of view Oversee all aspects of preparedness, mitigation and management of chemical, biological, radiological and nuclear (CBRN) emergencies or any disaster

	External affairs	which has security implications. Review risks of CBRN emergencies from time to time, giving directions for measures considered necessary for disaster prevention, mitigation, preparedness and effective response
High Level Committee (HLC)	Minister of Agriculture. Ministers of Home . Ministers of Finance. Vice Chairman of Niti Ayog.	Approve the GOI's financial assistance to the affected State Government from the corpus of the National Disaster Response Fund.
National Crisis Management Committee (NCMC)	Cabinet Secretary as Chairman, Secretaries of all the concerned Ministries /Departments & organizations	Oversee the Command, Control and Coordination of the disaster response. Give direction to the Crisis Management Group as deemed necessary. Gives directions to any Ministry/Department/Organisation for specific action needed for meeting the crisis situation.
Crisis Management Group (CMG)	Central relief commissioner / designated officer, Ministry of Home	Annually review the contingency plans formulated by various Ministries/Departments/Organisations in their respective sectors and measures required for dealing with natural disasters,

	Affairs Senior officers (called nodal officers) from various concerned Ministries Post disaster, the Resident Commissioner of the affected State is also associated.	Coordinate preparedness and relief activities of the Central Ministries and the State Governments. Obtain information from the nodal officers on measures relating to above. The CMG, in the event of a natural disaster, meets frequently to review the relief operations and extend all possible assistance required by the affected States.
National Disaster Management Authority (NDMA)	Prime Minister as Chairperson. Members, not exceeding nine in numbers. To be nominated by the Chairperson	Lay down policies, plans andguidelines for disaster management Coordinate their enforcement and implementation throughout the country. Approve the NDMP and the DM plans of the respective Ministries and Departments of Government of India. General superintendence, direction and control of National Disaster Response Force (NDRF)
National disaster response force (NDRF)	Specially trained Disaster Response Force headed by Director	Provide assistance to the concerned State Government/District Administration in the event of an imminent hazard

	General, NDRF there are 10 battalions from various para military forces	event or in its aftermath.
National Institute of Disaster Management (NIDM)	Union Home Minister Vice Chairman, NDMA 42 Members, which include Secretaries of various nodal Ministries and Departments of Government of India and State Governments and heads of national levels scientific, research and technical organizations, besides eminent scholars, scientists and practitioners.	Human resource development and capacity building for disaster management within the broad policies and guidelines laid down by the NDMA. Design, develop and implement training programmes, Formulate and implement a comprehensive human resource development plan, Provide assistance in national policy formulation, assist other research and training institutes, state governments and other organizations for successfully discharging their responsibilities, Develop educational materials for dissemination Promote awareness generation.

Nodal Central Ministries/Departments- The Ministry of Home Affairs is the nodal ministry for all disasters, except a few specific types of disasters for which the concerned Ministries have the nodal responsibilities for management of the disasters.

Armed Forces- Traditionally, the Armed Forces are called upon to assist the civil administration only when the situation is beyond their coping capacity. In practice, however, the Armed Forces form an important part of the Government's response capacity and are immediate responders in all serious disaster situations. These include providing services for communications, search and rescue operations, health and medical facilities and transportation, especially in the immediate aftermath of a disaster. Airlift, heli-lift and movement of relief assistance and emergency response to neighboring areas primarily fall within the expertise and domain of the Armed Forces. The Armed Forces will participate in imparting training to trainers and DM managers, especially in CBRN aspects, Heli-insertion, high-altitude rescue, waterman ship and training of paramedics.

Central Para Military Forces (CPMFs)

The CPMFs, which, play a key role at the time of immediate response to disasters. Besides contributing to the NDRF, they will develop adequate DM capabilities within their own forces and respond to disasters, whenever they occur in the areas where they are deployed. The local representatives of the CPMFs, wherever they are located, may be co-opted or invited to attend the meetings of the executive committee at the State and District level.

Civil Defence (CD) and Home Guards

The mandate of the Civil Defence (CD) and the Home Guards have been redefined to assign an effective role in the field of disaster management. They will be deployed for community preparedness and public awareness. A group of volunteers, reporting to duty stations in the event of any disaster, will be encouraged.

National Emergency Operation Centre (NEOC) (Control Room)

An Emergency Operations Center (Control Room) exists in the nodal Ministry of Home Affairs, which functions round the clock, to assist the Central relief commissioner / designated officer in the discharge of his duties. A national disaster helpline 1078 is functional in NDMA. The activities of the Control Room include collection and transmission of information concerning natural calamity and relief, keeping close contact with governments of the affected States, interaction with other Central Ministries/Departments/Organizations in connection with relief, maintaining records containing all relevant information relating to action points and contact points in Central Ministries etc. keeping up-to-date details of all concerned officers at the Central and State levels

State Levelinstitutional process and framework

The primary responsibility for DM rests with the States. The institutional mechanism put in place at the Centre, State and District levels will help the States manage disasters in an effective manner. The DM Act, mandates the State Governments, to take measures for preparation of state DM plans, integration of measures for prevention of disasters or mitigation into state development plans, allocation of funds, establishment of early

warning systems and to assist the Central Government and other agencies in various aspects of DM.

State Disaster Management Authority (SDMA)

Section 14 of the Act mandates each State to establish State Disaster Management Authority (SDMA). At the State Level, the State Disaster Management Authority (SDMA), headed by the Chief Minister, lays down policies and plans for disaster management in the State. It is also responsible to coordinate the implementation of the State Disaster Management Plan (SDMP), recommend provision of funds for mitigation and preparedness measures and review the developmental plans of the different departments of the State to ensure integration of prevention, preparedness and mitigation measures. The Chairperson of the SDMA shall, in the case of an emergency, have power to exercise all or any of the powers of the SDMA.

Powers and functions of State Authority.-

1. Subject to the provisions of this Act, a State Authority shall have the responsibility for laying down policies and plans for disaster management in the State.
2. The main roles are

a. lay down the State disaster management policy

b. approve the State Plan in accordance with the guidelines laid down by the National Authority

c. approve the disaster management plans prepared by the departments of the Government of the State

d. lay down guidelines to be followed by the departments of the Government of the State for the purposes of integration of measures for prevention of disasters and mitigation in their development plans and projects and provide necessary technical assistance.

e. coordinate the implementation of the State Plan

f. recommend provision of funds for mitigation and preparedness measures

g. review the development plans of the different departments of the State and ensure that prevention and mitigation measures are integrated therein

h. review the measures being taken for mitigation, capacity building and preparedness by the departments of the Government of the State and issue such guidelines as may be necessary.

State Executive Committee (SEC)

Section 20 of the Act mandates each state to constitute a State Executive Committee to assist the SDMA in the performance of its functions and to coordinate action in accordance with the guidelines laid down by the SDMP and ensure the compliance of directions issued by the State Government State Disaster Response Force (SDRF) . NDMA has been encouraging the States to constitute State Disaster Response Force (SDRF) as a standalone Force on the line of NDRF by selecting personnel from Armed

Police / Home Guards. NDMA has been facilitating the training of SDRF personnel organized by NDRF as per road map prepared jointly by the SDMA and the NDMA. Until now, 16 States have raised SDRF and 2 are in the process of being raised.

State/District Emergency Operation Centre (SEOC)

The SEOC will take stock of the emerging situation and assist the disaster managers in mobilising the respective line department's resources, manpower and expertise along with appropriate delegated authorities for on-scene actions / response.

Early warnings

The term 'early warning' is used in many fields to describe the provision of information on an emerging dangerous circumstances where that information can enable action in advance to reduce the risks involved. Early warning systems exist for natural geophysical and biological hazards, complex socio-political emergencies, industrial hazards, personal health risks and many other related hazards

An Early Warning System (EWS) can be defined as a set of capacities needed to generate and disseminate timely and meaningful warning information of the possible extreme events or disasters (e.g. floods, drought, fire, earthquake and tsunamis) that threatens people‘s lives. The purpose of this information is to enable individuals, communities and organizations threatened to prepare and act appropriately and in sufficient time to reduce the possibility of harm, loss or risk.

Elements of Early warning is the integration of four main elements

1. Risk Knowledge: Risk assessment provides essential information to set priorities for mitigation and prevention strategies and designing early warning systems.

2. Monitoring and Predicting: Systems with monitoring and predicting capabilities provide timely estimates of the potential risk faced by communities, economies and the environment.

3. Disseminating Information: Communication systems are needed for delivering warning messages to the potentially affected locations to alert local and regional governmental agencies. The messages need to be reliable, synthetic and simple to be understood by authorities and public.

4. Response: Coordination, good governance and appropriate action plans are a key point in effective early warning. Likewise, public awareness and education are critical aspects of disaster mitigation. The purpose of early warning systems is to detect, forecast, and when necessary, issue alerts related to impending hazard events

In order to fulfil a risk reduction function, however, early warning needs to be supported by information about the actual and potential risks that a hazard poses, as well as the measures people can take to prepare for and mitigate its adverse impacts. Early warning information needs to be communicated in people friendly manner in such a way that facilitates decision-making and timely action of response organizations and vulnerable groups. Early warning information comes from different meteorological offices (for weather related disasters- flood, cyclone etc.), Ministries of Health (for example, disease outbreaks) and Agriculture (for example, crop forecasts), local and indigenous sources, media sources and increasingly from Internet early warning services.

Need of Early Warning System

Early Warning for disaster reduction is a legitimate matter of public policy at the highest national levels for two main reasons:

- The first oneis public safety, and the protection of human lives.
- The second is the protection of the nation's resource base and productive assets (infrastructure and private property or investments) to ensure longterm development and economic growth.

Conversely, by reducing the impact of disasters, a government avoids the financial –and political- burden of massive rehabilitation costs. Investing in early warning and other measures of disaster reduction is neither simple nor inexpensive, but the benefits of doing so, and the costs of failing to are considerable.

Communication of early warning information.

An effective early warning system needs an effective communication system. Early warning communication systems are made of two main components: - communication infrastructure hardware that must be reliable and robust, especially during the natural disasters and appropriate and effective interactions among the main actors of the early warning process such as the scientific community, stakeholders, decision makers, the public, and the media. Many communication tools are currently available for warning dissemination such as Short Message Service (SMS) (cellular phone text messaging), email, radio, TV, and web service. Information and communication technology (ICT) is a key element in early warning. ICT plays an important role in disaster communication and dissemination of information to organizations in charge of responding to warnings and to the public during and after a disaster.

Community Based Early Warning System

Early warning systems have limitations in terms of saving lives if they are not combined with ―people-centered networks. To be effective, early warning systems must be understandable, trusted by and relevant to the communities that they serve. Warnings will have little value unless they reach the people most at risk, who need to be trained to respond appropriately to an approaching hazard. Community-Based Early Warning Systems (CBEWS) are anchored in the communities and managed by the communities. It is based on a "people-centered" approach that empowers individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner in a bid to reduce the possibility of personal injury, loss of life, damage to property, environment and loss of livelihood. It provides communities, practitioners and organizations involved in disaster risk management with advance information of risks that can be readily translated into prevention, preparedness and response actions. CBEWS helps to reduce economic losses by allowing people to better protect their assets and livelihood. Essential features of community-based early warning systems are:

- All community members especially the vulnerable groups should be involved at all stages of the CBEWS from designing to operating the systems, receiving the warning messages and responding to the warning.
- Measures taken should be based on the needs of everyone in the community including the most vulnerable segments of the community.
- The community members will own the process and system.

- CBEWS measures will enhance the capacity of the community members to deal with their situation.
- Meaningful participation in the decision-making process of EWS.

Early warning systems and policy

For early warning systems to be effective, it is essential that they be integrated into policies for disaster mitigation. Good governance priorities include protecting the public from disasters through the implementation of disaster risk reduction policies. It is clear that natural phenomena cannot be prevented, but their human, socio-economic and environmental impacts can and should be minimized through appropriate measures, including risk and vulnerability reduction strategies, early warning, and appropriate action plans. Most often, these problems are given attention during or immediately after a disaster. Disaster risk reduction measures require long term plans and early warning should be seen as a strategy to effectively reduce the growing vulnerability of communities and assets. The information provided by early warning systems enables authorities and institutions at various levels to immediately and effectively respond to a disaster. It is crucial that local government, local institutions, and communities be involved in the entire policy making process, so they are fully aware and prepared to respond with short and long-term action plans.

Key elements for successful implementation of early warning:

- Understand the most likely threats, likelihood of disasters and their potential consequences. Although natural disasters are not precisely predictable, they are most

often generally foreseeable. In other words, there are many areas where the occurrence of floods is likely; one does not necessarily know exactly when, but one knows they will occur sooner or later. Many natural hazards can be foreseen, or anticipated, from past experience, the analysis of current patterns of land use, or population distribution.

• Establish proper priorities- To allocate scarce resources most wisely, decision makers must rely on the type of analysis above, and make the disaster management choices which have the highest value, in terms of losses avoided. One common approach is to use the expected value criteria; that is, the likelihood of an event multiplied by the potential cost of this event if it occurred. • Developing institutional networks with clear responsibilities- Understanding the nature of natural hazards and related vulnerabilities, for early warning purposes, requires a combination of actors from several areas, such as science and research (including social sciences and cultural aspects), land use planning, environment, finance, development, education, health, energy, communications, transportation, labour and social security as well as national defence.

• Establish or strengthen the legal framework - Just as for any other aspect of public policy, early warning systems, as well as other disaster reduction applications need to be motivated and based within governmental responsibilities, especially since response to disasters may require exceptional executive powers for a specific period of time but its success cannot be accomplished without the benefits of widespread decision making and the participation of many others.

- Developing effective communication strategies- The context of early warning system communications has two aspects,

1. the hardware aspect relates to the maintenance of lifelines, i.e. the necessity to build or strengthen robust hazard-resistant communication systems
2. the software aspect relates to the maintenance of relationships, i.e. the need to establish and maintain effective links and working relationships among the actors involved in the early warning communication chain.

- Securing resources - A substantial amount of resources is needed to ensure monitoring, adequate early warning, concerted disaster reduction, and a return to normal life.

Disaster management agencies in India

National Institute of Disaster Management (NIDM)

- The National Institute of Disaster Management (NIDM) was constituted under an **Act of Parliament** with a vision to play the role of a premier institute for capacity development in India and the region.
- Under the Disaster Management Act 2005, NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management.
- NIDM provides technical support to the state governments through the Disaster Management Centres (DMCs) in the Administrative Training Institutes (ATIs) of the States and Union Territories.

- **NIDM hosts the SAARC Disaster Management Centre (SDMC) and works as its national focal point.**

International Strategy for Disaster Reduction (ISDR)

- Created in December 1999, UNISDR is the secretariat of the **International Strategy for Disaster Reduction (ISDR). India** is one of the participating countries and works closely with the United Nations International Strategy for **Disaster Reduction** (**UNISDR**)
- Its core areas of work includes ensuring disaster risk reduction (DRR) is applied to climate change adaptation, increasing investments for DRR, building disaster-resilient cities, schools and hospitals, and strengthening the international system for DRR.
- UNISDR's vision is based on the three strategic goals of the **Hyogo Framework for Action:** integrating DRR into sustainable development policies and planning, developing and strengthening institutions, mechanisms and capacities to build resilience to hazards, and incorporating risk reduction approaches into emergency preparedness, response, and recovery programmes.

(Include institutional process at central and state level)

Unit3

Inter-relationship between disasters and development

FACTORS AFFECTING VULNERABILITY

Human Factors: The severity of a disaster depends on both the physical nature of the extreme event and the social nature of the human populations affected by the event. A core point here is that different people, even within the same region, have different vulnerability to natural hazards.

(1) Wealth : Wealth is one of the most important human factors in vulnerability. Wealth affects vulnerability in several ways. The poor are less able to afford housing and other infrastructure that can withstand extreme events. They are less able to purchase resources needed for disaster response and are less likely to have insurance policies that can contribute. They are also less likely to have access to medical care. But there are exceptions. For example, some coastal areas contain expensive beachside real estate populated mainly by the rich, leaving the rich more vulnerable to tsunamis, storm surges, and other coastal hazards. Also, the rich tend to lose more money from disasters, simply because they have more valuable property at stake. Eg. Hurricane Katrina (wealthier area, fewer deaths, higher monetary damage); Cyclone Nargis (poorer area, more deaths, less monetary damage).

2. Education : Education is another important factor in hazard impacts. With education, we can learn how to avoid or reduce many impacts. When populations are literate, then written messages can be used to spread word about hazards in general or about specific disasters. Even without literacy, it is possible to educate a population about hazards in order to help it reduce its vulnerability. When populations include professionals trained in

hazards, then these people can help the populations with their hazards preparations and responses.

3. Governance : Governments can advance policies that reduce vulnerability. They can establish agencies tasked with reducing vulnerability, such as NDMA. They can support education and awareness efforts, as well as economic development to reduce poverty. Finally, they can foster social networks and empower individuals and communities to help themselves to prepare for and respond to hazards. Likewise, even without governments, communities can informally engage in many of these governance activities. Often the most vulnerable people are those who are politically marginalized, because these people have less access to key resources and opportunities. Eg. Myanmar government during Cyclone Nargis. This government is isolated from the international community and, thus, was not welcoming to international assistance in the aftermath of the cyclone. Haiti after its 2010 earthquake. Haiti, like Myanmar, is a poor country, but it has positive and close relationships with the international community and thus readily welcomed international assistance in the aftermath of the earthquake. This assistance saved many lives and is helping Haiti rebuild.

4. Technology : The capabilities of the available technology can also play a large role in disasters. Technology can improve our ability to forecast extreme events, withstand the impacts of the events, and recover afterwards. Technology is closely tied to wealth, education, and governance. Wealthier, more educated society's are more likely to have more advanced technology. A society's governance systems play a large role in how - and

how effectively - the available technology is used in a disaster situation. Eg. All the preparations for facing the disaster and response activities in Disaster.

5. Age: Children and the elderly tend to be more vulnerable. They have less physical strength to survive disasters and are often more susceptible to certain diseases. The elderly often also have declining vision and hearing. Children, especially young children, have less education. Finally, both children and the elderly have fewer financial resources and are frequently dependent on others for survival. In order for them to survive a disaster, it is necessary for both them and their caretakers to stay alive and stay together. Eg. 2003 European heat wave. About 40,000 people died in one of the hottest summers ever in Europe. Many of the deaths were elderly people. These people were not able to adapt to the extreme heat and had no one helping them out.

6. Gender : Women are often more vulnerable to natural hazards than men. This is in part because women are more likely to be poor, less educated, and politically marginalized. Women often face additional burdens as caretakers of families. When disaster strikes, women are often the ones tasked with protecting children and the elderly. This leaves them less mobile and more likely to experience harm themselves.

7.Cultural beliefs:

Some cultural beliefs and fatalistic attitudes contribute to a community's vulnerability. In some societies, natural disasters are considered to be acts of God and taken as if there is nothing human beings could do to prevent hazards from turning into disasters. Lack of

faith in the social system and lack of confidence in the ability to manage flood risks manifests itself in resistance to any such change.

8.Livelihoods:

The principal livelihoods of communities living in rural flood plains are mainly farming and fishing. However, recurring floods threaten their stability of their livelihoods owing to the loss of farm products or limited access to the markets for their products in the absence of adequate transport infrastructure. The landless poor, working as hired labourers, particularly during long flood seasons, have trouble finding jobs to meet their basic needs.

Caste: The caste system is vital to understand the way it might manifest before, during and after a disaster. In rural India, the geography of a village and the caste system go hand in hand, sometimes intensifying the experience of caste. Upper and middle castes in coastal villages live in elevated areas and own concrete houses and this helps them deal better with disasters. Lower-caste day labourers who live on the edges of villages, in low-lying areas, have a tougher time recovering from disasters. The way in which different castes inhabit a particular location exacerbates the impact or minimises the impact of the disaster. Scarcity of resources during natural disasters exacerbated the caste fault lines particularly with respect to access to relief. Almost 88% of the Scheduled Castes are poor and face multidimensional vulnerability, according to the 2007 Arjuna sengupta Committee report. Stranded at the bottom of India's agricultural economy, labourers like Sethi are economically the most vulnerable and unable to secure even the minimum

standard of living. Unlike any other social group, nearly 63% of Scheduled Castes are wage labourers, according to the National Sample Survey Office's 68th round for 2011-12.

Dam -embankments constructionand disaster impact

Dam is structure built across a stream, a river, or an estuary to retain water. Dams are built to provide water for human consumption for irrigating arid and semiarid lands, or for use in industrial processes. They are used to increase the amount of water available for generating hydroelectric power, to reduce peak discharge of floodwater created by large storms or heavy snowmelt, or to increase the depth of water in a river in order to improve navigation and allow barges and ships to travel more easily. Dams can also provide a lake for recreational activities such as swimming, boating, and fishing. Many dams are built for more than one purpose; for example, water in a single reservoir can be used for fishing, to generate hydroelectric power, and to support an irrigation system. Water-control structures of this type are often designated multipurpose dams.

Any Dam project if not designed on the sound principles of design after detail investigations in respect of hydrology, geology, seismicity etc., could spell a largescale calamity.Thus these are inherent risk to the project like improper investigation, planning, designing and construction which ultimately lead to human catastrophe. Though through detailed field investigations it has been ensured that the dam is founded on firm foundation, designed for suitable seismic design parameters, yet in view of that uncertain element of "Force Majeure" the eventuality of a disaster cannot be ignored but a rescue plan has to be devised for confronting such an exigency without being caught in the vast

realm of unpreparedness. A disaster is an unwarranted, untoward and emergent situation that culminates into heavy toll of life and property and is a calamity sometimes caused by “Force Majeure” and also by human error. The identification of all types of disaster in any proposed project scenario involves the critical review of the project vis-à-vis the study of historical past incidents/disasters in the similar situations. The evolution of disaster management plan dwells on various aspects such as provision of evacuation paths, setting up of alarms and warning systems, establishing communicating system besides delineating an Emergency Response Organization with an Effective Response System. Keeping in view the grievous affects a disaster can cause on human or animal population, loss of property and environment in and around the areas of impact. Therefore it is essential to assess the possibility of such failures.

An **embankment dam** is a large artificial dam. It is typically created by the placement and compaction of a complex semi-plastic mound of various compositions of soil, sand, clay, or rock.Such a dam is composed of fragmented independent material particles. The friction and interaction of particles binds the particles together into a stable mass rather than by the use of a cementing substance.

The building of a dam and the filling of the reservoir behind it places a new weight on the floor and sides of a valley. The stress of the water increases linearly with its depth. Water also pushes against the upstream face of the dam, a nonrigid structure that under stress behaves semiplastically, and causes greater need for adjustment (flexibility) near the base of the dam than at shallower water levels. Thus the stress level of the dam must be calculated in advance of building to ensure that its break level threshold is not exceeded.

Overtopping or overflow of an embankment dam beyond its spillway capacity will cause its eventual failure. The erosion of the dam's material by overtopping runoff will remove masses of material whose weight holds the dam in place and against the hydraulic forces acting to move the dam. Even a small sustained overtopping flow can remove thousands of tons of overburden soil from the mass of the dam within hours. The removal of this mass unbalances the forces that stabilize the dam against its reservoir as the mass of water still impounded behind the dam presses against the lightened mass of the embankment, made lighter by surface erosion. As the mass of the dam erodes, the force exerted by the reservoir begins to move the entire structure. The embankment, having almost no elastic strength, would begin to break into separate pieces, allowing the impounded reservoir water to flow between them, eroding and removing even more material as it passes through. In the final stages of failure the remaining pieces of the embankment would offer almost no resistance to the flow of the water and continue to fracture into smaller and smaller sections of earth or rock until these would disintegrate into a thick mud soup of earth, rocks and water.

Therefore, safety requirements for the spillway are high, and require it to be capable of containing a maximum flood stage. It is common for its specifications to be written such that it can contain at least a one-hundred-year flood.A number of embankment dam overtopping protection systems were developed around the turn of the third millennium. These techniques include the concrete overtopping protection systems, sheet piles, riprap and gabions, reinforced earth, minimum energy loss weirs, embankment overflow stepped spillways and the precast concrete block protection systems.

Climatic change adaptation

Climate change refers to a change in the state of the climate that can be by changes in the mean or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Global warming and climate change are now well recognised and accepted. The fourth Assessment Report of Intergovernmental Panel on Climate Change (IPCC) takes into account the increase in the global average air and ocean temperatures, precipitation and extreme rainfall, widespread melting of snow and ice, storms/storm surges/ coastal flooding and rising global mean sea level and reports that climate change is expected to increase the frequency and intensity of current extreme weather events and give rise to new vulnerabilities with differential spatial and socio-economic impacts on communities. The unprecedented increase is expected to have severe impacts on the hydrological cycle, water resource, droughts, flood, drinking water, forest and ecosystems, sea level/coastal area, losses of coastal wetlands and mangroves, food security, health and other related areas. The impact would be particularly disastrous for developing countries, including India, and further degrade the resilience of poor, vulnerable communities, which make up between one quarter and one half of the population of the most Indian cities.

Policy responses to climate change

There are two main policy responses to climate change: mitigation and adaptation. Mitigation addresses the root causes, by reducing greenhouse gas emissions, while adaptation seeks to lower the risks posed by the consequences of climatic changes. Both

approaches will be necessary, because even if emissions are dramatically decreased in the next decade, adaptation will still be needed to deal with the global changes that have already been set in motion.

Impact of climate change on India

The key environmental challenges in India have been sharper in the past two decades. Climate change is impacting the natural ecosystems and is expected to have substantial adverse effects in India, mainly on agriculture on which 58 percent of the population depends for livelihood, water storage in the Himalayan glaciers which are the source of major rivers and groundwater recharge, sea-level rise, and threats to a long coastline and habitations. Climate change will also cause increased frequency of extreme events such as floods and droughts. These, in turn, will impact India's food security problems and water security**.**

Adaptingwith the changing climate

Humans have been adapting to their environments throughout history by developing practices, cultures and livelihoods suited to local conditions. Building homes on stilts to protect against monsoon rains and consequent flooding is a good example. However, climate change raises the possibility that existing societies will experience climatic shifts (in temperature, cyclonic storm frequency, flooding and other factors) that previous experience has not prepared them for. Adaptation measures therefore should be planned in advance or put in place spontaneously in response to a local pressure. They include largescale infrastructure changes – such as building walls to protect against sea-level rise or improving the quality of road surfaces to withstand hotter temperatures – as well

behavioral shifts such as individuals using less water, farmers planting different crops and more households and small or marginal enterprises buying insurance against flood and cyclone. If we do not take urgent and immediate action to stop global warming, the damage could become irreversible. The likely impact of climate change and key actions to be undertaken to mitigate the same is described in following matrix.

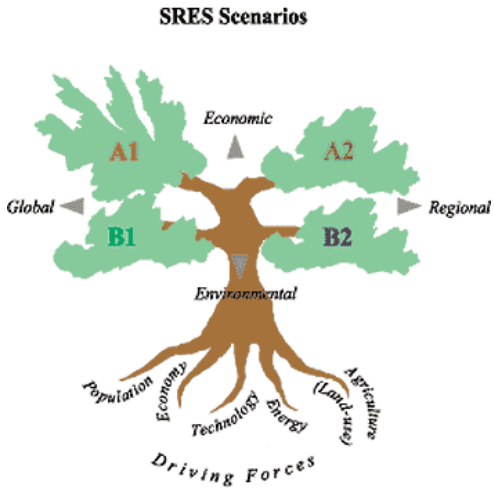
Emission Scenarios

The Intergovernmental Panel on Climate Change (IPCC) decided at its September 1996 plenary session in Mexico City to develop a new set of emissions scenarios. This Special Report on Emission Scenarios (SRES) describes the new scenarios and how they were developed.

The IPCC SRES scenarios contain various driving forces of climate change, including population growth and socio-economic development. These drivers encompass various future scenarios that might influence greenhouse gas (GHG) sources and sinks, such as the energy system and land use change. The evolution of driving forces underlying climate change is highly uncertain. This results in a very wide range of possible emissions paths of greenhouse gases.

The SRES team defined four level storyline labeled A1, A2, B1 and B2, describing the relationships between the forces driving greenhouse gas and aerosol emissions and their evolution during the 21st century for large world regions and globally. Each storyline represents different demographic, social, economic, technological, and environmental developments that diverge in increasingly irreversible ways. By making assumptions on how society will develop, such as how the world population will grow and how world

economies interact, it is possible to estimate the world's future emissions and their effects on the climate. This is known as the Storyline Approach.



A1:Rapid global growth scenario:

The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. A1FI follows a "business as usual" fossil fuel intensive future, A1B is a balanced energy picture, and A1T is a non-fossil fuel future.

A2:Regionalgrowthscenario

The A2 storyline and scenario family describes a very heterogeneous world. The

underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines.

B1:(Global/Environmental)

The B1 storyline and scenario family describes a convergent world with the same global population that peaks in midcentury and declines thereafter, as in the A1 storyline, but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.

3. B2: **(Local/Environmental)**

The B2 storyline focuses on a society that looks for local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population in accordance with the UN prediction, with intermediate levels of economic development, and less rapid technological change compared to the B1 and A1 storylines. It focuses on local and regional solutions to environmental protection and social equity.

Scenarios in Indian Context

India has reasons to be concerned about the impacts of climate change. Its large population depends on climate-sensitive sectors like agriculture and forestry for livelihoods. Any adverse impact on water availability due to recession of glaciers, decrease in rainfall and increased flooding in certain pockets would threaten food security, cause die back of natural ecosystems including species that sustain the livelihoods of rural households, and adversely impact the coastal system due to sea level rise and increased frequency of extreme events. In addition to these impacts, achievement of vital national development goals related to other systems such as habitats, health, energy demand, and infrastructure investments would be adversely affected. India's unique geography produces a spectrum of climates yielding a wealth of biological and cultural diversity. Land areas in the north have a continental climate with high summer temperatures with cold winters when temperatures may go below freezing.

In contrast are the coastal regions of the country where the temperature is more even throughout the year and rains are more frequent. There is large variation in the amounts of rainfall received in different parts of the country. Average annual rainfall is less than 13 cm in the Thar desert, while at Cherrapunji in the North- East it is as high as 1080 cm. The different climate regimes of the country vary from humid in the North-East (about 180 days rainfall in a year) to arid in Rajasthan (20 days rainfall in a year). A semi-arid belt in the peninsular region extends in the area between the humid west coast and the central and eastern parts of the country. The most important feature of India's

climate is the season of concentrated rain called the “monsoon”. The Southwest (SW) monsoon (May - September) is the most important feature of the Indian climate.

India was an early adopter of the climate change adaptation and awareness strategies. During the conference of the signatory states of the United Nations Framework Convention on Climate Change, held in Delhi in 2002, India pushed for a joint declaration on the significance of global warming. The Indian report to the UNFCCC also emphasizes the need to assess vulnerabilities and to plan adaptation measures. In June 2008, India’s prime minister published the National Action Plan on Climate Change (NAPCC), which encompasses both climate protection and adaptation.191 The plan defines eight priorities as National Missions: solar energy; energy efficiency; sustainable housing; water; preservation of ecosystem in the Himalayas; reforestation; sustainable agriculture; and strategic knowledge management. The responsible ministries are currently working on detailed implementation plans for these eight sectors. Adaptation measures are an important part of this integrated climate strategy. The first two areas (solar energy and energy efficiency) are mainly focused on climate protection, while the others include adaptation components, especially in the cases of agriculture and of knowledge management. What follows is a summary of the adaptation goals. This summary shows that the Indian government has already set strategic adaptation priorities. Detailed planning and implementation of the measures is only just beginning.

Adaptation Needs and Priorities

India's geography is highly diverse, comprising the Himalayan mountain range, coastal plains, and the Great Peninsular Plateau. This diverse topography produces a spectrum of climates over the subcontinent. The northern part of the country experiences a continental climate with extreme summer heat and very cool winters; in contrast, the coastal areas of the country experience year-round warm temperatures and frequent precipitation. Rainfall across the country is highly variable, and the country experiences four distinct seasons, described in relation to the monsoon: (a) winter: December to February; (b) pre-monsoon or summer: March to May; (c) southwest monsoon: June to September; and (d) post-monsoon or northeast monsoon: October and November.

The anticipated future impacts of climate change, identified by the Government of India (GOI) in its Initial National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) include:

- Decreased snow cover, affecting snow-fed and glacial systems such as the Ganges and Brahmaputra; 70 per cent of the summer flow of the Ganges comes from snowmelt
- Erratic monsoons with serious effects on rain-fed agriculture, peninsular rivers, water and power supply
- Decline in wheat production by 4-5 million tonnes with as little as a 1ºC rise in temperature
- Rising sea levels causing displacement along one of the most densely populated coastlines in the world and threatening freshwater sources and mangrove ecosystems
- Increased frequency and intensity of floods

- increased vulnerability of people in coastal, arid and semi-arid zones of the country
- Over 50 per cent of India's forests are likely to experience a shift in forest types, adversely impacting associated biodiversity and regional climate dynamics, as well as livelihoods based on forest products.

For the more than 800 million Indians who live in rural areas and depend on climate-sensitive sectors for their livelihoods—agriculture, forests and fisheries—the future looks alarming with the prospect of declining crop yields, degraded lands, water shortages and ill health. According to a 2008 report commissioned by the European Parliament, the majority of the vulnerable population of India is poorly equipped to cope effectively with the adversities of climate change due to low capabilities, weak institutional mechanisms and lack of access to adequate resources

Current Adaptation Action

India's new generation of climate change adaptation projects as per the NAPCC directives and missions are mostly in development at the moment. A number of adaptation focused projects have been launched recently with donor-support or concessional loans. Donors of these projects include the Asian Development Bank, Global Environment Facility (GEF), Rockefeller Foundation, Swiss Development Corporation (SDC), Special Climate Change Fund (SCCF), World Bank, World Wildlife

Fund, United States Agency for International Development (USAID), and Australia's Centre for International Agricultural Research.

The majority of these projects are focused on policy formulation and integration, water, and agriculture, with a smaller number focused on coastal zones, forestry, land and nature. The areas of meteorology, gender, infrastructure, health, and energy only have one ongoing adaptation action.

Additional adaptation projects may be financed through the Climate and Development Fund, which was established by the United Kingdom to provide a flexible source of funding to support shared priorities of the United Kingdom and India between 2008 and 2013. While new plans and programs for adaptation are being developed, many completed or on-going programs (especially water, coastal, agriculture, forests and disaster management sector programs) have strong adaptation components. In 2007, for instance, there were 22 programs in crop management, 19 in drought proofing, 19 in health, six in risk finance, six in disease control,12 in forestry and 30-odd in poverty alleviation in India—all supported by the central and/or state governments. The Government therefore has claimed that India is already spending over two per cent of its GDP on various programs that also support adaptation.

Proposed Adaptation Action

Of the various adaptation initiatives that are being developed in India, two have been presented to the SCCF for funding and programs being developed by SDC.

RELEVANCE OF INDIGENOUS KNOWLEDGE

Indigenous knowledge is often referred to in different terms such as local knowledge, traditional knowledge, peasant's knowledge, traditional environmental knowledge, traditional ecological knowledge, indigenous technical knowledge, endogenous knowledge and folk knowledge.

Indigenous knowledge refers to the methods and practices developed by a group of people from an advanced understanding of the local environment, which has formed over numerous generations of habitation in a certain location. This knowledge differs from other types of knowledge as it originates within the community. It is transferred through informal means of dissemination, is collectively owned, developed over several generations and subject to adaptation, and is embedded in a community's way of life as a means of survival and well-being.

"The traditional and local knowledge that exists and is developed through the experiences of the local community in the process of managing the conditions or context that challenge the people's everyday life".The main characteristics of indigenous knowledge are

- home-grown, derived from the solution of everyday life problems
- part and parcel of a community's cultural practices and ways of life
- often undocumented, passed on orally from one generation to another
- used in solving the immediate problems faced by the community
- dynamic, changing in parallel with events that may be taking place in a society;

Indigenous knowledge is therefore a body of knowledge existing within or acquired by local people over a period of time through accumulation of experiences,

society–nature relationships and community practices and institutions and passed down through generations

IMPORTANCE OF INDIGENOUS KNOWLEDGE

Indigenous knowledge systems present many alternatives to governments, scientists, practitioners and local communities on how they should approach different disasters. For instance, mixed cropping is a form of indigenous knowledge which can be applied to improve the yield of various crops, so that alternative crops are available for consumption if other crops fail. A community that possesses vast indigenous knowledge of disaster risk reduction is able to take care of itself and also able to deal with disasters with minimum external support. Through the use of their indigenous knowledge, people can deal with different kinds of hazards and disasters before the arrival of disaster risk reduction practitioners.

Indigenous knowledge is very important in planning for community development. This shows that indigenous knowledge can be used as a planning tool by local communities. Such knowledge can be used to predict the occurrence of disasters and their impact so that proper interventions are adopted. Developmental strategies cannot be successful without incorporating indigenous knowledge. In communities where indigenous knowledge is not widely used, such communities have continued to suffer severe consequences from natural disasters. Local people have a wealth of experience and understanding pertaining to their local environment. Therefore, they possess incorporating information that can be relied upon to help their communities plan for and

better manage disasters in order to reduce the risk and impact. Their involvement in disaster risk reduction programs is therefore important. It has been observed that disaster-affected people are not hopeless victims, but are citizens who possess certain capacities and important indigenous knowledge that practitioners can use.

Indigenous peoples knowledge provides information and insight that complement conventional science and environmental observations. It can also provide a holistic understanding of the environment, natural resources and culture, and the human interrelation between them. Therefore, ignoring indigenous communities' involvement in the planning stages of programs affecting their lives would likely result in a negative project output and impact. Indigenous knowledge is important in that it can be transferred and adapted to other communities in similar situations.It encourages community participation and empowers communities in reducing disaster risk and can provide invaluable information about the local context.Its non-formal means of dissemination can serve as a model for education about disaster risk reduction.

The value of indigenous knowledge is not limited to communities at risk. I It also brings an invaluable contribution to the field of disaster risk reduction. Disaster risk reduction practitioners, whose knowledge has a bias towards modern technology can benefit immensely from the indigenous knowledge of communities. In order for practitioners to realise the greater benefits of indigenous knowledge, they need to integrate this with scientific knowledge when dealing with hazards and disasters so that the two types of knowledge can complement each other.

According to the UNISDR the Sendai Framework for Disaster Risk Reduction 2015–2030, adopted by the Third United Nations World Conference, advocates for the use of indigenous peoples' knowledge and practices to complement scientific knowledge in disaster risk assessment. The framework recognises that indigenous peoples, through their experience and traditional knowledge, provide an important contribution to the development and implementation of plans and mechanisms, including early warning. Therefore, indigenous knowledge is a vital component of disaster risk reduction.

Limitations of indigenous knowledge for disaster risk reduction intervention

Although the indigenous knowledge of local communities is regarded as an important element for managing disasters, there are some limitations associated with it. One major problem with indigenous knowledge is that it is not wholly trusted by many in the communities, as well as disaster risk reduction practitioners. Scepticism by disaster risk reduction practitioners regarding the use of indigenous knowledge arises as a result of the fact that such knowledge lacks documentation.

Proponents (person who advocate the theory) of indigenous knowledge, including academics, have different views pertaining to the factors that contribute to a lack of trust and belief in the indigenous knowledge of communities argues that the uses of indigenous means of survival have not always proved to be sustainable. This suggests that indigenous knowledge may not always be a right intervention for all hazards and disasters affecting human communities. indigenous knowledge is sometimes accepted uncritically because of naive notions that whatever indigenous people do is naturally in

harmony with the environment. This negativity is especially construed as absolute truth when compared with modern science, where experts claim that its vast knowledge is universal; no one person, authority or social group would claim knowing it all and it has been scientifically proven to be correct.

If anything, local people should be enabled to actively participate in decision-making processes at regional, national and local levels. Their knowledge can provide important insights into the processes of observation, adaptation and mitigation of the consequences of climate change.

Relevance of appropriate technology in disaster management

Science and technology in disaster management

Science and technology help us to understand the mechanism of natural hazards of atmospherical, geological, hydrological, and biological origins which are made up of an orderly system of facts that have been learned from study, experiments, and observations of floods, severe storms, earthquakes, landslides, volcanic eruptions and tsunamis, and their impacts on humankind and his works. The scientific and technological disciplines which are involved include basic and engineering sciences, natural, social and human sciences. They relate to the hazard environment (i.e., hydrology, geology, geophysics, seismology, volcanology, meteorology, and biology), to the built environment (i.e., engineering, architecture, and materials), and to the policy environment (i.e., sociology, humanities, political sciences, and management science).

Application of technology in disaster management

Though it is not possible to completely avoid the natural disasters, but the sufferings can be minimized by creating proper awareness of the likely disasters and its impact by developing a suitable warning system, disaster preparedness and management of disasters through application of information technology tools.

There are mainly applications we can use to manage disasters:

1. **GIS and remote sensing**

GIS provides a tool for effective and efficient storage and manipulation of remotely sensed data and other spatial and non-spatial data types for both scientific management and policy oriented information. This can be used to facilitate measurement, mapping, monitoring and modeling of variety of data types related to natural phenomenon.

The specific GIS application in the field of Risk Assessment are:- Hazard Mapping to show earthquake, landslides, floods or fire hazards. These map could be created for cities, districts or even for the entire country and Tropical Cyclone Threat Maps are used by meteorological departments to improve the quality of the tropical storm warning services and quickly communicate the risk to the people likely to get affected by the cyclone.

Remote sensing makes observation of any object from a distance Remote sensing comprises Aerial Remote Sensing which is the process of recording information, such as photographs and images from sensor on aircrafts and Satellite Remote Sensing which consists of several satellite remote sensing system which can be used to integrate natural

hazard assessments into development planning studies. These are: Land sat, SPOT Satellite, Satellite Radar System, Advanced Very High Resolution Radio.

GIS can also be used in carrying out search and rescue operations in a more effective manner by identifying areas that are disasters prone and zoning them accordingly to risk magnitudes.

2. **Internet**

In the present era of electronic communication, the internet provides a useful platform for disaster mitigation communications. Launching of a well-defined website is a very cost-effective means of making an intra-national and international presence felt. It provides a new and potentially revolutionary option for the rapid, automatic, and global dissemination of disaster information. A number of individuals and groups, including several national meteorological services, are experimenting with the Internet for real-time dissemination of weather observation, forecasts, satellite and other data. In the most critical phase of natural disasters electronic communication have provided the most effective and in some instances perhaps the only means of communication with the outside world.

3. **Warning and forecasting system**

An advance system of forecasting, monitoring and issuing early warnings plays the most significant role in determining whether a natural hazard will assume disastrous proportions or not.

IMD provides cyclone warnings from the Area Cyclone Warning Centers (ACWCs). It has developed the necessary infrastructure to originate and disseminate the cyclone warnings at appropriate levels. It has made operational a satellite based communication system called Cyclone Warning Dissemination System for direct dissemination of cyclone warnings to the cyclone prone coastal areas.

Seismological observations in the country are made through national network of 36 seismic stations operated by the IMD, which is the nodal agency.

These stations have collected data over long periods of time.

Flood forecasts and warnings are issued by the Central Water Commission (CWC), Ministry of Water Resources. These are used for alerting the public and for taking appropriate measures by concerned administrative and state engineering agencies in the flood hazard mitigation. Information is gathered from the CWC's vast network of Forecasting Stations on various rivers in the country.

Relevance of local resources in disaster management

India has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions. Floods, droughts, cyclones, earthquakes and landslides are regular phenomena in India. The multi-hazard scenario depicted in the Vulnerability Atlas of India shows that out of the total geographical area of 32, 87,263 sq. km, about

60% of the landmass is prone to earthquakes of various intensities; over 40 million hectares is prone to floods; about 8% of the total area is prone to cyclones and 68% of the area is susceptible to drought.Over the past two decades, there has been an increase in disaster occurrences costing human and economic losses. This is due to the ever increasing vulnerabilities of people to natural disasters. The need is felt to reduce disaster risks by improving capabilities of people and ensuring preparedness, mitigation and response planning processes at various levels.

The recent disasters and its socio-economic impact on the country at large, and in particular the communities has underscored the need to adopt a multi dimensional approach involving diverse scientific, engineering, financial and social processes to reduce vulnerability in multi-hazard prone areas. In view of this, the Government of India has brought about a paradigm shift in its approach to disaster management. The change is from “relief and emergency response” to a balanced approach covering all phases of the Disaster Management Cycle. This approach acknowledges disaster management as a part of the development process, and investments in mitigation are perceived to be much more cost effective than relief and rehabilitation expenditure. In this regard, Government of India has taken various initiatives in area of disaster preparedness, mitigation and response through networking of various institutions, institutional capacity building, and policy interventions at all level.

Community participation and community ownership in disaster risk reduction is one of the key factors in reducing vulnerabilities of people and minimizing the loss. The

Government of India's focus Community Based Disaster Preparedness (CBDP) approach promotes community involvement and strengthening of their capacities for vulnerability reduction through decentralised planning process. This document deals with the concept, component and some of the best practices in India.

Preparedness by CBDRR

Preparedness to face disasters is required at all levels right from the household to the State Government to minimize the impact of disasters. The Government cannot reach out immediately to each and every household/village at the time of disaster. The community is the first responder of any disaster and develops some traditional coping mechanisms to reduce their vulnerabilities. Such communities living in a common territory comprise of women, men, elders, students, teachers and children. There can be recognized as, resettlement colonies, BPL houses, villages, wards, slums, juggle etc. where people of different social and economic background live together. These people are also responsible for their peace, prosperity, and protection. The involvement of the community is the key factor in any disaster preparedness. The participation of the community is vital to sustain the activities of rebuilding the shattered community life. CommunityBased Disaster Preparedness is: - A response mechanism to save life, livelihood, livestock, and assets with available resources within the community, which should - Lead to multi-pronged development interventions to address the root cause of vulnerability, and to a selfreliant disaster-proof community. In order to generate preparedness and response within the people, Community Based Disaster Preparedness

Plans (CBDP) has to be developed in all the vulnerable areas of Gujarat. A CBDP is a list of activities a community decides to follow to prevent loss of life, livelihoods, and property in case of a disaster. It also identifies well in advance, actions to be taken by individuals in the community so that each one is aware of his/ her responsibilities when an emergency warning is received. The plans involve training to the community to make them aware of disaster preparedness and make them responsible to protect themselves during and post disasters.

Include role of panchayath raj , PHC,(just one para each-)

Land use management and disaster

Managing land use activities is identified as a key aspect to preventing the potential of dislocation, damage and disruption to communities, particularly those persons within the rural area. Under the provisions of the Maranoa Regional Council Regional Planning Scheme certain provisions apply relating to the assessment of development. Such assessment offers a preventative approach to the risks associated within identified 'at risk' areas. Bushfire prone areas - The scheme has overlay areas that apply to natural features such as bushfire prone areas. The scheme identifies bushfire prone areas within maps to enable the operation of construction requirements for Class 1 buildings under the Building Code of Australia. Building matters - Maranoa Regional Council may request information to help in assessing a development application where land is contained in a

natural features and resources overlay. Overlays that are considered relevant to this plan are as follows:

Erosion prone areas • Natural hazard (bushfire prone area) • Landslide • Other overlay assessment (where risks exist). Such measures help prevent the likelihood of land use being incompatible with the risks associated with residential construction.

LUP is both a volunteered collective approach and a local authoritative decision-making process that integrates natural risks and sensitive social concerns into institutional, communal, customary and legal arrangements. The goal is to establish and enforce prohibitions over disaster-prone areas and legal restrictions or alternatives over exercise of land rights. Post-disaster rehabilitation programmes and reconstruction projects should also improve land tenure security by enforcing strict development rules and building standards, in accordance with the assessed level of risks at particular sites. In the context of DRM, LUP must not be reduced to its sole legal and technical components, such as urban planning maps and zoning regulations. Instead, LUP proposes a comprehensive approach that supports DRM by public land and housing policy formulation, land-use allocation, land distribution and titling, transparent investment, implementation of construction standards, social awareness and acceptance based on public participation . LUP also borrows effective methods and concepts from land-use administration, which implies a strong connection to a range of adapted land tenure possibilities allowed by the law, according to an appropriate juridical system such as common law or civil code and concordance with local customary law and socio-cultural practices.In accordance with the Voluntary Guidelines for RSP, the efficiency of preparedness for emergency and

resettlement strategies, and preventive actions, depend on comprehensive public participation and information in an LUP process before a disaster occurs. By participating and expressing its views on a decision-making process, a vulnerable population contributes to its empowerment by becoming risk-aware. Hence, responsible authorities can develop LUP proposals and review spatial plans that will ensure, transparently, that priorities and interests of communities are taken into account if, based on risk assessment, decisions made on restricting land use and resettlement become necessary. Participation for preparedness contrasts with emergency decisions made under pressure without a plan. This could include demolishing damaged buildings, restricting access to contaminated land and relocating affected residents to more viable plots. Public participation is recognized as a proven means to encourage social acceptance and awareness of enforced policies on preventive actions, risky planning, title renewal and alternatives for resettlement (that could also be preventive, not only reactive) (Correa et al., 2011). LUP proposals must also be gender sensitive and adopt a pro-poor approach. LUP could be defined as the collective practice of choosing, for risk reduction, the best location for a particular land use (e.g. residential) and the optimal use for a particular location. A systematic LUP process identifies disaster-prone areas (the risk of natural disaster and the extent of vulnerable social groups), by mapping such areas (the delimited locations) in order to allocate specific uses and enforce legal land-use and construction conditions. It should also identify other areas for appropriate relocation of vulnerable residents. To maximize opportunities for efficient post-disaster recovery and rehabilitation, one must prepare in advance the conditions of resilience among the

populations and institutions . That means that preparedness and foresight are congruent and consistent with local culture, institutional arrangements and physical resources on site. Public authorities can then introduce new laws and regulations in line with social and cultural practices, particularly with respect to housing, livelihoods, tenure and agriculture. LUP strengthens local resilience through public participation in designing socially acceptable solutions. This relates in particular to food, water and energy supply disruption and should be integrated within land-use policies that support recovery of local food production to minimize the consequences of the disaster in the short- and mid-term. As a socio-economic issue, resilience must be addressed, developed and articulated using practical and adaptive principles and policies. Densely populated regions and urban centres are usually not suitable for rapid resettlement and resumption of former activities and LUP must be adapted to such circumstances . By reducing the population in risky areas, urban planning could reduce vulnerability to natural disasters while preserving the most productive land for agriculture. However, by doing so, LUP could be opposed by those with property rights and legal interests in the land, and who claiming compensation for loss in value, benefits, and potential development. However, those living in risky zones could argue against plans to move out because of mispricing the risk (UNISDR, 2015) and the potential financial impacts of a disaster on their assets. These issues should be dealt with using LUP positive externalities (Deininger, 2003), such as decreasing local vulnerability, raising resilience to disaster, reducing damage and placing more emphasis on real value. Concerns about reducing the risks associated with natural disasters are not exclusive to poor regions, although their populations are often more vulnerable.

Generally, however, the at-risk populations of developed countries are well prepared and can recover from disasters relatively rapidly, with fewer casualties, because of strong institutional and financial capabilities (El-Masri and Tipple, 2002). LUP contributes substantially to pre-disaster and post-disaster phases because natural disasters are often closely associated with specific geographical areas (sea coast, steep slopes, desert, wetlands, canyons, faults, storm paths). LUP aims at implementing good governance of occupied land and social and economic development. It should take into account the spatial extension and location of natural disaster risks and numerous potential hazards, as well as the cumulative consequences of disasters according to their land configuration and vulnerability. Examples from Madagascar , Viet Nam , Pacific island countries , and Peru present different DRM cases that strengthened land policies and increased community preparedness for disasters.Good Land Governance (GLG) is recognized as a basis for human development and the creation of sustainable living environments . It can be defined strictly as a continuous political process, concerned with multi-level public decision-making related to land administration and land development. GLG is comprehensive, aiming at coordinating and harmonizing public, community and private interests in land, livelihoods, housing and real estate . Its practice relies on a coordinated approach to land tenure, LUP, land allocation, land valuation and land information systems. GLG concerns spatial distribution of land uses, infrastructure provision, public facilities and networks, economic development, social acceptability, environmental impact assessment, natural risk consideration, public participation, monitoring and readjustment processes. GLG is linked with LUP in that every use, construction, and

facility must be located carefully, trying to minimize future conflicts over use and to reduce risks associated with specific areas . GLG comes under the jurisdiction of numerous levels of public authority because it refers to political decision-making processes for allocating and collectively managing land resources and providing necessary means to plan and enforce policies. It encompasses issues related to urban and rural land development, forests, watercourses, minerals, infrastructures, heritage, and environmental degradation. GLG regards territory as a whole and applies to both private and public lands, irrespective of tenures and geographical scales. GLG requires both political stability and democratic participation . According to the subsidiarity principle of governance, GLG responsibilities are distributed among various public authorities concerned with the issue. While the protection of the territory and environment, the public domain, land policies, legislation and funding all reside in the hands of the state, LUP operations on the ground are decentralized according to circumstances prevailing at the local level. Meanwhile, in order to manage land problems and control land development,government departments and institutional agencies provide services, support and information according to their specific mandates. Even if all are involved in LUP in preparing for disasters, coordination of emergency activities in a post-disaster period must be the responsibility of a single authority. Without central coordination authority, time and resources can be wasted in the aftermath of a disaster because of disorganization and turmoil. LUP is useful for managing public lands, especially in ensuring that resource allocation and exploitation benefits neighbouring communities and does not create unforeseen negative impacts on habitats and the local economy. Because

LUP is a voluntary approach and process it can be adapted according to local customs to prevent land shortages, deforestation or invasive settlement. As a component of GLG, LUP contributes to effective land organization and management by paying close attention to private land-use rights and granting titles. Examples include, attribution to a family or a clan, overlapping of non-conflicting uses, timely restricted seasonal rights of way and control of intensive production to prevent environmental degradation. LUP must also be adaptive, evolving according to new situations that result from, for example, natural disasters and climate change .

Unit 4

Disaster management in India

India's Hazard Profile

India is prone to disasters due to a number of factors; both natural and human-induced, including adverse geo-climatic conditions, topographic features, environmental degradation, population growth, urbanisation, industrialisation, non-scientific development practices etc. Various hazards to which India is prone to can be broadly divided into three categories viz. Hydrological or climate related; Geological and Technological hazards. They have been discussed below:

Hydrological and Climate related Hazards

Floods

Floods can be caused by heavy rainfall, inadequate capacity of rivers to carry the high flood discharge, inadequate drainage to carry away the rainwater quickly to streams or

rivers, ice jams or landslides blocking streams, typhoons and cyclones etc. Flash floods occur because of high rate of water flow particularly in areas with less permeability of soil.

Over 40 million hectare of landmass in India is prone to floods. Nearly 75% of the total annual rainfall is concentrated over a short south-west monsoon season of three to four months from June to September. As a result there is a very heavy discharge from the rivers during this period causing widespread floods. From October to December each year, a very large area of South India, including Tamil Nadu, the coastal regions of Andhra Pradesh and the union territory of Puducherry, receives up to 30 percent of its annual rainfall from the northeast monsoon (or winter monsoon). These have caused devesatiing floods in Chennai in 2015. Most devastating floods in recent times have been the 2013 Assam floods, 2013 Uttarakhand Floods, 2012 Brahamputra Floods etc.

Cyclones

India has a very long coastline which is exposed to tropical cyclones arising in the Bay of Bengal and Arabian Sea. *Indian Ocean is one of the six major cyclone-prone regions in the world.* In India cyclones occur usually in April-May, and also between October and December. The Eastern coastline is more prone to cyclones as about 80 percent of total cyclones generated in the region hit there. The worst hitting cyclones have been the Andhra Pradesh cyclone of November 1977 and the super cyclone of Odisha in the year 1999. The impact of the cyclones is mainly confined to the coastal districts, the maximum destruction being within 100 Km. from the centre of the cyclones and on either side of the storm track. The principal dangers from a cyclone include the gales and strong

winds, torrential rain and high tidal waves (storm surges). Most casualties are caused by coastal inundation by tidal waves and storm surges.

Heat Waves, Cold waves

Heat waves refer to the extreme positive departure from the maximum temperature in summers. The fatalities caused by heat waves have increased in recent years. The problem of heat wave is compounded by a decrease in diurnal temperature Range (DTR). In urban areas, the heat wave is increasing fatalities. Cold waves occur mainly due to the extreme low temperature coupled with incursion of dry cold winds from north-west. Most affected areas of country due to the cold waves include the western and north-western regions and also Bihar, UP directly affected by the western disturbances.

Thunderstorm, Hailstorm, Dust Storm etc

India's central, north-eastern, north-western and northern parts are generally affected by these disasters. The southern coastal areas are less prone to thunderstorms, hailstorms and dust storms. The hailstorms are more frequent in Assam, Uttarakhand and some parts of Maharashtra. Dust storms are common in Rajasthan, MP and Haryana. Tornadoes are rare in India.

Droughts

Drought refers to the situation of less moisture in the soil (which makes the land unproductive) and scarcity of water for drinking, irrigation, industrial uses and other purposes, usually caused by deficient/less than average rainfall over a long period of time. Some states of India feature the perennial drought such as Rajasthan, Odisha, Gujarat, Madhya Pradesh etc.

Sixteen percent of the country's total area is drought-prone and approximately 50 million people are affected annually by droughts. In India about 68 percent of net sown area in the country is drought-prone. Most of the drought-prone areas identified by the Government of India lie in arid, semi-arid and sub-humid areas of the country. In the arid and semi-arid zones, very severe droughts occur once in every eight to nine years.

Geological Disasters

Earthquakes

Earthquake is almost impossible to be predicted, so it is the most destructive of all natural disasters. It is almost impossible to make arrangements and preparations against damages and collapses of buildings and other man-made structures hit by an earthquake. More than half of India's total area is vulnerable to seismic activity of varying intensities.

The most vulnerable regions are located in the Himalayan, Sub-Himalayan belt and Andaman & Nicobar Islands. The Himalayan ranges are among world's youngest fold mountains so the subterranean Himalayans are geologically very active.

Tsunami

Tsunami refers to the displacement of a large volume of a body of water such as Ocean. Most Tsunamis are seismically generated, result of abrupt deformation of sea floor resulting vertical displacement of the overlying water.

The Tsunami waves are small in amplitude and long wavelength (often hundred of kilometers long). The east and west coasts of India and the island regions are likely to be affected by Tsunamis generated mainly by subduction zone related earthquakes from the

two potential source regions, viz. the Andaman-Nicobar-Sumatra Island Arc and the Makran subduction zone north of Arabian Sea.

Landslides

Landslides are common in India in Himalayan region as well as Western Ghats. The Himalayan ranges are among the youngest fold mountains of world. They comprise a series of seven curvilinear parallel folds running along a grand arc of around 3400 kilometers. The landslides in this region are probably more frequent than any other areas in the world.

The Western Ghats, particularly Nilgiri hills also are notorious for frequent landslides.

Technologic Disasters

Industrial, Chemical & Nuclear Disasters

The industrial and chemical disasters can occur due to accident, negligence or incompetence. They may result in huge loss to lives and property. The Hazardous industries and the workers in these industries are particularly vulnerable to chemical and industrial disasters.

The most significant chemical accidents in recorded history was the 1984 **Bhopal Gas disaster**, in which more than 3,000 people were killed after a highly toxic vapour, (methyl isocyanate), was released at a Union Carbide pesticides factory.

Components of disaster relief

1. **Food and Water Needs**

Prepare an Emergency Food Supply

A disaster can easily disrupt the food supply at any time, so plan to have at least a 3-day supply of food on hand.

Keep foods that:

- Have a long storage life
- Require little or no cooking, water, or refrigeration, in case utilities are disrupted
- Meet the needs of babies or other family members who are on special diets
- Meet pets' needs
- Are not very salty or spicy, as these foods increase the need for drinking water, which may be in short supply

How To Store Emergency Food

When storing food, it is not necessary to buy dehydrated or other types of emergency food.

- Check the expiration dates on canned foods and dry mixes. Home-canned food usually needs to be thrown out after a year.
- Use and replace food before its expiration date.

Certain storage conditions can enhance the shelf life of canned or dried foods. The ideal location is a cool, dry, dark place. The best temperature is 40° to 70°F.

- Store foods away from ranges or refrigerator exhausts. Heat causes many foods to spoil more quickly.
- Store food away from petroleum products, such as gasoline, oil, paints, and solvents. Some food products absorb their smell.

- Protect food from rodents and insects. Items stored in boxes or in paper cartons will keep longer if they are heavily wrapped or stored in waterproof, airtight containers.

Preparing Food

Preparing food after a disaster or emergency may be difficult due to damage home and loss of electricity, gas, and water. Having the following items available will help you to prepare meals safely:

- Cooking utensils
- Knives, forks, and spoons
- Paper plates, cups, and towels
- A manual can- and bottle-opener
- Heavy-duty aluminum foil
- Propane gas or charcoal grill; camp stove
- Fuel for cooking, such as charcoal. Use charcoal grills or camp stoves outside home to avoid smoke inhalation and carbon monoxide poisoning.

Prepare an Emergency Water Supply

- Store at least 1 gallon of water per day for each person and each pet. Consider storing more water than this for hot climates, for pregnant women, and for people who are sick.
- Store at least a 3-day supply of water for each person and each pet. Try to store a 2-week supply if possible.
- Observe the expiration date for store-bought water; replace other stored water every 6 months.

- Store a bottle of unscented liquid household chlorine bleach to disinfect water and to use for general cleaning and sanitizing. Store bleach in an area where the average temperature stays around 70°F (21°C). Because the amount of active chlorine in bleach decreases over time due to normal decay, consider replacing the bottle each year.

Water Containers (Cleaning and Storage)

Unopened commercially bottled water is the safest and most reliable emergency water supply.

Use of food-grade water storage containers, such as those found at surplus or camping supply stores

Before filling with safe water,

- Wash the storage container with dishwashing soap and water and rinse completely with clean water.
- Sanitize the container by adding a solution made by mixing 1 teaspoon of unscented liquid household chlorine bleach in one quart of water.
- Cover the container and shake it well so that the sanitizing bleach solution touches all inside surfaces of the container.
- Wait at least 30 seconds and then pour the sanitizing solution out of the container.
- Let the empty sanitized container air-dry before use or rinse the empty container with clean, safe water that already is available.

Avoid using the following containers to store safe water:

- Containers that cannot be sealed tightly
- Containers that can break, such as glass bottles
- Containers that have ever held toxic solid or liquid chemicals, such as bleach or pesticides
- Plastic or cardboard bottles, jugs, and containers used for milk or fruit juices

For proper water storage:

- Label container as “drinking water” and include storage date.
- Replace stored water that is not commercially bottled every six months.
- Keep stored water in a place with a fairly constant cool temperature.
- Do not store water containers in direct sunlight.
- Do not store water containers in areas where toxic substances such as gasoline or pesticides are present.

After A Disaster:

- **Food:** Throw away food that may have come in contact with flood or storm water; perishable foods that have not been refrigerated properly due to power outages; and those with an unusual odor, color, or texture. Unsafe food can make cause illness even if it looks, smells, and tastes normal. When in doubt, throw it out.
- **Water:** Do not use water if it is contaminated to wash dishes, brushing, to prepare food, hand washing , to make ice, or make baby formula. Safe water for drinking, cooking, and personal hygiene includes bottled, boiled, or treated water. State, local, or tribal health department can make specific recommendations for boiling or treating water.

2. **Sanitation and Hygiene**

Good basic personal hygiene and handwashing are critical to help prevent the spread of illness and disease. Clean, safe running water is essential for proper hygiene and handwashing.

Hygiene is especially important in an emergency such as a flood, hurricane, or earthquake, but finding clean, safe running water can sometimes be difficult.

Handwashing

Keeping hands clean during an emergency helps prevent the spread of germs. If tap water is not safe to use, wash hands with soap and water that has been boiled and disinfected.

- Wet hands with clean, running water (warm or cold) and apply soap.
- Rub hands together to make a lather and scrub them well. Scrub the backs of hands, between fingers, and under nails.
- Continue rubbing hands for at least 20 seconds
- Rinse hands well under running water.
- Dry hands using a clean towel or air dry them.

Washing hands with soap and water is the best way to reduce the number of germs on them. If soap and water are not available, can use an alcohol-based hand sanitizer that contains at least 60% alcohol. Alcohol-based hand sanitizers can quickly reduce the number of germs on hands in some situations, but sanitizers **do not** eliminate all types of germs

When to Wash hands with soap and clean, running water

- Before, during, and after preparing food
- Before eating food

- After using the toilet
- After changing diapers or cleaning up a child who has used the toilet
- Before and after caring for someone who is sick
- After blowing your nose, coughing, or sneezing
- After touching an animal or animal waste
- After touching garbage
- Before and after treating a cut or wound

Do not use contaminated water to wash dishes, brush your teeth, wash and prepare food, or make ice.

Bathing

Bathing or showering after a water-related emergency should only be done with clean, safe water. Sometimes water that is not safe to drink can be used for bathing, but be careful not to swallow any water or get it in your eyes.

If have a drinking water from well, listen tor local health authorities for advice on using well water for showering and bathing. If extensive flooding has occurred or suspect that well may be contaminated, should contact local, state, or tribal health department for specific advice on well testing and disinfection.

Dental Hygiene

- Brushing teeth after a water-related emergency should only be done with clean, safe water. Listen to local authorities to find out if tap water is safe to use.

Wound Care

- Keeping wounds clean and covered is crucial during an emergency. Open wounds and rashes exposed to flood waters can become infected.

- Avoid contact with flood waters if have an open wound.
- Cover clean, open wounds with a waterproof bandage to reduce chance of infection.
- Keep open wounds as clean as possible by washing well with soap and clean water.
- If a wound develops redness, swelling, or oozing, seek immediate medical care.
- Vibrios are naturally occurring bacteria that live in certain coastal waters. They can cause a skin infection when an open wound is exposed to salt water or a mix of salt and fresh water, which can occur during floods.

The risk for injury during and after a hurricane and other natural disasters is high. Prompt first aid can help heal small wounds and prevent infection. Wash hands with soap and water before and after providing first aid for a wound to help prevent infection. Use an alcohol-based hand sanitizer that contains at least 60% if soap and water are not available. Tetanus, other bacterial infections, and fungal infections are potential health threats for persons who have open wounds.

Seek medical attention as soon as possible if:

- There is a foreign object (soil, wood, metal, or other objects) embedded in the wound;
- The wound is at special risk of infection (such as a dog bite or a puncture by a dirty object);
- An old wound shows signs of becoming infected (increased pain and soreness, swelling, redness, draining, or you develop a fever).

3. Shelter

Adequate shelter has a significant impact on human survival in the initial stages of a disaster.A shelter requires more than just a roof for a space to be habitable.People living in a shelter must have enough clothing, blankets, mattresses, stoves, fuel, and access to services such as water and sanitation. Shelters are commonly roofed, secure, hygienic, and liveable locations for people to utilize during periods of disaster until they are able to move back to their permanent dwellings.Many DR shelters are designed and planned so that they can be erected, dismantled, and stored for future use .These kinds of shelters are lightweight structures that can be used for a several purposes.

Shelters include tents, prefabricated housing, and public community buildings such as leisure centres, university halls of residence, places of worship, sports venues, and private rentals.

Categories of Shelter/Housing

Individuals tend to move between different DR shelter setups before they either return to their previous permanent house, or build new houses. Shelters can be divided into four categories: emergency shelters, temporary shelters, temporary housing, and permanent housing . The International Federation of the Red Cross and Red Crescent Societies (2013) have added additional categories to these, such as transitional shelters, progressive shelters, and core shelters/one-room shelters.

Emergency Shelter -This type of shelter is used for brief periods of time to deliver life-saving support and is the most basic kind of shelter support aside from staying in another permanent building for a single night to a few days during an emergency. This kind of shelter commonly does not allow for the extensive preparation of food or prolonged medical services.

Temporary Shelters -This type of shelter is meant for short-term use. A simple tent or a public mass shelter used for a few weeks following a disaster constitute a temporary shelter. According to the IFRC/RCS (2013), the duration of stay in such shelters may be limited, and therefore, prioritising speed and limiting costs should be taken into account when constructing this kind of shelter.

Temporary Housing - This type of shelter is often distributed for long-term periods such as six months to three years. Temporary housing such as rental houses and prefabricated unit allow people affected by a disaster to return to their normal daily activities. In many cases, temporary houses are installed on temporary land.

Transitional Shelters - This type of shelter is usually developed by displaced individuals themselves following a disaster, and such resourcefulness and self-management should be supported (IFRC/RCS, 2013). Transitional shelters are commonly relocated from a temporary site to a permanent location, upgraded into part of a permanent house, resold to generate income to aid with recovery, recycled for reconstruction, and reused for other purposes. Such transitional shelters are expected to serve for many months or years.

Progressive Shelters - This type of shelter is designed and built to be more permanent and upgradeable in the future through alterable structural components (IFRC/RCS, 2013).

Core Shelters/One-Room Shelters- This type of shelter is designed and built with the intent of being permanent housing in the future, including a foundation and all or some of the key services, such as plumbing and various utilities . The goal with this type of shelter is to build at least one or two rooms to meet permanent housing standards and facilitate improvement. These shelters are not intended to be a full permanent house.

Permanent Housing- Itmay be upgraded from a transitional shelter, a progressive shelter, a core shelter, or even a new house.Such houses should be resistant and resilient to future hazards and disasters. Of this range of shelter types, it is best for authorities to understand which type of shelter is most appropriate for a group of survivors' needs and conditions. It is also thought that phases of sheltering and houses are unlikely to work in a neat linear fashion .

Sheltering system in India

Despite great improvements in the capacity and effectiveness of the humanitarian system in India over recent decades, the most vulnerable in society in India are frequently excluded from access to services and assistance, and humanitarian shelter actors have a vital role to play in ensuring they are included in post disaster shelter and recovery programmes. There is considerable experience and knowledge of post-disaster shelter within CARE and other actors in shelter in India, and there is a good level of collaboration between different shelter actors, including civil society, NGOs, private sector and government agencies. However, there is little active research or development

of new approaches to shelter, and the shelter sector in India is only weakly linked to the global shelter sector. There is a need and opportunity for the shelter sector in India to collaborate more closely to share knowledge both in India and globally, and to take a more leading role in the global shelter sector, the leadership of which is currently too heavily concentrated in Europe and the US.

CARE and other NGOs and civil society organisations must continue to work closely and effectively with government agencies, and where appropriate the private sector, to ensure effective response which reaches and meets the needs of the most vulnerable. This will require strong cooperation and strong advocacy based on expert knowledge and experience.

Along with enhanced governance approaches in shelter responses, NGOs should strengthen their ability to be a voice for the most vulnerable after disasters and ensure strong advocacy capacity. A strong and sustainable India Shelter Forum should be formed to foster discussion, learning and knowledge management amongst shelter actors in India in order to improve the relevance and effectiveness of shelter responses and to allow the Indian shelter sector to engage in global discussions, access global research and learning and take a leading role in the global shelter sector.

In the wake of disasters (such as tsunamis, earthquakes, cyclones and floods) thousands are displaced and rendered homeless. The need for shelter becomes of utmost importance for the disaster affected people, without which they are exposed to numerous life-threatening risks. Women and children are the worst sufferers and require special attention. For CARE India shelter is not just a structure. It is a space that provides

security, privacy and a sense of dignity. CARE India has been responding to shelter needs of disaster affected people both in the immediate aftermath of a disaster as well as during the early recovery phase. The range of activities under shelter and rehabilitation support provided by CARE India include provision of shelter, non-food items (NFIs), emergency shelter (temporary), transitional shelter (semi-permanent), permanent shelter, community shelter and repair and construction of public buildings. CARE India has also organized training of its own staff as well as for peer organisations. CARE India is a member of the India Shelter Forum and recognizes the holistic nature of shelter programming and will make efforts to integrate the linkages with other sectors like WASH and protection maintaining focus on women and girls. CARE India is committed to quality and standards in shelter programming with efficiency and effectiveness. With this very intention CARE India has conducted a Post Disaster Shelter Evaluation in order to evaluate the medium – to long-term effectiveness of CARE India's shelter programmes and recommend measures to strengthen future shelter programmes, whether undertaken by CARE India or other agencies, to most effectively address the complex and interconnected needs of disaster-affected women, girls, men & boys.

4. Health

- Disasters and other emergencies often result in significant impacts on people's health, including the loss of many lives.
- Every new threat reveals the challenges for managing health risks and effects of emergencies and disasters.
- Deaths, injuries, diseases, disabilities, psychosocial problems and other health impacts can be avoided or reduced by disaster risk management measures involving health and other sectors.

- Disaster risk management for health is multi sectoral and refers to the systematic analysis and management of health risks, posed by emergencies and disasters, through a combination ofhazard and vulnerability reduction to prevent and mitigate risks, (ii) preparedness, (ii) response (iv) recovery measures.
- Resilient health systems based on primary health care at community level can reduce vulnerability, protect health facilities and services, and scale-up the response to meet the wide-ranging health needs in disasters.

Why is there a need for disaster risk management for health?

- **Natural, biological, technological and societal hazards put the health of vulnerable populations at risk and the potential to cause significant harm to public health.**

  Examples of these hazards are

- **Natural: earthquake, landslide, tsunami, cyclones, flood or drought.**
- **Biological: epidemic disease, infestations of pests.**
- **Technological: chemical substance, radiological agents, transport crashes.**
- **Societal: conflict, stampedes, acts of terrorism**

Disasters emergencies, and other crises may cause ill-health directly or through the disruption of health systems, facilities and services, leaving many without access to health care in times of emergency. They also affect basic infrastructure such as water supplies and safe shelter which are essential for health.

- The 2007 WHO global assessment found that less than 50% of national health sectors had a specified budget for emergency preparedness and response.

Factors affecting capacity include:

- weak health and disaster management systems.
- lack of access to resources and know-how.
- continuing insecurity due to conflict.

But a number of high-risk countries have strengthened their disaster prevention, preparedness and response systems

Disaster risk management for health in context

- Disaster risk management has emerged as a core element of sustainable development and an essential part of a safer world in the twenty-first century.
- Reducing risk is a long-term development process, managed by communities and individuals working together.

Health Systems in India

Primary health care (PHC)

- **It focuses on basic services to improve health status, which in turn builds community resilience and provides the foundation for responding to emergencies.**
- **Policies and strategies focusing on PHC can contribute to decreasing vulnerability and preparing households, communities and health systems for disasters.**
- **Following a disaster, focus is often given to acute care needs and specialist interventions.**
- **Community-based actions are at the front line of protecting health in emergencies because**
- **local knowledge of local risks is used to address the actual needs of the community.**
- **local actions prevent risks at the source, by avoiding exposure to local hazards.**
- **a prepared, active and well-organized community can reduce risks and the impact of emergencies.**
- **many lives can be saved in the first hours after an emergency through community response before external help arrives**

<u>Hospitals and health infrastructure</u>

- **Health systems are composed of public, private and nongovernmental facilities which work together to serve the community**

- **these include hospitals, pri-mary health care centres, laboratories, pharmacies and blood banks.**

  Safe hospitals programmes ensure health facilities are safely built to withstand hazards, remaining operational in emergencies.

  <u>Developing adaptable and resilient health care systems</u>

- **Surge capacity: Health care systems need to prepare to cope with large numbers of patients. This may require mobilising staff around the country to aid affected areas.**
- **Flexibility in health care systems: Flexibility to deliver different functions is an essential component of health care delivery. This may mean reducing some services in order to increase others.**

  Business continuity planning: Plans to maintain the continuity of health sector operations includes identifying priority services, mechanisms for response, co-ordination and communicating with staff and partner organisations

Multi sectoral action

- In order for the health of the population to be protected during and after a disaster, wider determinants of health such as water, sanitation, nutrition, and security also need to be adequately addressed through multi sectoral working.
- Essential infrastructure such as communications, logistics, energy and water supplies, and emergency services and banking facilities need to be protected through multi sectoral working to ensure the continuity of health services.

5. Disaster waste management

Disaster Waste (DW) can be generated by the actual disaster, as well as, later during the response and recovery phases.

Public health risks can arise from direct contact with waste accumulated in the streets, hazardous wastes such as asbestos, pesticides, oils and solvents, and indirectly from

vectors such as flies and rodents, and from post disaster collapse of unstable structures.Relief and reconstruction efforts can be hindered when DW blocks access to affected populations and areas.Environmental impacts, which are closely associated with human impacts, can include waterways, agricultural areas and communities contaminated by chemicals and heavy metals. Physical obstruction of waterways can also occur.In most cases, DW places more burdens on communities already struggling to cope with catastrophe.

DW also presents opportunities:

It may contain valuable material such as concrete, steel, and timber as well as organics for composting. This value can be realized as either a source of income or as a reconstruction material, and reduce burdens on natural resources that might otherwise be harvested for reconstruction.Safe handling, removal and management of DW are therefore important issues in disaster response and recovery. Current DW management practice often involves either no action, in which the waste is left to accumulate and decompose, or improper action, in which the waste is removed and dumped in an uncontrolled manner. Improper dumping may create long-term environmental problems that affect the community or occur on economically significant land and require the waste to be moved again, creating additional costs.

Disaster waste issues and their impacts

- Uncollected building rubble from damaged buildings - Impeded access and constrained rehabilitation & reconstruction activities. Waste tends to attract more waste since the site is already considered a dumping site.

- Dumping in inappropriate areas and/or proliferation of scattered dump sites - Potential human health and injury risks from dump sites too close to settlements, especially from hazardous materials. Destruction of valuable land. Impacts on drinking water supplies and damage to valuable fisheries. Additional costs if waste must be moved later. Increase in disease vectors (flies, mosquitoes, rats, etc.). Risk of waste piles collapsing. Risk of fires. Risk of cuts from sharp materials, including used syringes.

Hazard types and their waste characteristics

Earthquakes-

- Structures collapse - This can lead to challenges in sorting out hazardous waste (e.g.asbestos) from non-hazardous (e.g. general building rubble).
- Handling waste often requires heavy machinery, which communities may not be able to afford or have difficulty to access.
- Collapsed buildings may overlap across streets, making access difficult for the search and rescue and relief operations.
- Quantities of waste are high compared to other disaster types since all building contents normally become waste.

Flooding-

- Floods often lead to mass displacement, which in turn requires shelters and camps and leads to large volumes of household wastes.
- Initial damage depends on the structural integrity of infrastructure, while building contents are normally damaged extensively. Mould may be present and timber may have begun to rot.

- Buildings are typically stripped by owners and waste placed on roads for collection. Waste is often mixed with hazardous materials such as household cleaning products and electronic goods.
- Flooding may bring mud, clay and gravel into affected areas, making access difficult once the floodwater recedes. Removal may be required for relief and recovery operations.
- The mud, clay and gravel may be mixed with hazardous materials, requiring further assessment before dumping.

Tsunami-

- Strong tsunamis can cause widespread damage to infrastructure, spreading debris over large areas.
- Debris is often be mixed with soils, trees, bushes and other loose objects such as vehicles. This makes waste difficult to handle and segregate.

Hurricanes/typhoons/cyclones-

- Strong winds can tear the roof off buildings, after which walls may collapse.
- Poorly constructed houses and huts can ‘fold’ under roof tops. Even brick and concrete walls may collapse.
- Waste is spread over open land, streets, and marketplaces. This would include roofing materials, small items and dust carried by the wind. This may cause serious problems where asbestos is present
- Ships and boats are often thrown ashore and destroyed, requiring specialized waste management.

- Vessels that sink in harbours need to be removed.
- Electrical and telephone grids as well as transformers containing oil and PCBs may be destroyed.

Objectives of waste management

- Minimize risks to human life and health
- Reduce risks to the environment
- Ensure that the realization of any of the values in the plan benefits the affected communities

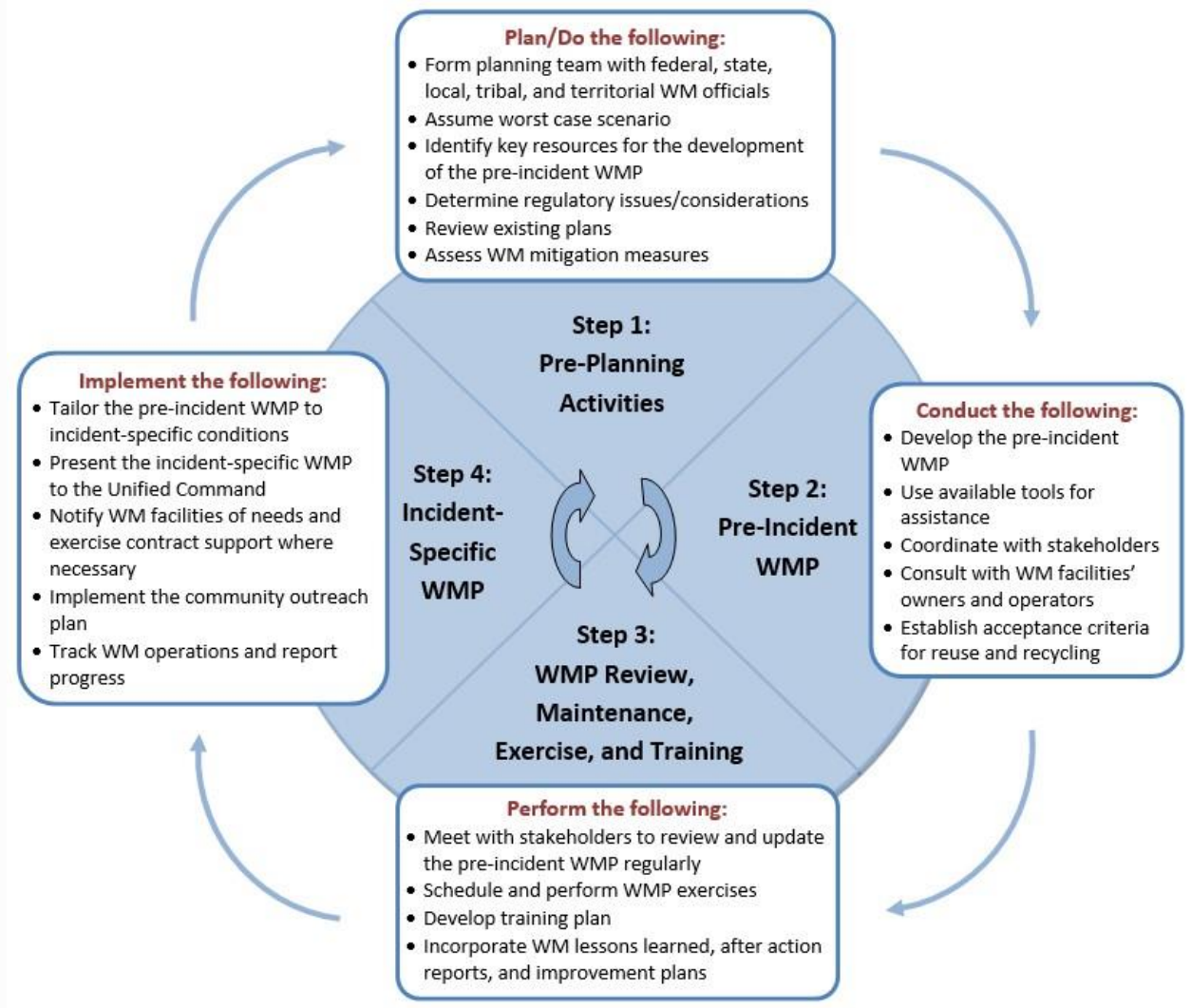
Benefits of Pre-incident Waste Management Planning

Nearly all incidents generate waste, debris and materials. While the amount of waste varies between incidents, the generated waste is often greater than the amount of waste many communities handle each year. Additionally, homeland security incidents may generate waste streams, such as chemical, biological and radiological-contaminated wastes, that typically are not handled by communities or waste management facilities. In addition to helping the whole community prepare for these potential wastes, pre-incident planning encompasses source reduction and hazard mitigation activities aimed at reducing the total amount of waste generated by an incident, especially for a large-scale natural disaster.

Pre-incident All-Hazards Waste Management Planning Process

EPA's pre-incident waste management planning process is designed to help communities prepare for an incident's waste management needs, regardless of the hazard. This recommended process guides emergency managers and planners through four steps that

cover the initiation, creation, updating and implementation of a waste management plan. The waste management planning process does not have to be completed at one time or by one person.



Post disaster waste management (Disposal of waste caused by a disaster)

- Disasters such as floods, earthquakes and hurricanes (cyclones) can produce large quantities of rubble**.**
- This will be a danger to people, block access roads, conceal trapped persons and block drainage channels.

It will also hinder the access of other emergency services

- Once all survivors have been released from the rubble , its removal and the demolition of dangerous structures should be a priority.
- If there is no approved waste disposal site near by, the wastes can be piled, in the short term, on areas of waste land.
- Not all rubble is waste.

Items such as zinc roofing sheets, furniture and bricks can be reused.

- If possible sort the rubble as it is being removed, storing reusable materials separately from the rest of the waste.
- Waste piles can be a serious fire risk so provide a security fence to keep out the public and ban the use of all naked flames, including cigarettes

Work with the community

- People affected by major disasters are badly traumatized.
- Giving them a task to perform can help them overcome the trauma.
- Employ neighbourhood groups to clean up their areas.
- This will bring money into the communities and strengthen their links with their areas.
- Introduce a rotation system so that all families in the community can benefit.
- The workforce should be protected from physical injury by the provision of masks, overalls, gloves and boots.
- They should be vaccinated against common diseases such as tetanus.
- Consult local health services for advice on vaccination.

Domestic waste

- If people have stayed close to their homes it is best to support the use of traditional practices.
- In rural areas this is likely to be burial, either within the family compound or in shared neighbourhood pits.
- Most urban areas will have had some form of communal collection system prior to the emergency.
- It may be necessary to set one up and support it financially, by supplying vehicles and by employing personnel. When recruiting people, hire from the local community.

Collection and transport

- In the early stages of an emergency, provide communal storage bins.
- As the situation stabilizes, the number of bins can be gradually increased to the density there was before the disaster.
- The type of transport used for moving the garbage from bins to its final point of disposal depends on the quantity of waste produced, the distance over which it has to be transported and available local resources.
- Recycling should be encouraged and managed properly as it provides a local source of income and reduces the amount of waste for disposal.

Other disposal methods

- Disposal systems such as composting, incineration and sanitary landfill can be considered once the situation has stabilized.
- They are unlikely to be a first phase emergency response activity.

- Management - The key to effective solid waste collection and disposal is good management.
- It is often necessary to support local institutions with funds and professional staff to enable them to meet their responsibilities.

Steps to follow in hazardous waste management

Identification of Hazardous Waste Generation: Identifying the HW generating industries is thefirst step. The HWs are classified under 18 categories and this information may

be used to screen the wastes generated and classifying them as HWs.

Data Collection: After identifying the HW generating sources, the inventory of the data pertaining to HW generation can be developed by conducting surveys through specially preparedquestionnaires to each of the identified sources.

Waste Characterization: The HW that is generated from the study region should be characterized. For this purpose, it is advisable that the samples may be collected from the wastegeneration source and analyzed in the laboratory. Detailed information on HW characterization pertaining to physical, chemical, andgeneral characteristics; and properties pertaining to ignitability, corrosivity, reactivity, & toxicity

Quantification of Hazardous Wastes: The HWs are quantified based on their individual characteristics. The quantity of HWs will be expressed in terms of each category for disposal (e.g. Recyclable, Incinerable, or Disposable etc). The wastes that are recyclable are

used/waste oil, lead wastes, zinc wastes.

Identification of sites for disposal: After quantifying the HW, and assessing the probable areaequirements for its treatment, storage and disposal, the sites are to be identified. For this purpose,toposheets and/or remote sensing images of the study region may be used.

Conducting EIA: The Environmental Impact Assessment (EIA) should be conducted in the siteidentified in the above step.

Implementing Programme: The programme should be implemented at the finaldesignated site. The site should contain adequate provisions for storage, treatment (Stabilization,Incineration etc.) and final disposal.

Laws , Policies plans and acts in disaster management

National policy on disaster management 2009

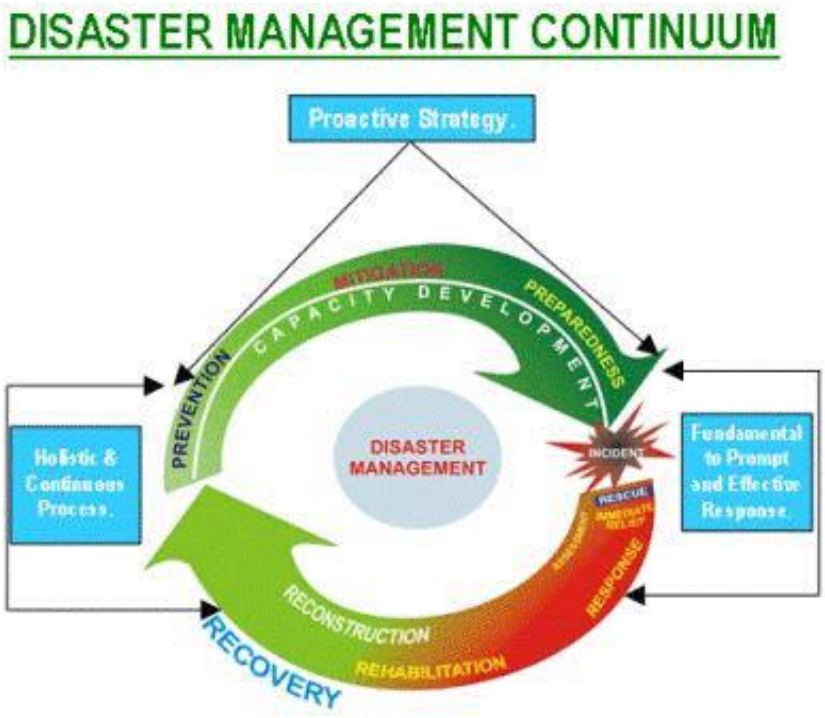
The vision is to build a safe and disaster resilient India by developing a holistic, proactive, multi-disaster oriented and technology driven strategy through a culture of prevention, mitigation, preparedness and response.

A disaster refers to a catastrophe, calamity or grave occurrence from natural or man-made causes, which is beyond the coping capacity of the affected community. DM involves a continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient for:

- Prevention of danger or threat of any disaster.
- Mitigation or reduction of risk of any disaster or its severity or consequences.

- Capacity building including research and knowledge management.
- Preparedness to deal with any disaster.
- Prompt response to any threatening disaster situation or disaster.
- Assessing the severity or magnitude of effects of any disaster.
- Evacuation, rescue and relief.
- Rehabilitation and reconstruction.

A typical DM continuum comprises six elements; the pre-disaster phase includes prevention, mitigation and preparedness, while the post-disaster phase includes response, rehabilitation, reconstruction and recovery.



A legal and institutional framework binds all these elements together

Approach

- A holistic and integrated approach will be evolved toward disaster management with emphasis on building strategic partnerships at various levels. The themes underpinning the policy are:
- Community based DM, including last mile integration of the policy, plans and execution.
- Capacity development in all spheres.
- Consolidation of past initiatives and best practices.
- Cooperation with agencies at national and international levels.
- Multi-sectoral synergy.

Objectives

The objectives of the national policy on disaster management are:

- Promoting a culture of prevention, preparedness and resilience at all levels through knowledge, innovation and education.
- Encouraging mitigation measures based on technology, traditional wisdom and environmental sustainability.
- Mainstreaming disaster management into the developmental planning process.
- Establishing institutional and techno-legal frame works to create an enabling regulatory environment and a compliance regime.
- Ensuring efficient mechanism for identification, assessment and monitoring of disaster risks.
- Developing contemporary forecasting and early warning systems backed by responsive and failsafe communication with information technology support.

- Promoting a productive partnership with the media to create awareness and contributing towards capacity development.
- Ensuring efficient response and relief with a caring approach towards the needs of the vulnerable sections of the society.
- Undertaking reconstruction as an opportunity to build disaster resilient structures and habitat for ensuring safer living.
- Promoting productive and proactive partnership with media in disaster management

The disaster management act 2005

Disaster management in India, leading up to 2005, consisted of a reactive, relief- centric and post disaster approach. The passage of the Disaster Management Act in 2005 caused a paradigm shift in the conventional regime of disaster management and disaster control focussed on preparedness and mitigation.

Scope and objective

The Disaster Management Act was passed with the primary objective of preparedness, prevention and early planning towards disaster. Its statement of objective reads that it is "An Act to provide for the effective management of disasters and for matters connected therewith or incidental thereto".

The Act received the assent of the president on 6th of January 2006 and is applicable to the whole of India. It provides for a detailed action- plan right to guide the central government through to the district and local levels to draw, implement and execute disaster management plans.

Salient features

The Act designates the Ministry of Home Affairs as the nodal ministry for controlling the overall national disaster management.

It puts into place a systematic structure of institutions at the national, state and district levels. Four important entities have been placed at the national level-

- The National Disaster Management Authority (NDMA)- It is tasked with laying down disaster management policies and ensuring timely and effective response mechanism.
- The National Executive Committee (NEC)- It is comprised of secretary level officers of the Government of India assigned to assist the NDMA
- The National Institute of Disaster Management (NIDM)- It is an institute for training and capacity development programs for managing natural
- National Disaster Response Force (NDRF)- It refers to trained professional units that are called upon for specialized response to disasters.

The Act also provides for state and district level disaster management authorities responsible for, drawing plans for implementation of national plans. The Act further contains the provisions for financial mechanisms such as the creation of funds for emergency response, National Disaster Mitigation Fund and similar funds at the state and district levels.

Progress made under the Act

The Disaster Management Act incorporates the belief that investments in mitigation are far more cost- effective than expenditure on relief and rehabilitation. By laying down

measures for strategic partnerships and drawing up blue- prints of action plans to counter catastrophes of various degrees, the Act has brought about significant progress in a number of areas, including-

- Detailed directions to guide disaster management efforts
- Capacity development in all spheres
- Consolidation of past initiatives and best practices
- Co-operation with agencies at national and international levels

Institutional Framework under the DM Act

National Disaster Management Authority (NDMA)

The NDMA, as the apex body for disaster management, is headed by the Prime Minister and has the responsibility for laying down policies, plans and guidelines for DM (and coordinating their enforcement and implementation for ensuring timely and effective response to disasters) . The guidelines will assist the Central Ministries, Departments and States to formulate their respective DM plans. It will approve the National Disaster Management and DM plans of the Central Ministries or Departments. It will take such other measures as it may consider necessary, for the prevention of disasters, or mitigation, or preparedness and capacity building, for dealing with a threatening disaster situation or disaster. Central ministries or departments and State Governments will extend necessary cooperation and assistance to NDMA for carrying out its mandate. It will oversee the provision and application of funds for mitigation and preparedness measures. NDMA has the power to authorize the Departments or authorities concerned, to make emergency procurement of provisions or materials for rescue and relief in a threatening

disaster situation or disaster. The general superintendence, direction and control of National Disaster Response Force (NDRF) are vested in and will be exercised by the NDMA. The National Institute of Disaster Management (NIDM) works within the framework of broad policies and guidelines laid down by NDMA.

The NDMA is mandated to deal with all types of disasters, natural or man-made. Whereas, such other emergencies including those requiring close involvement of the security forces or intelligence agencies such as terrorism (counter-insurgency), law and order situation, serial bomb blasts, hijacking, air accidents, Chemical, Biological, Radiological and Nuclear (CBRN) weapon systems, mine disasters, ports and harbour emergencies, forest fires, oil field fires, and oil spills will continue to be handled by the extant mechanism i.e., National Crisis Management Committee.

NDMA may, however, formulate guidelines and facilitate training and preparedness activities in respect of Chemical, Biological, Radiological and Nuclear (CBRN) emergencies.

National disaster management plan 2019

The revision of the existing National Disaster Management Plan 2016 started in April, 2017 with a consultative workshop. This was followed by several rounds of extensive consultations internally and with different stakeholders and experts from different domains.

Vision

Make India disaster resilient, achieve substantial disaster risk reduction, and significantly decrease the losses of life, livelihoods, and assets – economic, physical, social, cultural,

and environmental – by maximizing the ability to cope with disasters at all levels of administration as well as among communities.

Scope

As per the DM Act 2005, the National Plan shall include:

a. Measures to be taken for prevention of disasters or the mitigation of their effects

b. Measures to be taken for the integration of mitigation measures in the development plans

c. Measures to be taken for preparedness and capacity building to effectively respond to any threatening disaster situations or disaster

d. Roles and responsibilities of different Ministries or Departments of the Government of India in respect of measures of the three aspects mentioned above

Objectives Along with the mandate given in the DM Act 2005 and the NPDM 2009, the national plan has incorporated the national commitment towards the Sendai Framework. Accordingly, the broad objectives of the NDMP are:

1) Improve the understanding of disaster risk, hazards, and vulnerabilities

2) Strengthen disaster risk governance at all levels from local to centre

3) Invest in disaster risk reduction for resilience through structural, non-structural and financial measures, as well as comprehensive capacity development

4) Enhance disaster preparedness for effective response

5) Promote “Build Back Better” in recovery, rehabilitation and reconstruction

6) Prevent disasters and achieve substantial reduction of disaster risk and losses in lives, livelihoods, health, and assets (economic, physical, social, cultural and environmental)

7) Increase resilience and prevent the emergence of new disaster risks and reduce the existing risks

8) Promote the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures to prevent and reduce hazard exposure and vulnerabilities to disaster

9) Empower both local authorities and communities as partners to reduce and manage disaster risks

10) Strengthen scientific and technical capabilities in all aspects of disaster management

11) Capacity development at all levels to effectively respond to multiple hazards and for community-based disaster management

12) Provide clarity on roles and responsibilities of various Ministries and Departments involved in different aspects of disaster management

13) Promote the culture of disaster risk prevention and mitigation at all levels

14) Facilitate the mainstreaming of disaster management concerns into the developmental planning and processes

THE CIVIL DEFENCE ACT, 1968 ACT NO. 27 OF 1968

The Civil Defence Act, 1968 defines civil defence as any measure, not amounting to actual combat, that protects persons, property and places in India from hostile attack. It includes measures that deprive such attack of its effect. The measures may be taken before, after or during such attack.

Powers of the Central Government

The central government may make rules regarding a number of items. Some of these are related to:

- Instruction of members of public regarding civil defence and equipment for that purpose Prohibiting and regulating traffic
- Control of light and sounds
- Prohibiting or regulating the use of explosives, vessels, wireless telegraph, photographic and other recording equipment
- Control of roads, waterways, water supply etc.
- Preventing and controlling the use of uniforms
- Prohibiting any person to be out of doors between specified hours
- Regulating the conduct of persons in areas, the control of which is considered necessary or expedient
- Prohibiting the printing and publishing of newspaper, book etc containing matters prejudicial to civil defence.

Powers of the State Government

- Constituting Civil Defence Corps for any area within the state, and appointing a person of the rank of District Magistrate or higher as its Controller
- Appointing a Director of Civil Defence, to whom the Controllers have to report
- Making orders under the rules framed by the central government.

Other Key Features

- The Act specifies penalties for non-compliance

- Orders made in exercise of any power conferred by this Act may not be questioned in any court
- The provisions of this Act do not apply to the Armed Forces of the Union.

The Amendment Bill

The Civil Defence Amendment Bill, 2009 expands the definition of civil defence to include "any measure taken for the purpose of disaster management before, during, at or after any disaster".

The Bill defines "disaster" and "disaster management" as defined in the Disaster Management Act, 2005.

UNIT V DISASTER MANAGEMENT: CASE STUDIES

Forest Fire

- **Surface Fire -** A forest fire may burn primarily as a surface fire, spreading along the ground as the surface litter (senescent leaves and twigs and dry grasses etc) on the forest floor and is engulfed by the spreading flames.
- **Underground Fire -** The fires of low intensity, consuming the organic matter beneath and the surface litter of forest floor are sub-grouped as underground fire. In most of the dense forests a thick mantle of organic matter is find on top of the mineral soil. This fire spreads in by consuming such materials. These fires usually spread entirely underground and burn for some meters below the surface. This fire spreads very slowly and in most of the cases it becomes very hard to detect and control such type of fires. They may continue to burn for months and destroy vegetative cover of the soil. The other terminology for this type of fire is Muck fires.

MAN MADE DISASTERS: CASE STUDIES

- Natural and man made disasters have the direct and indirect impact on the health of the population, resulting in physical trauma, acute disease and emotional trauma along with increase in the morbidity and mortality associated with chronic diseases. A public health sector which conducts routine surveillance, good immunization coverage, maintains adequate environmental control is

recommended to withstand the increased need following a disaster, while also expecting the health system to be prepared to resist the disaster.

- Each year million so people are affected by natural and man made disasters around the world.l999 was an example of the devastation that natural hazards can have on humanity. Tornados, hurricanes, heavy rains, and earth quakes resulted in tens of thousands of deaths and many more affected. Close to a million people have found themselves homeless, economically impacted, or injured because of these disasters.
- Different types of disasters result in different patterns of injury and these, in turn, produce variable levels of morbidity and mortality. Generally it is believed that earthquakes and rapid flooding (i.e. tsunamis and flash floods) are capable of producing large numbers of deaths. Earthquakes and high wind events (such as tornados) are capable of producing large numbers of severe injuries requiring intensive care. Every disaster scenario is unique in its own way and presents new and unusual challenges to victims and rescue emergency personnel alike. On one hand, each disaster must be evaluated independently of past events in order to recognise the special features of the situation at hand. In this manner, one avoids the common mistake of preparing for the last disaster situation as opposed to anticipating the next one. On the other hand, certain disaster situations do follow general patterns and develop along similar paths. It is vital to appreciate these subtle patterns in order to provide community planners and allied health professionals with a foundation to design a comprehensive emergency response plan. Certain disasters lead to certain types of injuries more than others. This can be an important fact to bear in mind when planning an

emergency response, taking stock of available medical supplies, or estimating the needs of a community or geographical area.

Fluvial floods (river floods)

A fluvial, or river flood, occurs when the water level in a river, lake or stream rises and overflows onto the surrounding banks, shores and neighboring land. The water level rise could be due to excessive rain or snowmelt.

The damage from a river flood can be widespread as the overflow affects smaller rivers downstream, which can cause dams and dikes to break and swamp nearby areas..

The severity of a river flood is determined by the duration and intensity (volume) of rainfall in the catchment area of the river. Other factors include soil water saturation due to previous rainfall, and the terrain surrounding the river system. In flatter areas, floodwater tends to rise more slowly and be shallower, and it often remains for days. In hilly or mountainous areas, floods can occur within minutes after a heavy rain, drain very quickly, and cause damage due to debris flow.

To determine the probability of river flooding, we should consider past precipitation, forecasted precipitation, current river levels, and well as soil and terrain conditions.

Pluvial floods (flash floods and surface water)

A pluvial flood occurs when an extreme rainfall event creates a flood independent of an overflowing water body. Yet pluvial flooding can happen in any location, urban or rural; even in areas with no water bodies in the vicinity. There are two common types of pluvial flooding:

- **Surface water floods** occur when an urban drainage system is overwhelmed and water flows out into streets and nearby structures. It occurs gradually, which provides people time to move to safe locations, and the level of water is usually shallow (rarely more than 1 meter deep). It creates no immediate threat to lives but may cause significant economic damage.
- **Flash floods** are characterized by an intense, high velocity torrent of water triggered by torrential rain falling within a short amount of time within the vicinity or on nearby elevated terrain. They can also occur via sudden release of water from an upstream levee or a dam. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurtling debris that is often swept up in the flow.

Coastal flood (storm surge)

Coastal flooding is the inundation of land areas along the coast by seawater. Common causes of coastal flooding are intense windstorm events occurring at the same time as high tide (storm surge), and tsunamis.

Storm surge is created when high winds from a windstorm force water onshore — this is the leading cause of coastal flooding and often the greatest threat associated with a windstorm. The effects increase depending on the tide - windstorms that occur during high tide result in devastating storm surge floods. In this type of flood, water overwhelms low-lying land and often causes devastating loss of life and property.

The severity of a coastal flood is determined by several other factors, including the strength, size, speed, and direction of the windstorm. The onshore and offshore topography also plays an important role. To determine the probability and magnitude of a

storm surge, coastal flood models consider this information in addition to data from historical storms that have affected the area.

Landslides

A landslide is the movement of rock, earth, or debris down a sloped section of land. Landslides are caused by rain, earthquakes, volcanoes, or other factors that make the slope unstable.

Geologists, scientists who study the physical formations of the Earth, sometimes describe landslides as one type of mass wasting. A mass wasting is any downward movement in which the Earth's surface is worn away. Other types of mass wasting include rockfalls and the flow of shore deposits called alluvium.

Near populated areas, landslides present major hazards to people and property. Landslides cause an estimated 25 to 50 deaths and $3.5 billion in damage each year in the United States.

Causes of landslides

Landslides have three major causes: geology, morphology, and human activity.

Geology refers to characteristics of the material itself. The earth or rock might be weak or fractured, or different layers may have different strengths and stiffness.

Morphology refers to the structure of the land. For example, slopes that lose their vegetation to fire or drought are more vulnerable to landslides. Vegetation holds soil in place, and without the root systems of trees, bushes, and other plants, the land is more likely to slide away.

A classic morphological cause of landslides is erosion, or weakening of earth due to water. In April 1983, the town of Thistle, Utah, experienced a devastating landslide brought on by heavy rains and rapidly melting snow. A mass of earth eventually totaling 305 meters wide, 61 meters thick, and 1.6 kilometers long (1,000 feet wide, 200 feet thick, and one mile long) slid across the nearby Spanish Fork River, damming it and severing railroad and highway lines.

Human activity, such as agriculture and construction, can increase the risk of a landslide. Irrigation, deforestation, excavation, and water leakage are some of the common activities that can help destabilize, or weaken, a slope.

Types of landslides

There are many ways to describe a landslide. The nature of a landslide's movement and the type of material involved are two of the most common.

Landslide Movement

There are several ways of describing how a landslide moves. These include falls, topples, translational slides, lateral spreads, and flows.

In falls and topples, heavy blocks of material fall after separating from a very steep slope or cliff. Boulders tumbling down a slope would be a fall or topple.

In translational slides, surface material is separated from the more stable underlying layer of a slope. An earthquake may shake the loosen top layer of soil from the harder earth beneath in this type of landslide.

A lateral spread or flow is the movement of material sideways, or laterally. This happens when a powerful force, such as an earthquake, makes the ground move quickly, like a liquid.

Landslide Material

A landslide can involve rock, soil, vegetation, water, or some combination of all these. A landslide caused by a volcano can also contain hot volcanic ash and lava from the eruption. A landslide high in the mountains may have snow and snowmelt.

Volcanic landslides, also called lahars, are among the most devastating type of landslides. The largest landslide in recorded history took place after the 1980 eruption of Mount St. Helens in the U.S. state of Washington. The resulting flow of ash, rock, soil, vegetation and water, with a volume of about 2.9 cubic kilometers (0.7 cubic miles), covered an area of 62 square kilometers (24 square miles).

Drought

It is a natural event of prolonged shortages in the water supply, whether atmospheric (below-average precipitation), surface water or ground water. A drought can last for months or years, or may be declared after as few as 15 days. It can have a substantial impact on the ecosystem and agriculture of the affected region and harm the local economy. It usually happens when an area receives lesser rainfall than expected or in comparison to the normal rainfall level for that area. Hot temperatures can make a drought worse by evaporating moisture from the soil. But droughts don't just happen in hot and dry places.

One way to monitor droughts is from weather satellites in space. For example, satellite data was used to develop a tool that alerts farmers about upcoming flash droughts.

The National Oceanic and Atmospheric Administration, or NOAA, GOES-R (Geostationary Operational Environmental Satellites-R Series) and JPSS (Joint Polar Satellite System) series satellites can capture thermal infrared images of Earth. These images provide information about the amount of heat on Earth's surface. This information can be used to estimate evapotranspiration, which is a measure of how much water is being transferred from the land to the atmosphere through the soil and plants.

By comparing the weekly evapotranspiration data from satellites with the average for the region, scientists can predict whether or not a region is at risk for flash droughts — and give warnings to farmers.

Causes of Drought

1. Land and water temperatures cause drought. As overall temperatures increase more water evaporates and turns to severe weather conditions . Landscapes and crops need more water to survive and overall the demand for water increases.
2. Soil moisture levels also contribute to drought. When soil moisture is depleted there is less evaporation of water to create clouds. Surface temperatures rise, more water is needed and less is available which contributes to a more severe drought.
3. Excessive irrigation is an excellent of people contributing to a drought.
4. If the timing of water doesn't match the agricultural season you may have too much water when you don't need it and too little when you do need it. Proper

storage and collection of water is key to counter balancing this cycle and clearly in the scope of human management.

Classification of drought

The climatological community has defined four types of drought:

1) meteorological drought, 2) hydrological drought, 3) agricultural drought, and 4) socioeconomic drought.

Meteorological drought– It happens when dry weather patterns dominate an area. It is the situation when there is a 25% decrease in average rainfall for a given period of time (IMD Pune). This can begin and end rapidly.

Hydrological drought– It occurs when low water supply becomes evident, especially in streams, reservoirs, and groundwater levels, usually after many months of meteorological drought due to depletion of surface water Hydrological drought takes much longer to develop and then recover.

Agricultural drought- Happens when crops become affected. It is the result of soil moisture stress due to imbalance between available soil moisture and evapotranspiration demand of crops.

Socioeconomic drought– It relates the supply and demand of various commodities to drought.

Standardized Precipitation Index (**SPI**) is a widely used index to characterize meteorological drought on a range of timescales. On short timescales, the **SPI** is closely related to soil moisture, while at longer timescales, the **SPI** can be related to groundwater and

reservoir storage.

SPI	SPI category
≥2.00	Extremely wet
1.50–1.99	Severely wet
1.00–1.49	Moderately wet
0–0.99	Mildly wet
–0.99–0	Mild drought
–1.49– –1.00	Moderate drought
–1.99– –1.50	Severe drought
≤–2.00	Extreme drought