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UNIT-I

HAZARDS, VULNERABILITY AND DISASTER RISKS

Definitions of Disaster, Vulnerability and Resilience

A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Though often caused by nature, disasters can have human origins.

$$\text{(Vulnerability + Hazard) / Capacity = Disaster}$$

The combination of hazards, vulnerability and inability to reduce the potential negative consequences of risk results in disaster.

As per the Oxford dictionary a disaster is “a sudden accident or a natural catastrophe that causes great damage or loss of life”.

A Disaster is an event or series of events, which gives rise to casualties and damage or loss of properties, infrastructure, environment, essential services or means of livelihood on such a scale which is beyond the normal capacity of the affected community to cope with.

Disaster is also sometimes described as a “catastrophic situation in which the normal pattern of life or ecosystem has been disrupted and extra-ordinary emergency interventions are required to save and preserve lives and or the environment”.

The United Nations defines disaster as “the occurrence of sudden or major misfortune which disrupts the basic fabric and normal functioning of the society or community”.

A disaster is an event of nature or man-made that leads to sudden disruption of normal life of a society, causing damage to life and property to such an extent that normal social and economic values available are inadequate to restore normalcy after a disaster.

Disaster may be defined as a “catastrophic situation in which the normal patterns of life have been disrupted and extraordinary emergency interventions are required to save and preserve human lives and the environment”.

A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources.

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

In disaster management, risk is defined as the interaction between likelihoods of hazards and consequences of hazards. It can be said that,

$$\text{Risk} = \text{Likelihoods of Hazards} / \text{Hazard's Consequences.}$$

Difference between hazards and vulnerability

S.No.	Hazards	Vulnerability
1	A hazard can be defined as a dangerous phenomenon, substance, human activity or condition 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.	Vulnerability refers to the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.
2	The hazards of concern to disaster risk reduction are of natural origin and related environmental and technological hazards and risks.	There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors.
3	Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination.	Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management.
4	Hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.	Vulnerability varies significantly within a community and over time.

Definition: Internally Displaced Persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence.

In particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights, or natural or human made disasters, and who have not crossed an internationally recognized State border.

Definition : Refugees A person who is owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group, or political opinion, is outside the country of his nationality, and is unable to or owing to such fear, is unwilling to avail himself of the protection of that country.

Definition: Climate Migrants Persons who abandon their place of origin as a result of climate change effects: Floods, pests, climate cycle disorder, global warming as well as the

implementation of the capitalist economic model that deforests, degrades, and uncontrollably extracts non-renewable resources and encourages monoculture.

Disaster Management

Disaster Management: As per Disaster Management Act, 2005, “disaster management” means a continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for:

1. Prevention of danger or threat of any disaster;
2. Mitigation or reduction of risk of any disaster or its severity or consequences;
3. Capacity-building;
4. Preparedness to deal with any disaster;
5. Prompt response to any threatening disaster situation or disaster;
6. Assessing the severity or magnitude of effects of any disaster; evacuation, rescue and relief;
7. Rehabilitation and reconstruction; Disaster Management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters.

The main aim of disaster management is to lessen the impacts of disaster. Disaster management is the ‘continuous process of planning and its implementation to reduce the impact of disaster’.

Goals of Disaster Management:

1. Reduce, or avoid, losses from hazards;
2. Assure prompt assistance to victims;
3. Achieve rapid and effective recovery.

Types of Disaster Management

The disaster management process can be divided into two stages:

1. Crisis Management and
2. Risk Management.

Crisis Management:

Crisis is an abnormal situation in which, decisions has to be taken at short period of time (Ibrahim et al. 2003).

Crisis can be divided into two types:

- a) **Community crisis** which is generated by natural and technical agents, disaster and conflicts (civil war, riots and civil disturbance) and
- b) **Non-community crisis**, such as transport accident which does not impact the entire community.

Crisis management involves an accurate and timely diagnosis of the criticality of the problem and dynamics of events. This requires knowledge, skills, courageous leadership, high level of risk taking ability, and vigilance. Successful crisis Management requires motivation, sense of urgency of the matter, commitment, and creative thinking with long-term strategic vision.

Risk Management:

In disaster management, risk is defined as the interaction between likelihoods of hazards and consequences of hazards. It can be said that $\text{Risk} = \text{Likelihoods of Hazards} * \text{Hazard's Consequences}$.

‘Likelihood’ is defined as the probability and frequency of hazards and ‘consequence’ is understood as the impacts of hazards.

According to Coppola, risk can be reduced by reducing likelihood of the hazards and for consequences of hazard.

Hence, Risk (R) = Hazards (H) * Vulnerability (V)/Coping Capacity (C).

Risk Management involves ‘systematic management of administrative decisions, organization, operational skills and responsibilities to apply policies, strategies, and practices for disaster risk reduction’.

Disaster management includes administrative decisions and operational activities that involve,

1. Prevention
2. Mitigation
3. Preparedness
4. Response
5. Recovery
6. Rehabilitation.

Disaster management involves all levels of government. Nongovernmental and community based organizations play a vital role in the process. Modern disaster management goes beyond post-disaster assistance. It now includes pre-disaster planning and preparedness activities, organizational planning, training, information management, public relations and many other fields. Crisis management is important, but is only a part of the responsibility of a disaster manager.

The new paradigm is the Total Risk Management (TRM) which takes a holistic approach to risk reduction. Disaster Management Cycle The traditional approach to disaster management has been to regard it as a number of phased sequences of action or a continuum. These can be represented as a disaster management cycle. The basic disaster management cycle consists of six main activities.



Fig. 1.1.1 Disaster management cycle

Key Phases of Disaster Management

There are three key phases of activity within disaster management:

1. **Pre - Disaster:** Before a disaster to reduce the potential for human, material or environmental losses caused by hazards and to ensure that these losses are minimized when the disaster actually strikes.

2. **During Disaster :** It is to ensure that the needs and provisions of victims are met to alleviate and minimize suffering.
3. **Post Disaster :** After a disaster to achieve rapid and durable recovery which does not reproduce the original vulnerable conditions.

Traditionally people think of disaster management only in term of the emergency relief period and post disaster rehabilitation. Instead of allocated funds before an event to ensure prevention and preparedness.

A successful disaster management planning must encompass the situation that occurs before, during and after disasters.

Pre - Disaster Phase

Prevention and Mitigation:

Reducing the risk of disasters involves activities, which either reduce or modify the scale and intensity of the threat faced or by improving the conditions of elements at risk.

Although the term, prevention is often used to embrace the wide diversity of measures to protect persons and property its use is not recommended since it is misleading in its implicit suggestion that natural disasters are preventable.

The use of the term reduction to describe protective or preventive actions that lessen the scale of impact is therefore preferred.

Mitigation embraces all measures taken to reduce both the effects of the hazard itself and the vulnerable conditions to it in order to reduce the scale of a future disaster. In addition to these physical measures, mitigation should also be aimed at reducing the physical, economic and social vulnerability to threats and the underlying causes for this vulnerability.

herefore, mitigation may incorporate addressing issues such as land ownership, tenancy rights, wealth distribution, implementation of earthquake resistant building codes, etc.

Preparedness

The process embraces measures that enable governments, communities and individuals to respond rapidly to disaster situations to cope with them effectively.

Preparedness includes for example, the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories, public awareness and education and the training of personnel.

It may also embrace search and rescue measures as well as evacuation plans for areas that may be at risk from a recurring disaster.

All preparedness planning needs to be supported by appropriate rules and regulations with clear allocation of responsibilities and budgetary provision.

Early Warning

This is the process of monitoring the situation in communities or areas known to be vulnerable to slow onset hazards, and passing the knowledge of the pending hazard to people in harm's way.

To be effective, warnings must be related to mass education and training of the population who know what actions they must take when warned.

The Disaster Impact

This refers to the “real-time event of a hazard occurring and affecting elements at risk.

The duration of the event will depend on the type of threat; ground shaking may only occur in a matter of seconds during an earthquake while flooding may take place over a longer sustained period.

1. During Disaster Phase

Response

This refers to the first stage response to any calamity, which include for examples such as setting up control rooms, putting the contingency plan in action, issue warning, action for evacuation, taking people to safer areas, rendering medical aid to the needy etc., simultaneously rendering relief to the homeless, food, drinking water, clothing etc. to the needy, restoration of communication, disbursement of assistance in cash or kind.

The emergency relief activities undertaken during and immediately following a disaster, which includes immediate relief, rescue, and the damage, needs assessment and debris clearance.

2. The Post - Disaster Phase

Recovery

Recovery is used to describe the activities that encompass the three overlapping phases of emergency relief, rehabilitation and reconstruction.

Rehabilitation

Rehabilitation includes the provision of temporary public utilities and housing as interim measures to assist long-term recovery.

Reconstruction

Reconstruction attempts to return communities to improved pre-disaster functioning. It includes such as the replacement of buildings; infrastructure and lifeline facilities so that long-term development prospects are enhanced rather than reproducing the same conditions, which made an area or population vulnerable in the first place.

Development

In an evolving economy, the development process is an ongoing activity. Long- term prevention/disaster reduction measures for examples like construction of embankments against flooding, irrigation facilities as drought proofing measures, increasing plant cover to reduce the occurrences of landslides, land use planning, construction of houses capable of withstanding the onslaught of heavy rain/wind Speed and shocks of earthquakes are some of the activities that can be taken up as part of the development plan.

Disasters: Types of Disasters

A disaster is a serious disruption occurring 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.

Disasters are routinely divided into natural or human-made, although complex disasters, where there is no single root cause, are more common in developing countries.

Specific disaster may spawn a secondary disaster that increases the impact. A classic example is an earthquake that causes a tsunami, resulting in coastal flooding. Some manufactured disasters have been ascribed to nature.

Some researchers also differentiate between recurring events, such as seasonal flooding, and those considered unpredictable.

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.

Various phenomena like earthquakes, landslides, volcanic eruptions, floods, hurricanes, tornadoes, blizzards, tsunamis, and cyclones are all natural disasters that kill thousands of people and destroy billions of dollars of habitat and property each year.

However, the rapid growth of the world's population and its increased concentration often in hazardous environments has escalated both the frequency and severity of disasters.

Developing countries suffer more or less chronically from natural disasters due to ineffective communication combined with insufficient budgetary allocation for disaster prevention and management.

Recent Natural Disasters in India are,

1. 2019-20 locust infestation.
2. 2020 Uttarakhand forest fires.
3. Cyclone Amphan
4. Cyclone Nisarga.

Human - Made Disasters

Human-instigated disasters are the consequence 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.

One opinion argues that disasters can be seen as human-made, due to human failure to introduce appropriate emergency management measures.

Recent Human man disaster in India include,

1. Visakhapatnam gas leak
2. Assam gas and oil leak
3. Gujarat chemical plant explosion

Natural Disasters

Types of Natural Disasters				
Geological Disasters	Hydrological Disasters	Meteorological Disasters	Space Disasters	Other Types of Disasters
Avalanche Landslides Earthquakes Sinkholes Volcanic Eruption	Flood Tsunami Limnic Eruption	Cyclonic Storm Blizzard Cold waves Heat waves Drought Hailstorms Tornadoes	Impact Events Solar Flares Gamma-Ray Bursts	Forest fires

Examples of Natural Disasters						
Type	Disaster	Date	Affected Areas	Event		
Geological	Avalanche	31 May	Huascarán-A	An	earthquake	triggered an

Disasters		1970	ncash, Peru	avalanche in Peru, killing nearly 20,000 people.
	Landslides	18 August, 1998	Malpa, Uttarakhand	An entire village was wiped away in the Pithoragarh district of Uttarakhand
	Earthquakes	26 January, 2001	Gujarat	An earthquake which registered 7.9 on the Richter scale, ripped through Gujarat, killing over 1,00,000 people
	Sinkholes	February, 2007	Guatemala City, Central America	A sinkhole over a 100 meters deep formed suddenly. The event resulted in the death of five people and evacuation of thousands
	Volcanic Eruption	79 AD	Italy	Mount Vesuvius – the deadliest volcano to ever erupt. It released 100,000 times the thermal energy of the Hiroshima-Nagasaki bombings. It was speculated that around 2,000 people died as a direct result
Hydrological Disasters	Flood	1931	Republic of China	A series of floods devastated China. It was also called one of the deadliest floods in history, with the death toll estimated to be between 3.7 million to 4 million
	Tsunami	11 March , 2011	Pacific Coast of Japan	A 9.0 magnitude earthquake caused a 33 feet high tsunami to strike. It resulted in the deaths of over 18,500 individuals. The tsunami also caused the nuclear meltdown of the Fukushima Nuclear Power Plant.
	Limnic Eruption	21 August 1986	Lake Nyos, Cameroon	A limnic eruption is a rare kind of natural disaster. Because of its invisible nature, only two instances of this disaster have been ever observed. The deadliest among the two was the Lake Nyos limnic eruption. 1746 people and 3500 cattles were killed in this event.
Meteorological Disasters	Cyclonic Storm	2020	India	Cyclone Amphan caused widespread damage in Eastern India, while Cyclone Nisarga wreaked havoc on the West Coast of India.
	Blizzard	1972	Iran	In 1972, a blizzard dropped nearly 26 feet of snow, completely covering

				200 villages in Iran. It was the deadliest in recorded history, causing the death of 4,000 individuals.
	Cold waves	2020	Baghdad	In February 2020, Baghdad experienced the very first snowfall since the 1910s.
	Drought	2015-18	Cape Town	Cape Town, in South Africa faced a major water crisis between mid 2017 to 2018. This crisis had an extensive impact on public health and the nation's economy.
	Tornadoes	April 26, 1989	Daulatpur-Saturia, Bangladesh	The Daulatpur-Saturia tornado was the deadliest tornado to occur in recorded history. It killed approximately 1,300 people and injured an estimated 12,000 people.
Space Disasters	Impact Events	~66 million years	Entire earth	The Chicxulub impactor is the asteroid that struck earth roughly 66 million years ago. This, along with the event's aftermath caused the extinction of 75% of all plant and animal species.
Other Types of Disasters	Forest fires	2019-2020	Australia	The 2019-20 Australian Bushfires resulted in 34 deaths, destruction of 5,900 buildings, and an estimated 46 million acres were burnt.

Human Made Disasters

S. No.	Example	Profile	First response
1.	Bioterrorism	The intentional release or dissemination of biological agents as a means of coercion	Get information immediately from public health officials via the news media as to the right course of action; if you think you have been exposed, quickly remove your clothing and wash off your skin; put on a HEPA to help prevent inhalation of the agent
2.	Civil unrest	A disturbance caused by a group of people that may include sit-ins and other forms of obstructions, riots, sabotage and other forms of crime, and which is intended to be a demonstration to the public and the government, but can escalate into general chaos.	Contact local police or law enforcement.
3.	Fire	Even with strict building fire codes, people still perish needlessly in fires.	Attempt to suppress fire in early stages; evacuate personnel on alarm, as necessary; notify fire department; Shut off utilities; monitor weather advisories
4.	Hazardous material spills	The escape of solids, liquids or gases that can harm people, other living organisms, property or the environment, from their intended controlled environment such as a container.	Leave the area and call the local fire department for help. If anyone was affected by the spill, call the your local emergency medical services line
5.	Nuclear and radiation accidents	An event involving significant release of radioactivity to the environment or a reactor core meltdown and which leads to major undesirable consequences to people, the environment, or the facility	Recognize that a CBRN incident has or may occur. Gather, assess and disseminate all available information to first responders. Establish an overview of the affected area. Provide and obtain regular updates to and from first responders.

6.	Power failure	Caused by summer or winter storms, lightning or construction equipment digging in the wrong location	Wait 5-10 minutes; power off all servers after a graceful shutdown; do not use telephones, in the event of severe lightning; shut down main electric circuit usually located in the basement or the First floor.
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Natural and Manmade Disasters

Natural Disasters

Some of the common natural disasters, their impact on environment, and their prevention, control and mitigation are discussed below:

When disasters occur due to natural forces they are called natural disasters, over which man has hardly any control.

Some common natural disasters are earthquakes, landslides floods, droughts, cyclones, etc. Tsunamis, volcanic eruptions and wildfires are also included under natural disasters. These disasters cause enormous loss to life and property.

Earthquakes :

An earthquake is the shaking of the earth's surface caused by rapid movement of the earth's crust or outer layer.

Ever since it came into existence 4.6 billion years ago, the earth has been a dynamic, evolving system.

The position of the different continents and oceans that we see today, has changed a number of times in the earth's history.

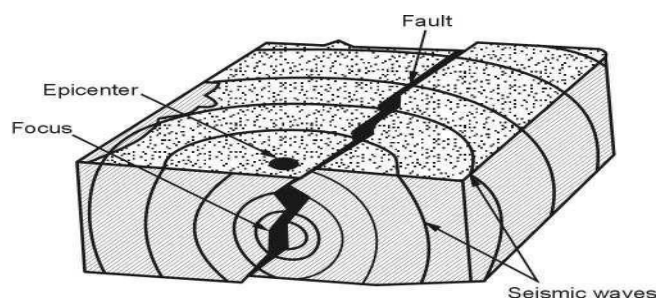
The earth is primarily composed of three layers :

1. The outer crust,
2. The middle mantle, and
3. The inner core.

The Earth's outer layer or crust is made up of a number of zig-saw pieces like structures that interlock into one another.

These pieces are called tectonic plates. These plates are in continuous motion over the mantle, which is known as tectonic movements. These tectonic processes are also responsible for the mountain building processes.

The plates that are moving past over one another are slowed by friction along their boundaries.



Elements of earthquake

Due to this, the rocks are under strain. When the stress on the rocks exceeds certain limits, the rocks rupture and form a fault along which the rocks are displaced during tectonic movements. This sudden rupture of the rocks releases energy in the form of earthquake waves.

Grades	Effects
2.5	Generally not felt, but recorded on seismograph
3.5	Felt by many people
4.5	Some local damage may occur
6	A destructive earthquake
7	A major earthquake
8 and above	Massive earthquake

Table - Richter scale

Thus earthquake is a form of energy, which is transmitted to the surface of the earth in the form of waves called seismic waves.

The study of earthquakes and the waves they create is called seismology (from the Greek Seismos, “to shake”).

Scientists who study earthquakes are called seismologists. The instrument that records the seismic waves is called seismograph.

The exact spot under the earth surface at which an earthquake originates is called the **focus** or **hypocenter**.

The point on the earth surface above the focus is called the **epicenter**. The Richter scale is used to measure the intensity of earthquakes.

The intensity is measured on a scale of 0 to 8 and above.

Impact of Earthquake on the Environment

The destruction, an earthquake causes, depends on its magnitude and duration or the amount of shaking that occurs.

In the last 500 years, earthquakes around the world have killed several million. The destruction, an earthquake causes, depends on its magnitude and duration or the amount of shaking that occurs.

In the last 500 years, earthquakes around the world have killed several million people. Earthquake is one of the most catastrophic natural disasters.

Massive loss of life and property occurs due to collapse of buildings. Besides, roads, bridges, canals, electric poles, etc. are severely damaged.

Certain regions of the earth are more prone to earthquakes.

These are places located in the unstable regions of the earth crust, which are subjected to tectonic activities.

Countries like Japan, parts of Southeast Asia, Turkey, Iran, Mexico, etc. are affected by severe earthquakes. In India, the entire Himalayan region, parts of the Gangetic Plain, Kutch and Andaman and Nicobar islands are in the earthquake hazard zone.

The major impacts of earthquakes are as follows:

Dates	Details
Oct 2005	Jammu & Kashmir, intensity 7.4, about 40000 people died.
26th Jan 2001	Gujrat, intensity 7.9, about 20000 people died.
29th March 1999	Chamoli, Uttaranchal, intensity 6.8, about 1000 people died.
22nd May 1997	Jabalpur and Mandala, M.P. about 50 people died.
30th Sep 1993	Latur and Osmanabad, Maharashtra, about 10000 people died.
20th Oct 1991	Uttarkashi, Uttaranchal, intensity 6.6, about 1000 people died.

Table -Brief list of recent Indian earthquakes

Shaking of the ground and surface rupture

This is the main cause of destruction in which buildings, bridges, roads, canals and other structures are damaged.

Liquefaction :

Earthquakes make sands and silts to transform from a solid to liquid state. This also results in building collapse.

Landslides :

Earthquakes of high intensity often trigger many landslides in the hilly regions.

Fires :

It is a major hazard associated with earthquakes. The shakings of the ground and building damage often break the gas pipes and electric lines that cause fires.

Changes in the land elevation :

The surface topography of a region and groundwater conditions are altered after an earthquake.

Tsunami :

- ☐ It is a Japanese term meaning 'harbour waves'. Tsunamis are massive sea waves that are mainly caused due to earthquakes in the ocean floor or possibly due to an undersea landslide or volcanic eruption. When the ocean floor is tilted or offset during an earthquake a set of waves is
- ☐ created similar to the concentric waves generated by an object dropped into the water.
- ☐ These waves are massive in size and gain height as they approach the seashore.
- ☐ Tsunamis up to the height of 30 m are recorded.
- ☐ Tsunamis are the most catastrophic among natural disasters as they affect a very wide geographical area.
- ☐ The tsunami of 26 December, 2004 killed around three lakh people and affected parts of

Indonesia, Andaman and Nicobar Islands in India, Sri Lanka and even Somalia.

Prevention and mitigation of earthquake and hazard reduction programs

Despite the advances made by modern science, the exact time and place where an earthquake may strike cannot be predicted.

Hence, the occurrence of an earthquake cannot be prevented. However, there are certain regions that are earthquakes prone and so the administration must work before hand to minimize the damages due to occurrence of earthquakes in such areas.

The control and mitigation measures in earthquake prone regions include hazard reduction programmes, development of critical facilities and proper land use planning.

Hazard reduction programs :

These include the following :

1. Earthquake education and evacuation plans.
2. Use of proper construction material that is not injurious even if the structures collapse.
3. Construction of quake resistant buildings having proper structural design.

Development of critical facilities:

These include the following:

1. Establishment of earthquake regulatory agencies for fast relief.
2. Establishment of specific health care units for treating earthquake injuries proper land use planning.
3. Mapping of faults and weak zones in earthquake prone areas.
4. Buildings such as schools, hospitals, offices, etc. should be in areas away from active faults.

Floods :

Floods refer to the 'inundation of large parts of land which otherwise remain dry by water for some duration of time'.

Floods are one of the most common natural disasters occurring in many parts of the world every year.

Floods occur due to heavy rainfall within a short duration of time in a particular region which causes the rivers and streams to overflow.

Since most of the precipitation occurs within span of two to three months during the rainy season, most floods occur during that time.

The floods in the mountainous regions due to cloudbursts or damming of streams are referred to as flash-floods. In flash-floods, the water drains away quickly but only after causing extensive damage.

The plain areas of a region which are drained by a number of rivers, are the places most affected by floods.

In India, states like Assam, Bihar and parts of Gangetic Uttar Pradesh are quite prone to floods during the rainy season.

The Ganga and Brahmaputra rivers and their tributaries are most susceptible to floods. However, heavy rains cause occasional floods in parts of Gujarat, Maharashtra, Karnataka and Tamil Nadu.

Flooding, in India, is a major problem and some part or the other is affected by the fury of floods usually during the months from July to September.

Floods cause untold miseries to the affected regions in the form of huge losses of life and

property. There is great damage to agriculture and livestock.

Flood affected areas face acute shortages of food and drinking water. Besides, floods cause a number of water borne diseases such as diarrhea, gastroenteritis, jaundice, malaria, etc.

Impact on the Environment :

Though the lives lost in floods may not be as high as in case of earthquakes or cyclones, the damage to the environment is immense.

The problem is further aggravated if the floods last for a longer duration of time. Floods not only damage property and endanger if lives of humans and animals, but have other effects as well, such as :

1. Floods cause the spread of many epidemic diseases.
2. Rapid runoff causes soil erosion.
3. Wildlife habitat and forests are often destroyed.
4. Manmade structures like buildings, bridges, roads, sewer lines, power lines, etc. are damaged.
5. Floods cause widespread damage to the standing crops and degrade the
6. Flood affected areas are faced with acute shortage of food and drinking water.

Prevention, Control and Mitigation:

Though floods are a natural hazard, it is sometimes intensified due to undesirable human activities.

The measures that can be taken to control the extent of flood damage include land use planning, building of physical barriers, preventing human encroachment and use of technology for relief.

Land Use Planning:

Proper land use planning in flood prone areas includes:

1. Demarcation of the flood-prone areas that are first inundated during floods.
2. Construction work and concentration of human population should be avoided in the floodplains.
3. Afforestation on the upper reaches of the river (catchment areas) to control soil erosion and excessive runoff.

Building of Physical Barriers :

Flood can be prevented by building certain structures, such as :

1. Embankments along the banks of rivers in densely populated areas.
2. Building of reservoirs to collect excess water during floods.
3. The construction of channels that divert floodwater.

Preventing Human Encroachment:

Human encroachment should be avoided in the following areas :

1. Floodplains and catchment areas.
2. This would control deforestation and soil erosion which would prevent excessive runoff.

Use of technology for relief:

Advanced technology can be used in the following ways :

1. Advanced communication techniques for flood forecasting and warning.
2. Fast evacuation of people.
3. To provide relief in temporary shelters.

4. Immediate supply of medicines, drinking water, food and clothes.
5. Epidemic diseases must be controlled through spraying, vaccination, etc.

Drought

Drought is a condition of abnormally dry weather within a geographic region. Drought refers to the lack or insufficiency of rain for an extended period of time in a specific region.

During droughts, rainfall is less than normal causing a water imbalance and resultant water shortage. It occurs when the rate of evaporation and transpiration exceeds precipitation for a considerable period.

Drought should not be confused with dry climate, as in the Sahara or Thar Desert. It is marked by an unusual scarcity of water and food for the humans as well as animals.

Certain regions of the world, such as parts of Central Africa, are characterized by low amount of rainfall resulting in perennial drought-like conditions.

Some part of India is often affected by drought even during the rainy season. As India is primarily an agricultural country, droughts cause untold miseries to the common people.

Many Indian farmers are still totally dependent on rainfall for irrigation and because of abnormally dry spells there is extensive crop damage.

The main drought prone areas of the country are parts of Rajasthan, Maharashtra, Karnataka, Orissa, Tamil Nadu and Chhattisgarh. However, sometimes drought-like conditions also prevail in the Gangetic Plain also.

Impact on the Environment :

1. The severity of the drought is gauged by the degree of moisture deficiency, its duration, and the size of the area affected.
2. If the drought is brief, it is known as a dry spell or partial drought.

Drought causes serious environmental imbalances, which are summarized below:

1. Water-supply reservoirs become empty, wells dry up and there is acute water shortage.
2. Groundwater level is also depleted because of less recharge.
3. Soil degradation and erosion occurs. Soil cracks because of shrinkage during desiccation.
4. There is extensive crop damage.
5. People become impoverished and there are diseases due to malnutrition.
6. Widespread damage to flora and fauna air including domestic animals.

Prevention, Control and Mitigation:

Rains are caused by a number of natural factors like air currents, wind direction, etc. Thus, droughts are a natural phenomenon, beyond human control and prevention.

Though, global warming may have changed the pattern of rainfall in the recent times. In modern times, by the use of satellites, we can predict the weather pattern over a particular area.

Drought-like conditions can be overcome by better water harvesting techniques. Certain precautions can be taken in drought prone areas, which relate to management of water resources, proper agricultural techniques and relief by different agencies.

Management of water resources:

These include the following:

1. Conservation of water through rainwater harvesting, building check dams, bunds, etc.
2. Construction of reservoirs to hold emergency water supplies.

Proper Agricultural Techniques:

These include the following:

1. Increased use of drought resistant crops.
2. Proper irrigation techniques, such as drip and trickle irrigation that minimize the use of water.
3. Over-cropping and overgrazing should be avoided.

Relief measures:

Immediate relief to the drought-affected people should be provided in the form of :

1. Employment generation programmes, like 'food for work' in the drought affected areas.
2. To provide fodder for domestic animals.

Cyclones

Cyclone is an area of low atmospheric pressure surrounded by a wind system blowing in anti-clockwise direction, formed in the northern hemisphere.

In common terms, cyclone can be described as a giant circular storm system. In a cyclone, the wind speed must be more than 119 km/hr.

Cyclones generate in the seas and oceans and move with a very high speed towards the land.

Cyclones form when moisture evaporates from the warm oceans during the hot season. The air rises, condenses and gathers momentum as it moves over the ocean. Due to the extreme low pressure in the centre, more and more air rushes inwards and it grows to a considerable size and intensity.

It strikes the land with a devastating force and gradually withers off on land when they are cut from their source of ocean moisture.

Cyclones are named variously depending on their source of origin. They are called hurricanes in the Atlantic, typhoons in the Pacific, cyclones in the Indian Ocean and willy-willies around Australia.

Impact on the Environment:

Cyclones are quite common in the Bay of Bengal and often cause much damage in Bangladesh and coastal areas of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu.

Bangladesh has been devastated by cyclones a number of times. In November 1970, a severe cyclone caused a 6 m rise in sea-level and the consequent flooding killed approximately three lakh people.

Another cyclone in 1971 killed more than one lakh people.

The cyclone that hit Orissa in 1999, is the worst recorded natural disaster in India. Even an advanced country like America recorded more than 10,000 deaths and huge financial losses when New Orleans was hit by a hurricane named Katrina, during August 2005.

Cyclones cause devastation when they hit the landmass in the form of very strong winds, heavy rains and storm tides.

1. The coastal low lying areas are most affected.
2. The affected areas are inundated both with rainfall and the surge of seawater.
3. Devastation is also increased due to the accompanying high velocity winds.
4. Widespread damage in the form of uprooted trees, blown-off roof tops, standing crops, injuries and death to humans and animals.
5. Many shipwrecks occur during cyclonic storms.
6. The affected areas are impoverished and are followed by spread of epidemic and diseases.

Prevention, Control and Mitigation :

The occurrence of cyclones is a natural phenomenon, over which humans have no control, hence it cannot be prevented.

However, some scientists have speculated that rise in global warming may cause an increased occurrences of cyclones.

The devastating effects of cyclones can only be controlled and mitigated through some effective policies such as use of advanced technology, hazard reduction initiatives and relief measures.

Use of Advanced Technology :

1. Satellites can easily forecast the origin of cyclones in advance.
2. Satellite images can track the movement and intensity of cyclones.
3. Installation of early warning systems in the coastal areas.

Hazard Reduction Initiatives :

1. Increasing public awareness regarding cyclones.
2. Increasing the public response to cyclone warnings through training.
3. Development of underground shelter belts in the cyclone prone areas.

Relief Measures :

1. Rushing relief to the affected areas in the form of medicines, food, clothes, etc.
2. Checking the spread of epidemic water borne diseases as cyclones are generally accompanied by flooding.

Landslides :

Landslides refer to a rapid down-slope movement of rocks or soil mass under the force of gravity.

It is also known as **slope failure** and **mass wasting**. Landslides may be typed as mudflow where there is down-slope movement of soil and debris flow, which is the down-slope movement of coarse material and rocks.

Landslides may occur when water from rain and melting snow, seeps through the earth on a sloppy surface and encounters a layer of loose, unstable material such as clay.

Landslides mostly occur on unstable hillsides by the action of rain or snow that seep through the soils and rocks.

This results in the sliding of earth and rock masses down the hill slopes. These are further triggered due to deforestation and human encroachment on unstable slopes. All the hilly regions of our country are prone to landslides.

The important factors responsible for landslide occurrence are as follows:

1. Stability of slopes
2. The type of earth and rock material
3. The type of vegetation
4. The role of ground water conditions and precipitation
5. Presence of streams, etc.

Avalanche :

It is a type of landslide involving a large mass of snow, ice and rock debris that slides and fall rapidly down a mountainside.

Avalanches are initiated when a mass of snow and ice begins to rapidly move downhill because of the overload caused due to a large volume of new snowfall.

This results in internal changes of the snow pack, producing zones of weakness along which fissure occurs.

Impact on the Environment :

Landslides, though local in nature, occur quite often in many parts of the world. Landslides occur in the hilly regions; the Himalayan region in India is particularly prone to landslides.

Every year landslides occur, especially during the monsoon season and cause much damage to life and property.

For example, Malpa landslide in 1999 in the Kumaon hills, took the lives of many pilgrims who were going to Mansarovar in Tibet.

The impact on the environment is manifested in the form of :

1. Uprooted trees and degraded soil
2. Buried building and settlements
3. Damage to crops and plantation
4. Frequent roadblocks in the hilly areas
5. Injuries and death to humans and animals.

Prevention, Control and Mitigation :

Though landslides are a natural phenomenon and may occur without human interference, in certain cases human activities like deforestation, mining, etc. can also induce landslides.

Landslides can be controlled, to some extent, by adopting initiatives, such as providing slope support and minimizing human encroachment.

Providing Slope Support :

By building retaining walls made of concrete, gabions (stone filled wire blocks) and wooden and steel beams, etc.

By providing drainage control measures so that water may not infiltrate into the slope.

Minimizing Human Encroachment:

Mining activities should be monitored in the hilly, unstable regions.

1. Plantation of trees should be undertaken on the unstable hilly slopes.
2. By preventing human encroachment in the form of buildings, roads, agriculture, grazing, etc. on unstable slopes.

Man-Made Disasters:

When the disasters are due to carelessness of human or mishandling of dangerous equipment's they are called man-made disasters.

Common examples of these disasters are train accidents, aero plane crashes, collapse of buildings, bridges, mines, tunnels, etc.

Man-made disasters are the result of carelessness or human errors during technological and industrial use.

The disasters are in the form of accidents, which occur all of a sudden and take a huge toll on life and property. Mostly such disasters cause injuries, diseases and casualties where they occur.

Man-made disasters are mainly of two types:

A) Local disasters:

These are small-scale disasters such as train accidents, plane crashes and shipwrecks.

B) Industrial and technological disasters:

These are much larger in scale and are the result of technology failures or industrial accidents. Such disasters affect both local population and may even cover a much larger

Minimizing Human Encroachment:

1. Mining activities should be monitored in the hilly, unstable regions.
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Man-Made Disasters

When the disasters are due to carelessness of human or mishandling of dangerous area. Industrial disasters result due to accidental leakage of water or air pollutants. Many of the chemicals are extremely toxic and carcinogenic which affect the human population in an adverse way. Some people die instantly while others are crippled for whole life in the form of blindness, paralysis and many other chronic diseases.

Impact on the environment:

Leakage of toxic chemicals from the industries and accidents in the nuclear reactors has short-term and long-term effects on the environment and human health. Short-term effects on human health relate to casualties and diseases like blindness, cancer, paralysis, heart trouble, gastric and respiratory abnormalities. Long-term effects include genetic imbalances in humans and its impact on the future generations. Soil and water sources also remain polluted for long durations of time.

Prevention, control and mitigation :

Man-made disasters can be minimized to a large extent by adopting the following measures :

1. Proper training of personnel working in the hazardous industries.
2. Proper maintenance and care of safety measures.
3. Removing human encroachments around hazardous industries.
4. Making the people aware about the first-aid methods in case of accidents.
5. Applying wet cloth over the mouth and nose in case of gas leakages minimizes the health hazards.
6. Remaining indoors in case of radioactive accidents.
7. Providing the people with proper medical care, in some cases throughout their life.
8. Providing adequate compensation to the affected people by way of money and employment.

Bhopal Gas Tragedy (BGT)

The most serious industrial disaster occurred on December 3, 1984 at Bhopal, India, which is known as the Bhopal Gas Tragedy (BGT).

The Bhopal gas tragedy occurred due to leakage of methyl isocyanide (MIC) gas from the factory of Union Carbide of India Ltd. MIC gas is used as an ingredient in pesticides.

It leaked from the factory and formed the deadly cloud over Bhopal. People living in slums in the vicinity of the factory were the most affected and more than 5000 people were killed, half of them due to direct exposure and other half due to after affects.

MIC is a colorless gas which causes severe irritation, violent coughing, swelling of the lungs, bleeding and death due to direct inhalation. It also caused loss of eyesight in more than 1000 people.

More than 50,000 people were affected with respiratory, eye, gastric, neurological and

gynecological problems.

Another technological disaster is due to the potential damages of nuclear fallout. An example is the Chernobyl Nuclear Disaster.

Chernobyl Nuclear Disaster

This nuclear disaster occurred at the Chernobyl Nuclear Power Plant, which was one of the largest power plants in the Ukrainian Republic of erstwhile USSR, on April 26, 1986.

It is the worst nuclear disaster recorded in a nuclear power plant. This nuclear power plant had four reactors of 1000 megawatt each for electricity generation.

A sudden power surge resulted in two explosions, which destroyed the reactor core and blasted a large hole in the roof of the reactor building.

The Radioactive debris moved up through that hole to heights of 1 km. Approximately 100 to 150 million curies of radiation (radioactive isotopes of iodine and calcium) escaped into the atmosphere.

To reduce emissions, the rescue team bombarded the reactor with 5,000 metric tonnes of shielding material consisting of lead, boron, sand and clay. Soviet officials placed the toll of human lives to 31.

However, according to western estimates, 2000 people were killed. Large areas of the Ukrainian, Byelorussia Republics of the USSR and even parts of Poland, Denmark and Sweden were contaminated.

Around 200,000 people had to be evacuated and resettled.

The after affects lasted for many years and a rise in the incidence of thyroid and blood cancer has been observed in a wide group of people.

Other effects on the human health included skin diseases, hair loss, nausea, anemia, respiratory and reproductive diseases.

Technological Disasters

Technological disasters are events caused by human action or inaction, leading to significant damage and disruption. They encompass structural collapses, industrial accidents, oil spills, and other man-made incidents.

Types of Technological Disasters

1. Structural Collapse

Causes: Poor construction practices, design flaws, lack of maintenance, natural disasters exacerbating structural weaknesses.

Impacts:

- ☐ **Social:** Loss of life, displacement of communities, trauma.
- ☐ **Economic:** Loss of property, decreased investor confidence, reconstruction costs.
- ☐ **Political:** Regulatory scrutiny, policy changes, government accountability.
- ☐ **Environmental:** Debris and waste, land destabilization.
- ☐ **Health:** Injuries, fatalities, long-term health issues from dust and debris.
- ☐ **Psychosocial:** Mental health issues, community disruption, loss of trust in authorities.

2. Industrial Accidents

Causes: Equipment failure, human error, inadequate safety measures, natural disasters.

Impacts:

- ❑ **Social:** Casualties, community displacement.
- ❑ **Economic:** Business losses, legal costs, compensation claims.
- ❑ **Political:** Regulatory changes, legal actions, public pressure.
- ❑ **Environmental:** Pollution, contamination, habitat destruction.
- ❑ **Health:** Exposure to toxic substances, respiratory issues, long-term health problems.
- ❑ **Psychosocial:** Trauma, anxiety, distrust in industries and authorities.

3. Oil Spills

Causes: Tanker accidents, pipeline leaks, drilling incidents, equipment failure.

Impacts:

- ❑ **Social:** Livelihood losses, displacement of communities, impact on tourism.
- ❑ **Economic:** Cleanup costs, loss of marine resources, compensation claims.
- ❑ **Political:** Stricter regulations, international relations impact.
- ❑ **Environmental:** Marine and coastal ecosystem damage, long-term contamination.
- ❑ **Health:** Respiratory problems, skin irritations, long-term exposure risks.
- ❑ **Psychosocial:** Community stress, mental health issues, loss of cultural sites.

Disaster Vulnerability Profile of India

General Profile

India, due to its diverse geography and socio-economic conditions, is highly vulnerable to a variety of disasters, including technological disasters.

Tamil Nadu

Tamil Nadu, a state in southern India, faces specific challenges:

- **Urbanization:** Rapid urban growth increases vulnerability to structural collapses and industrial accidents.
- **Industrialization:** A high concentration of industries raises the risk of accidents and environmental pollution.
- **Coastal Location:** Proximity to the sea makes it susceptible to oil spills.

Impacts in India

- **Social:** High population density increases casualty risks.
- **Economic:** Significant industrial and agricultural sectors mean large economic losses.
- **Political:** Frequent disasters lead to regular policy and regulatory changes.
- **Environmental:** Diverse ecosystems are at risk from pollution and degradation.
- **Health:** Public health infrastructure can be strained by frequent disasters.
- **Psychosocial:** High disaster frequency leads to widespread mental health challenges.

Global Trends in Disasters

Urban Disasters

- **Causes:** Urbanization, aging infrastructure, climate change.
- **Trends:** Increased frequency of building collapses, industrial accidents.

Pandemics

- **Causes:** Global travel, urban density, ecological disruption.
- **Trends:** Increased incidence of pandemics due to global interconnectedness.

Complex Emergencies

- **Causes:** Combination of conflict, natural disasters, and technological failures.
- **Trends:** More frequent and severe due to global instability and climate change.

Interrelations between Disasters and Sustainable Development Goals (SDGs)

Disasters significantly impact the achievement of SDGs, particularly:

- **SDG 1:** No Poverty - Disasters can push vulnerable populations further into poverty.
- **SDG 3:** Good Health and Well-being - Health impacts from disasters are profound.
- **SDG 6:** Clean Water and Sanitation - Disasters often disrupt water and sanitation infrastructure.
- **SDG 11:** Sustainable Cities and Communities - Urban disasters directly challenge the goal of making cities safe and sustainable.
- **SDG 13:** Climate Action - Climate change exacerbates the frequency and severity of disasters.

Effective disaster risk reduction and management are crucial for sustainable development, requiring integrated approaches that consider the social, economic, environmental, and health dimensions of disasters.