Unit-4

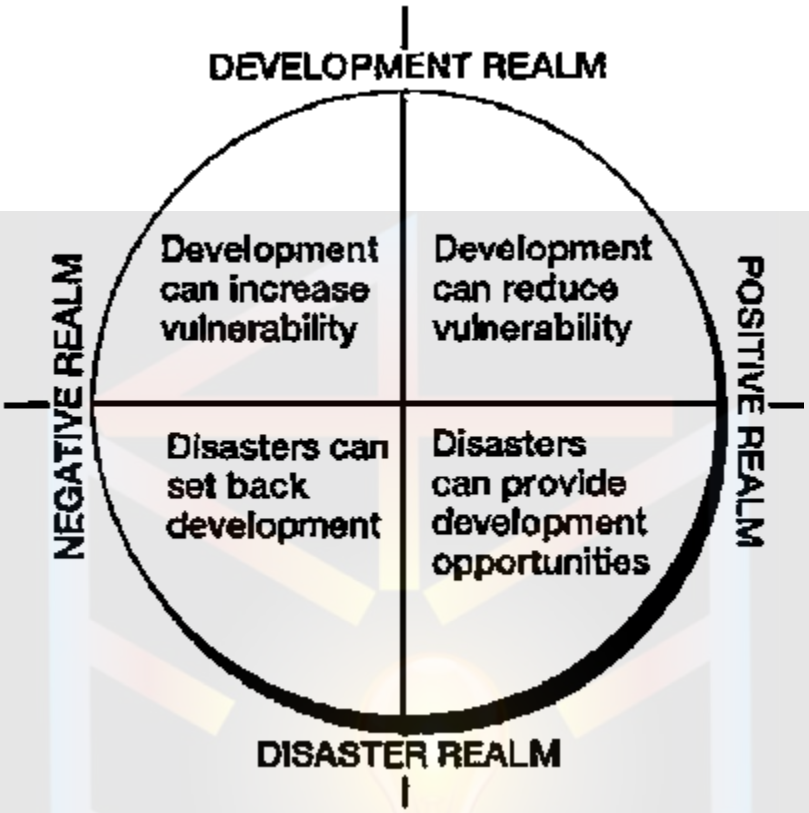
Relationship between disaster and development

- Disasters can both destroy development initiatives and create development opportunities.
- Development schemes can both increase and decrease vulnerability.

- When a disaster did occur, the response was directed at meeting emergency needs and cleaning up.
  In the current approach, it has been realized that much more can and need to be done to reduce the severity of hazards and disasters.
- A growing body of knowledge on the relationships between disasters and development indicates four basic themes as follows:

➢ Disasters set back development programming
➢ Rebuilding after a disaster provides significant opportunities to initiate development programmes.
➢ Development programmes can increase an area's susceptibility to disasters.
➢ Development programmes can be designed to decrease the susceptibility to disasters

Projects are thus being designed to include disaster recovery programmes and with long term development needs in mind.



□ The relationship between disasters and development can be summed up with 4 concepts:

- development can increase vulnerability
  - development can reduce vulnerability
  - disasters can set back development
  - disasters can provide development opportunities

□ Disaster effects vary with the hazard type causing the disaster

□ Vulnerability varies between different societies and economies

- newly industrializing economies
  - rural/agricultural economies
  - small island economies
  - highly stressed economies

Factors affecting vulnerability:

Demographic factors:

- size of vulnerable population
- population density

socioeconomic factors:

- a country's level of development
- an individual wealth

Community preparedness

- public education
- recent hazard events
- early warning system
- building codes

A community's ability to deal with a hazard

- governance
- effective lines of communication
- emergency personnel
- insurance cover

Differential impacts:

Caste:

- Housing condition of these people are precarious and risk
- During flood they have no space to take shelter, neither the higher caste people allow them to take temporary shelter in their paka houses.
- poverty and disaster make them worse.
- Lack of information about a possible occurrence of disaster make threat to their lives and livelihood.
- Bonded labour increases.
- Scheduled Tribe people inhabited at the foot of the hills and mountain and flash flood wash them away

Gender:

- Women, children, widow, destitute and adolescent girls are most vulnerable.
- Young women, adolescent girls and young widows are exposed to sexual violence.
- Elderly persons are both women and men are neglected.

Age:

- Youngest and oldest people are mostly impacted

Location

- People living in the low land area, river sides, side of the river embankment, Sea coast lines are most prone to be affected by the natural calamities.

- Places often prone to ethnic or communal violence.
- Places more prone to earthquake.

Disability

- Unable to hear danger signals, alarms, etc.
- Difficulty in evacuation & protection
- Difficulty in getting access to relief and compensation money
- Difficulty locating avenues of escape
- Have to face the shock of losing all that they had attained in life

IMPACTS OF DAMS AND EMBANKMENTS ON PEOPLE:

- Environmental impacts of dams
  - Terrestrial ecosystems and biodiversity
  - Greenhouse gas emissions
  - Downstream aquatic ecosystems and biodiversity
  - Impacts of changes in flow regines
  - Impacts of trapping sediments and nutrients behind a dam
  - Blocking migration of aquatic organisms
- Non reciprocal effects of dams on society
  - Hydropower
  - Irrigation, drainage and flood control
  - Displacement of people and livelihoods
  - Downstream livelihood
  - Cultural heritage

■ Socio economic impacts through planning and project cycle

Dams and their Effects on Forests and Tribal People!

- dams constitute a major direct and indirect cause of forest loss
- most users of hydro-electricity live far away from the impacted areas
- the sites selected for dam building are inhabited by indigenous peoples, tribal people, ethnic minorities.
- The fact is that more than 40,000 large dams — those that measure more than 15 metres in height — are currently obstructing the world's rivers, whose reservoirs cover more than 400,000 square kilometers of land.
- They have also resulted in deforestation elsewhere, as farmers displaced by the dams have had to clear forests in other areas in order to grow their crops and build their homes.
- dams imply road building, thus allowing access to previously remote areas by loggers and "developers", resulting in further deforestation processes.
- At the same time, dams imply a number of health hazards, starting with diseases - AIDS, syphilis, tuberculosis, measles, malaria, schistosomiasis, river blindness, etc.
- In far too many cases, dam-building has resulted in widespread human rights violations

- Local people have increasingly been able to organize themselves and to establish local, national and international alliances with other concerned organizations.

- Major examples are the Narmada Bachao Andolan movement in India, the Bio Bio Action Group in Chile, the Coalition of Concerned NGOs on Bakun in Malaysia, the People Affected by Dams movement in Brazil among many others. It has now become possible to stop large hydro dams. They are definitely not a symbol of development but one of economic and political power resulting in social and environmental degradation

Embankment - a wall or bank of earth or stone built to prevent a river flooding an area or to store water in a dams.

- **So it has same features of dams**

Impact of change in land use

Socio economic Impacts of Land–Use Changes

• Conversion of farmland and forests to urban development

• Soil erosion, salinization, desertification, and other soil degradations

• Urban development has encroached upon some rural communities to such an extent that the community's identify has been lost

• Suburbanization intensifies income segregation and economic disparities among communities

• Land use regulations that aim at curbing land development will raise housing prices,

• Land use regulation must strike a balance between private property rights and the public interest

Environmental Impacts of Land–Use Changes

• Runoff from agriculture is a leading source of water pollution

• Draining wetlands for crop production and irrigation water diversions has had a negative impact on many wildlife species

• Irrigated agriculture has changed the water cycle and caused groundwater levels to decline in many parts of the world

• Intensive farming and deforestation may cause soil erosion, salinization, desertification,

• Deforestation adds to the greenhouse effect, destroys habitats that support biodiversity

• Urban development causes air pollution, water pollution, and urban runoff .

• Habitat destruction, fragmentation, and alteration associated with urban development are a leading cause of biodiversity

• Urban development and intensive agriculture in coastal areas and further inland is a major threat to the health

CLIMATIC CHANGE:

Disaster risk is magnified by climate change; it can increase the hazard while at the same time decreasing the resilience of households and communities.

projected impacts of climate change that will drive disaster risk include:

- **Decreasing agricultural yields in warmer environments due to heat stress**
- **Rising sea levels**
- **More severe and frequent extreme precipitation events,** which will intensify **existing patterns of extensive risk**
- **Changes in the geographic distribution of weather-related hazards,**
- **Decreasing resilience,**

Climate change refers to the sum of all statistical weather information of the atmospheric elements, with specified area over a long period of time.

Climate is a dynamic process and changes to a lesser or greater degree.

The Earth's surface and lowest part of the atmosphere have warmed up to an average by almost 0.6C during the last 100 years.

The United Nations Framework Convention on Climate Change (UNFCC-1992) and the Kyoto Protocol (KP-1997) represent the first steps taken by the international community to protect the climate system.

Several countries have agreed to reduce greenhouse gas emissions by about 5% by 2008 to 2012.

In practical terms, this means

1. using resources, particularly fossil-fuel-derived energy more efficiently

2. reusing and recycling products wherever possible and

3. developing renewable forms of energy that are inexhaustible and do not pollute the environment

Causes of climate change

1. Variation of Earth's orbital characteristics

2. Atmospheric carbon dioxide variations

3. Volcanic eruptions and

4. Variations in solar output

Effects of climate change

1. Mean Sea Level (MSL) is increased by around 1.8mm per year.

2. Many ecosystems of the world will have to adapt rapidly

3. The rate of species becoming extinct will be increased.

4. Human health, agriculture, forestry and water resources will be affected.

5. Increasing change in surface temperatures, changing rates of evapo-transpiration and precipitation

6. unexpected flooding and drought

7. Societies experiencing social, economic and climatic stress will be worst affected.

Global warming - Definition, Effects, Control and Remedial measures

Global warming is defined as the increase in temperature of Earth, that causes change in climate

An increase in industrial, agricultural and other human activity results in release of more green house gases in the atmosphere. These gases cause the atmosphere to trap increasing amounts of heat energy in the Earth's surface making the planet warmer than usual.

The global temperature is now 1C higher than in 1900.

The warmest year of the millenium was 1998.

The International Red Cross and Red Crescent have analyzed the past 33 years of natural disasters and 90% of them were weather related.

Effects of Global Warming

1. More heat waves
2. Expansion of desert area
3. Natural fires in forest lands
4. More evaporation of water from oceans and water bodies
5. Melting of Ice caps in Arctic and Antarctic regions
6. More cloud formation in the atmosphere
7. Shorter and warmer winters coupled with longer and hotter summers
8. Changes in rainfall pattern
9. Rise in sea level
10. Flooding and submergence of low lying coastal areas
11. Disruption in farming
12. More drought
13. Impact on plants, animals and humans

Control and remedial measures:

1. Reduction in consumption of fossil fuels such as coal and petroleum
2. Use of bio-gas plants
3. Use of nuclear power plants

4. Increasing forest cover

5. Use of unleaded petrol in automobiles

6. Installation of pollution controlling devices in automobiles

Ozone layer depletion process

Ozone is a colourless, odorless gas composed of three atoms of oxygen (O3).

Ozone is formed naturally in the upper stratosphere when wavelengths less than 240nm are absorbed by normal oxygen molecules which dissociate to give O atoms. The O atoms in combination with other oxygen molecules produce ozone.

In the stratosphere, about 19 to 30 km above the Earth's surface, ozone is constantly being produced and destroyed naturally.

This production and destruction makes stratosphere with ozone layer that filters the Ultra-Violet radiation from the Sun and protects life on Earth.

Man-made chemicals called Chloro Fluoro Carbons(CFCs) are used as aerosol sprays, refrigerants and coolants etc destroy ozone molecules in the stratosphere.

The equations involved are:

$Cl + O_3 = ClO + O_2$

$ClO + O = Cl + O_2$

Hence, net effect: $O_3 + O = 2O_2$

Chlorine atom in the above reaction functions as a catalyst and is not consumed in the reaction. Chloro-Fluoro-Carbons are very stable molecules and can live upto 100 years.

Ozone Depletion Potential (ODP)

The ozone depletion potential of a compound is defined as the measure of its ability to destroy stratospheric ozone. It may be defined as the ratio of total amount of ozone destroyed by a particular agent to the amount of ozone destroyed by the same mass of CFC-11.

The ODP of CFC-11 is always taken as 1.0 ODP is a relative measure with CFC-11 taken as a standard reference.

Factors affecting ODP

1. Nature of the halogen

2. The number of chlorine or bromine atoms in a molecule.

3. Molecular mass and

4. Atmospheric lifetime

Effects on human health

1. Reddening of skin in sun shine (Sun burn)

2. Skin cancer

3. Reduction in body's immunity to disease

4. Eye disorders like cataracts and blindness

Other living organisms

1. UV rays are particularly harmful to small plants and animals living in the sea called 'plankton'.

2. UV rays damage certain crops like rice

3. UV radiation can damage polymers used in paint, clothing.

Green house gases:

Greenhouse gases are those that absorb and emit infrared radiation .

In order, the most abundant greenhouse gases in Earth's atmosphere are:

- Water vapor (H_2O)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Ozone (O_3)
- Chlorofluorocarbons (CFCs)
- Hydrofluorocarbons (incl. HCFCs and HFCs)

Atmospheric concentrations are determined by the balance between sources (emissions of the gas from human activities and natural systems) and sinks (the removal of the gas from the atmosphere by conversion to a different chemical compound)

The proportion of an emission remaining in the atmosphere after a specified time is the "airborne fraction" (AF).

The *annual airborne fraction* is the ratio of the atmospheric increase in a given year to that year's total emissions.

Without greenhouse gases, the average temperature of Earth's surface would be about −18 °C (0 °F), rather than the present average of 15 °C (59 °F).

The atmospheres of Venus, Mars and Titan also contain greenhouse gases.

Human activities since the beginning of the Industrial Revolution (around 1750) have produced a 40% increase in the atmospheric concentration of carbon dioxide (CO2), from 280 ppm in 1750 to 406 ppm in early 2017.

Adaptation:

- An adjustment in natural or human systems in response to actual or expected climate stimuli or their effects which moderates harm or exploits benefit opportunities is adaptation

Indigenous knowledge

- Also called as local knowledge, traditional knowledge, peasant's knowledge, traditional ecological knowledge, indigenous technical knowledge,
- Main characteristics of indigenous knowledge
  - Home grown, derived from the solution of everyday life problems
  - Part and parcel of community's cultural practices and ways of life
  - Often undocumented, passed on orally from one generation to another
- Indigenous knowledge is body of knowledge existing within or acquired by local people over a period of time
- Importance of indigenous knowledge:
  - Inhabitants of coastal areas have been developing mechanisms to survive and to adapt to such hazards for centuries.

- Qualitative
- Holistic
- Mind and matter together
- Moral, spiritual
- Empirical observations and accumulation of facts by trial and error
- Diachronic data

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:

• 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. Theses 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.

• **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.

• **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

GIS

GIS is defined as a system for capturing, storing, checking, integrating, manipulating, analysing and displaying data which are spatially referenced to the earth.

Remote Sensing

Remote sensing is defined as the art and science of obtaining information about an object, area or phenomena, through the analysis of data acquired by a device that is not in contact with the object, area or phenomena under investigation.

GIS in disaster management

GIS can be useful in the following ways in disaster management:

1. to create hazard inventory maps

2. locate critical facilities
3. to create and manage associated databases
4. for effective vulnerability assessment

APPLICATIONS OF REMOTE SENSING & GIS IN DISASTER MANAGEMENT

1. Space technologies and disaster mitigation communities helps to develop accurate methods for prevention, preparedness and relief measures.
2. Disaster preparedness focusses on warnings and forecasts of impending disasters.
3. Disaster relief occurs after (and sometimes during) the emergency.
4. Satellite monitoring involves assessment of damage incurred during the disaster.
5. Satellite technology helps in identifying escape routes.
6. Remote sensing and GIS are among the many tools available.
7. The spectral bands in VIS (VISible), NIR (Near Infra Red), IR (Infra Red), SWIR (Short Wave Infra Red), TIR (Thermal Infra Red) and SAR (Synthetic Aperture Radar) provide adequate spectral coverage. This data can be enhanced using a computer and used for effectively managing disasters.
8. Repetitive or multi-temporal coverage is justified since the data can be used to study dynamic phenomenon whose changes can be identified over time. For example:
    1. Natural hazard events

2. Changing land use patterns
3. Hydrologic and geologic characteristics of a region

9. Experts in disaster management:
    1. Monitor the situation
    2. Accurately simulate complex natural phenomena
    3. Suggest appropriate contingency plans and
    4. Prepare spatial databases
10. The following are the characteristics of remotely sensed images:
    1. Spatial continuity
    2. Uniform accuracy and precision
    3. Multi-temporal coverage
    4. Complete coverage regardless of site location
11. Use of remotely sensed data:
    1. Planning efficient escape routes
    2. Charting quickest routes for ambulances to reach victims
    3. Locating places for shelter for victims or refugees
    4. Calculating population density in disaster prone areas
    5. Rapidly identifying hardest-hit disaster areas
    6. Pre-disaster assessments to facilitate planning
    7. Monitoring reconstruction or rehabilitation

8. Developing, maintaining or updating accurate base maps.

Earthquakes

- Faults associated with earthquakes can be identified on good resolution satellite imagery.

1. Land-use and geological maps give vital pointers towards potential earthquake zones.
2. Satellite sensors that are active in VIS (VISible) and NIR (Near Infra Red) spectral bands are useful for the above mentioned purpose.
3. IRS, NOAA, SPOT, LANDSAT and IKONOS collect required data. However, LANDSAT imageries are popular as they have a huge historical archive data and are cost effective.

According to the seismic classification of India, Zone V that covers the following locations is most prone to earthquakes:

1. North-East India
2. Jammu & Kashmir
3. Himachal Pradesh
4. Uttarakhand (Due to movement of Indian and Asian plate) and
5. Gujarat

Tsunami

1. Tsunamis are water waves or seismic sea waves caused by large-scale sudden movement of sea floor.
2. They are less than 1m surface height in mid ocean where they originate.

3. They travel at speeds touching 900 kmph.
4. Time between successive waves is almost 20 to 40 minutes.
5. Near the coastline, sea receedes lower than the lowest tide and then rises as a giant wave.
6. Satellite or aerial photography when combined with a good GIS database of an area, provides critical information to emergency managers.

Floods : Floods are a result of excess run-off, which could increase or decrease depending upon various factors such as:

1. Intensity of rainfall
2. Snow melt
3. Soil type
4. Soil moisture condition
5. Land use / Land cover

Flood plains and flood prone areas can be identified on remotely sensed imagery.

Remotely sensed imagery is used for:

1. Flood mapping using images of peak flood and post flood
2. Flood forecasting based on cloud patterns

The major hurdle in recording floods is that optical satellites cannot penetrate clouds that are present in atmosphere during rainfall.

Optical satellites perform passive remote sensing while Synthetic Aperture Radar (SAR) uses remote sensisng which is active remote sensing.

Fire:

Fire detection by satellites provides a highly efficient means of detecting and eradicating forest fires without large number of ground based workers.
Thermal Infrared imagery shows 'HOTSPOTS'

Instruments used to predict occurrence of natural disasters

- Continuous television and radio broadcasts of severe weather by real-time
- near real-time data from meteorological stations and satellite images for prediction of cyclones or floods
- Seismic instruments are used to measure low-frequency ground motion caused by earthquakes.
- Instruments that are used to predict earthquakes include the following:
  1. Creepmeters, to warn of movement of the earth's soil;
  2. Global positioning systems, to warn of movement of the earth's crust;
  3. Laser light, to warn of disrupted light beam transmission from one side of a fault line to another;
  4. Magnetometer, to warn of magnetic field changes;
  5. Strainmeters, through the coordinated use of the seismometer and the seismograph, to warn of underground vibrations or shock waves.
- A drought can be predicted by the consistent lack of rainfall
- A Tsunami can be predictted using a 'tsunameter'

Landslides and use of remote sensing to predict their occurrence

Predicting occurrence of landslides using remote sensing techniques:

Landslides are one of the most damaging natural hazards in mountainous

terrain.
Weathered material soaked with rain water slides down due to gravity.

This sudden downward slip movement of rock material is called landslide.

Landslides can occur due to:

- condition of soil
- moisture and
- angle of slope

The main factors triggering landslides are:

- heavy and prolonged rainfall
- cutting and deep excavation on slope for construction of buildings, roads, canals
- earthquake shocks and tremors

Widespread deforestation for development activities and increasing population pressure has forced people to conduct agriculture on steeper slope.

Remote sensing images provide useful land use information that can be used in conjunction with GIS software along with other spatial factors to predict the occurrence of a landslide.

Satellite images can be used to recognise and interpret detailed geomorphic characteristics of large and small landslides and determine the likelihood of a landslide.

Remote sensing techniques have been widely used to study characteristics of land surface due to advantage of repetitive data acquisition of a large area in a short time.

Elevation and terrain slope can be determined from Digital Elevation Model (DEM) generated from aerial photographs using stereo correlation techniques.

All the risk maps are combined using spatial analysis and a final risk map is produced taking into account all the factors.

Crowdsourcing and ICT in disaster management

Crowdsourcing:

- Crowd-sourcing is a method of information collection that utilizes data collected from volunteers.
- It is being increasingly used to produce information before a disaster takes place and thus aiding in disaster preparedness.

ICT:

Information and Communications Technologies (ICTs) are used in anticipating, communicating and organizing actions before, during and after disaster events.

'Sahana' and 'Ushahidi' are two software programs that focus on crisis management.

The lifecycle of a crowdsourced emergency report consists of:

- the local observer

-a web-user with some knowledge of linked open-data and
-the information manager working for a relief organisation

Crowdsourcing linked open data is the next step towards a full exploitation of crowdsourced information in disaster management.