Lecture 13 Disaster management, Floods, earthquakes, cyclones and land slides.

Disaster is a sudden, calamitous event bringing great damage, loss, destruction and devastation to life and property. The damage caused by disaster is immeasurable and varies with the geographical location, climate and the type of the earth surface. This influences the mental, socio-economic, political and cultural state of the affected area. Generally, disaster has the following effects in the concerned areas**,**

1. It completely disrupts the normal day to day life

2. It negatively influences the emergency systems

3. Normal needs and processes like food, shelter, health, etc. are affected and deteriorate depending on the intensity and severity of the disaster.

It may also be termed as "a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected society to cope using its own resources."

Types of Disaster

Generally, disasters are of two types – **Natural** and **Manmade**. Based on the devastation, these are further classified into major/minor natural disaster and major/minor manmade disasters. Some of the disasters are listed below,

Major natural disasters:

- Flood
- Cyclone
- Drought
- Earthquake

Minor natural disasters:

- Cold wave
- Thunderstorms
- Heat waves
- Mud slides
- Storm

Major manmade disaster:

- Setting of fires
- Epidemic
- Deforestation
- Pollution due to prawn cultivation
- Chemical pollution.
- Wars

Minor manmade disaster:

- Road / train accidents, riots
- Food poisoning
- Industrial disaster/ crisis
- Environmental pollution

Disaster Management

There are no standardized rules defining the different phases of the disaster management cycle. Different agencies use different cycles depending upon their objectives. However, while approaches vary, it is agreed that disaster management activities should be carried out in a cycle. The following figures illustrates the phases of the disaster management cycle, which are described as follows:

The Disaster Management Cycle

Disaster prevention, mitigation and preparedness

The first important steps towards reducing disaster impact are to correctly analyse the potential risk and identify measures that can prevent, mitigate or prepare for emergencies. Information and Communication Technology can play a significant role in highlighting risk areas, vulnerabilities and potentially affected populations by producing geographically referenced analysis through, for example, a geographic information system (GIS). The importance of timely disaster warning in mitigating negative impacts can never be underestimated. For example, although damage to property cannot be avoided, developed countries have been able to reduce loss of life due to disasters much more effectively than their counterparts in the developing world. A key reason for this is the implementation of effective disaster warning systems and evacuation procedures used by the developed countries, and the absence of such measures in the developing world.

Comparison of Damage Caused by Three Recent Disasters

Incident	Considered area	Number of deaths	Estimated financial loss
Indian Ocean tsunami (December 2004)	Sri Lanka	30,920 or 38,195 (two different official estimates)	US$1 billion damage and US$1.8 billion recovery costs
Northern Pakistan earthquake (October 2005)	Pakistan	87,350 (official) Over 100,000 (unofficial)	US$5 billion
Hurricane Katrina (August 2005)	New Orleans, USA	1,604 accounted for (both direct and indirect) 2,000 missing	US$25 billion-US$100 billion US$75 billion (according to the US National Hurricane Center)

All the figures reported in the above table are rough estimates as it is impossible to have exact figures in such situations. However, it clearly shows that in the case of Hurricane, Katrina, although the economic loss and damage to property were much higher, the number of deaths was remarkably less than that resulting from the Indian Ocean tsunami in Sri Lanka and the Pakistan earthquake. This is largely because in Sri Lanka and Pakistan, the victims were mainly communities living below the poverty line – a factor that significantly contributed to their vulnerability – and because effective disaster warning systems were not in place. In New Orleans, official warnings were dispatched in advance and

many in the affected areas were evacuated in time. In addition, the disaster management process was much better than what it had been in Sri Lanka and Pakistan, despite the heavy criticism it received.

A warning can be defined as the communication of information about a hazard or threat to a population at risk, in order for them to take appropriate actions to mitigate any potentially negative impacts on themselves, those in their care and their property.

The occurrence of a hazard does not necessarily result in a disaster. While hazards cannot be avoided, their negative impacts can be mitigated. The goal of early public warning is to ensure to the greatest extent possible that the hazard does not become a disaster. Such warnings must be unambiguous, communicate the risks succinctly and provide necessary guidance.

The success of a warning can be measured by the actions that it causes people to take, such as evacuation or avoiding at-risk areas. In a disaster situation, there is no doubt that timely warnings allow people to take actions that saves lives, reduce damage to property and minimize human suffering. To facilitate an effective warning system, there is a major need for better coordination among the early warning providers as well as those handling logistics and raising awareness about disaster preparedness and management.

While disaster warnings are meant to be a public good, they are often most effectively delivered through privately-owned communication networks and devices. There are many new communication technologies that allow warning providers not only to reach the people at risk but also to personalize their warning message to a particular situation. Opportunities are available right now to significantly reduce loss of life and potential economic hardship if disaster warning systems can be improved.

It is important to note that disaster warning is indeed a system, not a singular technology, constituting the identification, detection and risk assessment of the hazard, the accurate identification of the vulnerability of a population at risk, and finally, the communication of information about the threat to the vulnerable population in sufficient time and clarity so that they can take action to avert negative consequences. This final component underscores the importance of education and creating awareness in the population so that they may respond with the appropriate actions.

Disaster Warning

Disaster Reduction identifies several key parties that play major roles in the disaster management process, especially in disaster warning.

Communities, particularly those most vulnerable, are vital to people-centred early warning systems. Their input into system design and their ability to respond ultimately determine the extent of risk associated with natural hazards. Communities should be aware of hazards and potential negative impacts to which they are exposed and be able to take specific actions to minimize the threat of loss or damage. As such, the geographic location of a community is an essential determinant in the selection of disasters on which the system should focus their community education. For example, coastal communities need to be educated and prepared for the possibility of a tsunami, while a mountain community can be educated to respond to an early warning system for landslides.

Local governments should have considerable knowledge of the hazards to which their communities are exposed. They must be actively involved in the design and maintenance of early warning systems, and understand information received to be able to advise, instruct or engage the local population in a manner that increases their safety and reduces the potential loss of resources on which the community depends.

National governments are responsible for policies and frameworks that facilitate early warning, in addition to the technical systems necessary for the preparation and issuance of timely and effective hazard warnings for their respective countries. They should ensure that warnings and related responses are directed towards the most vulnerable populations through the design of holistic disaster response and early warning frameworks that address the specific needs of the related micro- and macro-level actors. The provision of support to local communities and local governments to develop operational capabilities is an essential function to translate early warning knowledge into risk reduction practices.

Regional institutions and organizations should provide specialized knowledge and advice in support of national efforts to develop or sustain the operational capabilities of countries that share a common geographical environment. Regional organizations are crucial to linking international capabilities to the particular needs of individual countries and in facilitating effective early warning practices among adjacent countries.

International bodies should provide support for national early warning activities and foster the exchange of data and knowledge between individual countries. Support may include the provision of advisory information, technical assistance, and policy and organizational support necessary to ensure the development and operational capabilities of national authorities or agencies responsible for early warning practice.

Non-governmental organizations (NGOs) play a critical role in raising awareness among individuals and organizations involved in early warning and in the implementation of early warning systems, particularly at the community level. In addition, they play an important advocacy role to help ensure that early warning stays on the agenda of government policy makers.

The private sector has a diverse role to play in early warning, including developing early warning capabilities in their own organizations. The private sector is also essential as they are usually better equipped to implement Information and Communication Technology-based solutions. The private sector has a large untapped potential to help provide skilled services in the form of technical manpower, know-how, or donations of goods or services (in-kind and cash), especially for the communication, dissemination and response elements of early warning.

The media plays an important role in improving the disaster consciousness of the general population and in disseminating early warnings. The media can be the critical link between the agency providing the warning and the general public.

The scientific community has a critical role in providing specialized scientific and technical input to assist governments and communities in developing early warning systems. Their expertise is critical to analysing the risks communities face from natural hazards, supporting the design of scientific and systematic monitoring and warning services, fostering data exchange, translating scientific or technical information into comprehensible messages, and disseminating understandable warnings to those at risk.

Channels Used for Disaster Warning

Radio and Television

Considered the most traditional electronic media used for disaster warning, radio and television have a valid use. The effectiveness of these two media is high because even in developing countries and rural environments where the tele-density is relatively low, they can be used to spread a warning quickly to a broad population. The only possible drawback of these two media is that their effectiveness is significantly reduced at night, when they are normally switched off.

After the Indian Ocean tsunami of 2004, many radio manufacturers considered introducing new digital radio alert systems that react even if the set is switched off. In order to trigger this alarm, a special flag integrated into the received signal from a terrestrial transmitter or a satellite would be used and the set would automatically tune to the emergency broadcast channel. The only disadvantage of

this system is that to introduce a new generation of receivers in analogue environment generally takes 5 to 10 years. With digital receivers, this would be somewhat easier (Dunnette, 2006).

Telephone (Fixed and Mobile)

Telephones can play an important role in warning communities about the impending danger of a disaster.

Short Message Service

Short message service (SMS) is a service available on most digital mobile phones that permits the sending of short messages (also known as 'text messages', 'SMSes', 'texts' or 'txts') between mobile phones, other handheld devices and even landline telephones.

Satellite Radio

A satellite radio or subscription radio is a digital radio that receives signals broadcast by communications satellite, which covers a much wider geographical range than terrestrial radio signals. Satellite radio functions anywhere there is line of sight between the antenna and the satellite, given there are no major obstructions such as tunnels or buildings. Satellite radio audiences can follow a single channel regardless of location within a given range.Satellite radio can play a key role during both disaster warning and disaster recovery phases. Its key advantage is the ability to work even outside of areas not covered by normal radio channels. Satellite radios can also be of help when the transmission towers of the normal radio station are damaged in a disaster.

Internet/Email

The role Internet, email and instant messages can play in disaster warning entirely depends on their penetration within a community and usage by professionals such as first responders, coordinating bodies, etc. While these media can play a prominent role in a developed country, where nearly half of all homes and almost all offices have Internet connections, this is not the case in the developing world. In many developing countries, less than 5 percent of the population uses the Internet and even those who are users do not use it on a regular basis. In such a situation, it is difficult to expect Internet and email to play any critical role.

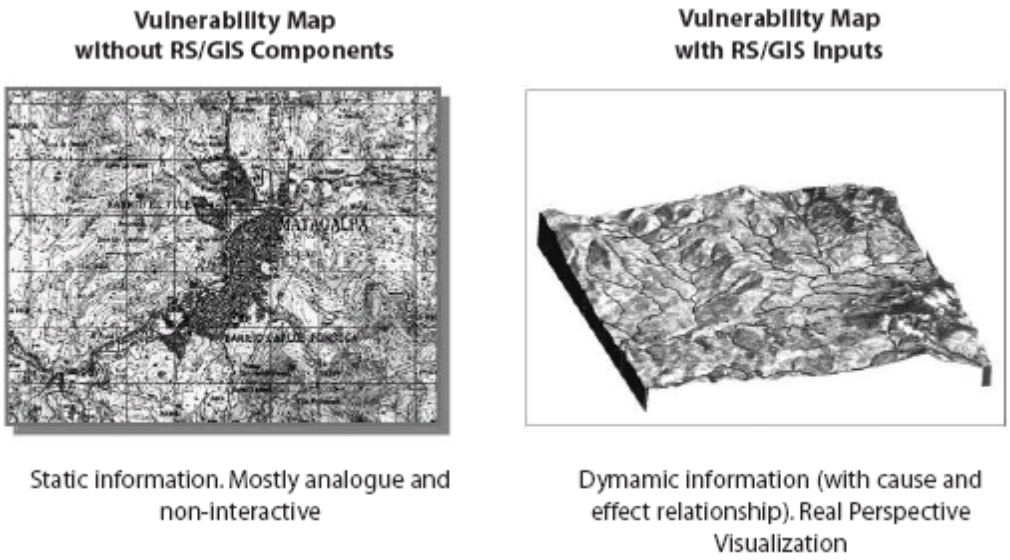
GIS and Remote Sensing in Disaster Management

GIS can be loosely defined as a system of hardware and software used for storage, retrieval, mapping and analysis of geographic data. Spatial features are stored in a coordinate system (latitude, longitude, state, plane, etc.) that references a particular place on the earth. Descriptive attributes in tabular form are associated with spatial features. Spatial data and associated attributes in the same coordinate system can then be layered together for mapping and analysis. GIS can be used for scientific investigations, resource management and development planning.

Remote sensing is the measurement or acquisition of information about an object or phenomenon by a recording device that is not in physical or intimate contact with the object. In practice, remote sensing is the remote utilization (as from aircraft, spacecraft, satellite or ship) of any device for gathering information about the environment. Thus, an aircraft taking photographs, earth observation and weather satellites, monitoring of a foetus in the womb via ultrasound, and space probes are all examples of remote sensing. In modern usage, the term generally refers to techniques involving the use of instruments aboard aircraft and spacecraft.

As disaster management work usually involves a large number of different agencies working in different areas, the need for detailed geographical information in order to make critical decisions is high. By utilizing a GIS, agencies involved in the response can share information through databases on computer-generated maps in one location. Without this capability, disaster management workers have to access a number of department managers, their unique maps and their unique data. Most disasters do not allow time to gather these resources. GIS thus provides a mechanism to centralize and visually display critical information during an emergency.

There is an obvious advantage to using a map with remote sensing or GIS inputs instead of a static geographical map. A static map is mostly analogous and is not interactive. On the other hand, a vulnerability map with GIS input provides dynamic information with cause and effect relationship. As shown in Figure , the visualization effect is much more effective in the latter case.



Difference Between an Ordinary (2D) Map and a Map with GIS Input

The use of GIS in different phases

Planning

Locating and identifying potential problems is a core requirement in disaster management. GIS can be used effectively to achieve this objective. Using a GIS, it is possible to pinpoint hazard trends and start to evaluate the consequences of potential emergencies or disasters. When hazards are viewed with other map data, such as buildings, residential areas, rivers and waterways, streets, pipelines, power lines, storage facilities, forests, etc., disaster management officials can formulate mitigation, preparedness, response and possible recovery needs.

Mitigation

After potential emergency situations are identified, mitigation needs can be addressed. This process involves analysing the developments in the immediate aftermath of a disaster, evaluating the damage and determining what facilities are required to be reinforced for construction or relocation purposes. Mitigation may also include implementing legislation that prevents building structures in areas prone to earthquake, flood or tsunami. Other mitigation approaches may target fire-safe roofing materials in wildfire hazard areas. Utilizing existing databases linked to geographic features in GIS makes the task of monitoring these possible.

Preparedness

During the preparedness and response phases, GIS can accurately support better response planning in areas such as determining evacuation routes or locating vulnerable infrastructure and vital lifelines, etc. It also supports logistical planning to be able to provide relief supplies by displaying previously available information on roads, bridges, airports, railway and port conditions and limitations. Apart from this, activities such as evacuee camp planning can also be done using GIS.

Disaster response

The most difficult period of a disaster is the immediate aftermath. This period calls for prompt action within an exceptionally short period of time. In the aftermath of any disaster, a significant number of individuals will be injured and/or displaced. Many of them may still be living with the trauma they have encountered, including loss of loved ones. Affected individuals may also be without food or other essential items. They might be waiting in temporary shelters, with no idea what to do next. Some might need immediate medical attention, while the disaster aftermath environment also creates ideal breeding grounds for possible epidemics.

- Tracing Missing Persons
- Coordinating Donor Groups
- Recording the Locations of Temporary Camps and Shelters

Disaster recovery

Disaster reconstruction has to start as soon as the initial disaster cleanup has taken place. This is a very complex endeavour, requiring a huge array of skill sets and a thorough knowledge of an ever-increasing variety of techniques and equipment. A range of software tools are being used for these purposes. Thus, while the role of Information and Communication Technology in the long-term disaster recovery process is not as apparent as it is in disaster warning, there is no doubt that Information and Communication Technology is being used widely to expedite these activities.

Specific Disaster Management Software

Different types of software tools are being used to gather, store and analyse data related to disasters, not only in post-disaster conditions, but also as a long-term measure to mitigate the risk of the disasters. One such approach is known as DesInventar.

DesInventar is a methodical way to gather and store information about characteristics and effects of different types of disasters, particularly the ones not visible from global or national scales. This allows for the observation and analysis of accumulated data regarding these 'invisible' disasters at a global or national scale.

Despite the fact that disaster preparedness has not been identified as one of the Millennium Development Goals, it is apparent that proper mechanisms for disaster awareness and means of disaster recovery are essential to achieving the Millennium Development Goals. In particular, the Millennium Development Goal targets such as integrating the principles of sustainable development into country policies and programmes, and reversing the loss of environmental resources can never be achieved without giving due emphasis to effective disaster management strategies.

Disaster management in India

The **National Disaster Management Authority** (NDMA), headed by the Prime Minister of India, is the Apex Body for Disaster Management in India. The setting up of the NDMA and the creation of an enabling environment for institutional mechanisms at the State and District levels is mandated by the Disaster Management Act, 2005.

Evolution of NDMA

Emergence of an organization is always an evolutionary process. Establishment of NDMA has also gone through the same processes. Towards this aim, the Government of India (GOI), in recognition of the importance of Disaster Management as a national priority, has set up a High-Powered Committee (HPC) in August 1999 and also a nation committee after the 2001 Gujarat earthquake, for making recommendations on the preparation of Disaster Management plans and suggestion effective mitigation mechanisms. The Tenth Five-Year Plan Document also had, for the first time, a detailed chapter on Disaster Management. Similarly, the Twelfth Finance Commission of India was also mandated to review the financial arrangements for Disaster Management. On 23 December 2005, the Government of India enacted the Disaster Management Act, which envisaged the creation of the National Disaster Management Authority (NDMA), headed by the Prime Minister of India, and State Disaster Management Authorities (SDMAs) headed by respective Chief Ministers of the States, to spearhead and implement a holistic and integrated approach to Disaster Management in India.

Floods

A flood is an expance of water submerging land. A flood is caused by excess water in a location, usually due to rain from a storm or thunderstorm or the rapid melting of snow. A flood happens when an area of land, usually low-lying, is covered with water. The worst floods usually occur when a river overflows its banks. The flood is constituted not only of the overflowing water but also of all other waters that are unable to drainoff into water channels.

Causes of floods

1) When snow on a mountain melts or when a river or a lake of some sort overflows
2) Flooding from water displacement, such as in a landslide,
3) The failure of a dam,
4) An earthquake induced tsunami,
5) A hurricane's storm surge or melt water from volcanic activity.
6) Flooding of Coastal areas by high tides or by tsunami waves caused by undersea earthquakes.
7) A flood that rises and falls rapidly with little or no advance warning is called a flash flood. Flash floods usually result from intence rainfall over a relatively small area.

Elements at risk

1) Buildings built of earth (mud),weak foundation and water soluble material.
2) Basement of buildings.
3) Utilities such as sewerage, water supply.
4) Agricultural equipment and crops, vehicles, fishing boats etc.

Effects of flood

- Physical damage- structures such as buildings get damaged due to flood water. Landslides can also take place. Top soil gets washed away
- Causalities - people and livestock die due to drowning. It can also lead to epidemics and diseases.
- Water supplies- Contamination of water. Clean drinking water becomes scarce.
- Crops and food supplies- shortage of food crops can be caused due to loss of entire harvest.

Flood management

Flood management involves the following activities:

1) **Mapping**- of the flood prone area.
2) **Land use control**- no major development should be permitted in the areas subjected to flooding.
3) **Construction of engineered structures**- strong structures to withstand flood forces. Moreover the buildings should be constructed on an elevated area and if necessary should be build on stits.
4) **Flood control**- it aims to reduce flood damage. It includes:
    a) Flood reduction
    b) Flood diversion
    c) Flood proofing

For example,

- London is protected from flooding by a huge mechanical barrier across the river Thames, which is raised when the water level reaches a certain point.

Notable floods

- Jakarta on January 2007 till now is having a 1.5 M flood.whole city is affected. 80 people killed.
- The floods in peninsular Malaysia, Sabha and Sumithra in December 2006 and January 2007 is considered to be the worst in 100 years, resulting in evaluation of over 100,000 people in the worst-hit state of Johor at its peak.
- Ethiopia saw one of its worst floods in August 2006.

Cyclone

The name cyclone was first coined by Captain Henry Piddington, Chairman of Marine Court, Calcutta in 1848. It is derived from Greek word means coil of a snake. Cyclone is an meteorological phenomena in which an area of low pressure characterized by inward spiraling winds that rotate counter clockwise in the northern hemisphere and clockwise in the southern hemisphere of the earth. Near the places of their origin they are only 80 Km in diameter, but well developed cyclones have their diameter ranging from 300 to 1500 km. They move at faster rate over the oceans than over the land because the irregularities of the land surface retard their speed. The six main types of cyclones are polar cyclone, polar low, extra tropical, subtropical, tropical and mesoscale.

Polar cyclone

Polar or arctic cyclones are vast areas of low pressure. A polar cyclone is a low pressure weather system usually spanning 1,000-2000 kilometers per hour, in which the air circulates in a counterclockwise fashion in the northern hemisphere.

Polar low

A polar low is a small-scale, short-lived atmosphere system (depression) that is found over the ocean areas in both the Northern and southern hemispheres. They are part of the larger class of meso scale weather systems. Polar lows can be difficult to detect using conventional weather reports and are a hazard to high latitude operations, such as shipping and gas and oil platforms. Polar lows have been referred to by many other terms, such as comma cloud, mesocyclone, polar meso scale vortex, Arctic hurricane, Arctic low and depression.

Extra-tropical

An extra tropical cyclone sometimes inaccurately called a cyclone is a synoptic scale low pressure weather system that has neither tropical nor polar characteristics. The “extra-tropical” refers to the fact that this type of cyclone generally occurs outside of the tropics, in the middle latitudes of the planet. These systems may also be described as “mid-latitude cyclones” or “post-tropical cyclones.

Sub-tropical

A sub-tropical cyclone is a weather system that has some characteristics of an extra-tropical cyclone. It can in a wide band of latitude, from the equator to 50°C. ZIYAD is a very dangerous cyclone now affecting Mauritius.

Tropical

A tropical cyclone is a low-pressure cyclonic storm system. It is caused by evaporated water which comes off the ocean and becomes a storm. Typical cyclones are the worst natural hazards in the tropics. They are large revolving vortices in the atmosphere extending horizontally from 150-1000 km and vertically from the surface from 12-14 km. Strong winds spiraling anti-clockwise in the Northern Hemisphere blow around the cyclone center at the low level. At the higher levels, the sense of rotation is just opposite to that at the lower level. They generally move 300-5000 km per day over the ocean.

While moving over the ocean, they pick up energy from the warm water of the ocean and some of them grow into a devastating intensity. On an average, about 5-6 tropical cyclones form in the Bay of Bengal and the Arabian sea every year, out of which 2-3 may be severe.

Depending on their location and strength, there are various terms by which tropical cyclones are known, such as hurricane, typhoon, tropical storm, cyclonic storm and tropical depression. They are all cyclonic storm systems that form over the oceans. Tropical cyclones can produce extremely strong winds, tornadoes, torrential rain, high waves, and storm surges. The heavy rains and storm surges can produce extensive flooding. Although one cannot control cyclones, the effects of cyclones can be mitigated through effective mitigation policies and strategies.

- Installation Of Earth Warning Systems **:** Such systems fitted along the coastlines can greatly assist forecasting techniques, thus helping in early evacuation of people in the storm surge areas.
- Developing communication infrastructure Amateur Radio has today emerged as second line unconventional communications systems and is an important tool for disaster mitigation.
- Developing shelter belts: Shelter belts with plantations of trees can act as effective wind-and tide-breakers. Apart from acting as effective windbreakers and protecting soil crops from being damaged, they also prevent soil erosion.
- Developing community cyclone shelters: Cyclone shelters at strategic locations can help in minimizing the loss of human life. In the normal course of life, these shelters can be used as public utility buildings.
- Construction of permanent houses: There is a need to build appropriately-designed concrete houses that can withstand high winds and tidal waves.
- Training and education: Public awareness programs that inform the population about their response to cyclone warnings and preparedness can go a long way in reducing causalities.
- Land use control and settlement planning: Ideally, no residential and industrial units should be permitted in the coastal belt of 5 km from the sea, as it is the most vulnerable belt. No further growth of settlements in this region should be permitted. Major settlements and other important establishments should be located beyond 10 km from the sea.

Earthquakes and Mitigation Measures

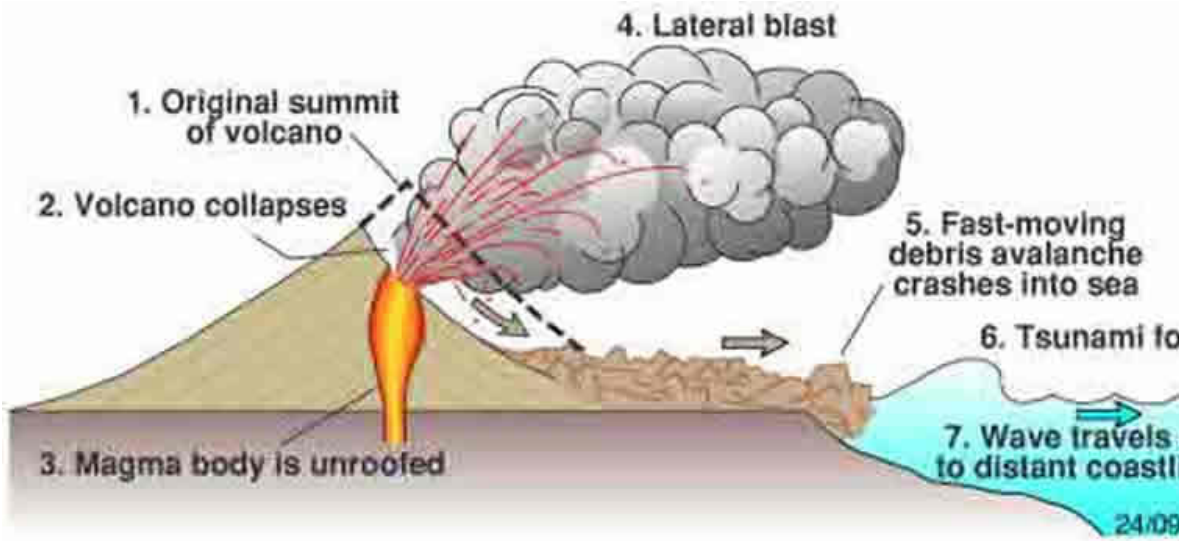
Earthquake is those movements of the earth crust which make the ground vibrate and shake backward and forward. The shaking of earth crust proceeds in the form of waves from the centre of disturbance. Longitudinal waves, transverse waves and surface waves are the 3 types of waves. Earthquake may be caused by two types of forces.

1) Techtonic occurrence: techtonic occurrence like faulting, breaking of rocks, raising or sinking of layers of the earth, folding of the strata or vapour seeking to escape from the earth.

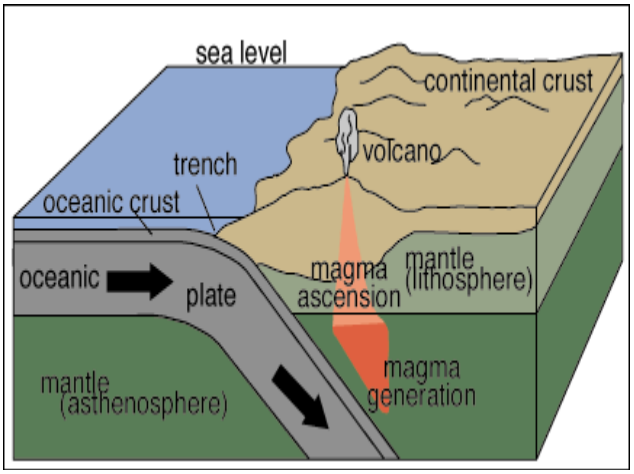
2) volcanic activity: violent eruptions and intrusion of igneous magma from below the earth.

Types of earthquake:

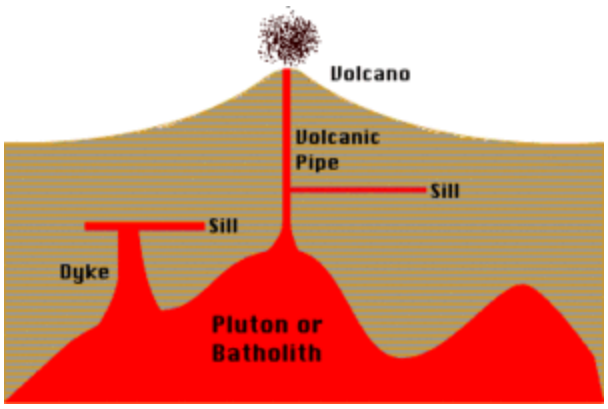
Volcanic earthquake: are associated with the flow of hot magma interrupting volcanoes. These happen to be localized and seldom cause any extensive damage.



Techtonic earthquake: are those which result from structural and justments inside the earth.



Plutonic earthquake: are those which have their origin at greater depths. They may also be generated in the same manner as the techtonic earthquake far belw the surface of the earth.



Effects of earthquake:

- Collapse of manmade structure like building, bridges, towers etc.
- Roads get affected due to subsidence of the ground and enormous fissures appear on land.
- Extensive landslides in hilly regions and rocky depris come down to block the path of streams.
- When earthquake are accompanied by volcanic activity, the destruction is very enormous**.**

Mitigation measures:

- Damage to structure can be avoided by prohibiting restriction on such earthquake prone zones.
- Power lines and pipelines can be built with extra slack where they cross such earthquake prone zones.
- New buildings should be constructed with proper earthquake resistant measures. They require secure anchoring and tight bonding of foundations, frame, outer and inner walls, floors and roofs.
- Vulnerable older building located in high risk areas might be rebuilt to withstand anticipated earth quake.

Indian Scenario

It has been several years since the earthquakes struck Gujarat on January 26, 2001, rehabitation has been done on a massive scale. Gujarat's experience has taught that building shelters with less vulnerability to earthquakes should also take into consideration of the specific needs of the victims instead of being a top-down approach. The role of NGO's in this is very important. Their strength lies in

their manpower, informality in operations and valuable human resources. Their ability to reach out to the community and sensitivity to local traditions is an asset in such situations.

The initiatives of the International Fund for Agricultural Development in supporting the self-employed Woman association(SEWA) and the Government's initiative in community-based livelihood security for earthquakes and drought victims have the potential to shape future disaster response and development projects in Gujarat, the Gujarat Woman's Economic Development Corporation (GWEDC) initiative in reviving woman's businesses after the calamity also provides many practical lessons in regenerating local economies and artisan markets.

The coordination between Government, local NGO's and local community initiatives, both for rescue as well as rehabilitation, needs to be strengthened as this can cause delays, overlaps and waste of relief material and efforts.

Land Slides and Mitigation Measures

In the recent years, intensive construction activity and the destabilizing forces of nature have aggravated the land Slide problem. Landslides refer to the downward sliding of huge quantities of land masses. Sliding occurs along steep slopes of hills of mountains. The rate of movement of such a mass is never constant. Landslides occur as a result of changes on a slope, sudden or gradual, either in its composition, structure, hydrology or vegetation. The changes can be due to geology, climate, weathering, changing land use and earthquakes.

The causes of landslides may be grouped into two types:

- Inherent or internal causes.
- Immediate causes.

Effect of landslides:

Landslides are not only destructive to the man but also to the structures. One of the most disastrous landslides occurred in Switzerland in 1806, when great masses of loose rock and soil suddenly slide down into the valley form the mountainside. It resulted in killing of 800 persons. Initially the Vajont

Dam, was the highest arch failed due to landslide on October 9, 1963, when a rock mass of about 600 million tons slide down into the lake.

- A significant reduction in hazards caused by landslides can be achieved by prevention of the exposure of population and facilitates by physically controlling the landslides.
- Development programs that involve modification of the topography, exploitation of natural resources and change in the balance load on the ground should not be permitted.
- Some critical measures that could be undertaken to prevent further landslides are drainage measures, erosion control measures such bamboo check-dams, terracing, jute and coir netting and rock control measures such as grass plantation, vegetated dry masonry walls, retaining walls and, most importantly, preventing deforestation and improving afforestation.
- Disasters cannot be totally prevented. However, early warning systems, careful planning and preparedness on part of the vulnerable community would help in minimizing the loss of life and property due to these disasters.

Lecture 13 Disaster management, Floods, earthquakes, cyclones and land slides.

1	The natural hazard that does not occur in India?	
	a) Earthquake	**b)Volcano**
	c) Cyclone	d) Radioactive emissions.
2	Mud slide is a ---------- Disaster	
	a)Man made	b)Natural Disaster
	c)major Natural Disaster	**d) Minor natural Disaster**
3	The main reason for high Loss of life in developing world due to disasters is lack of ---------- **(effective disaster warning systems)**	
4	The advantage of using a map with remote sensing or GIS instead of a static geographical map is ----------	
	a)Not interactive	**b)Interactive**
	c)No visualization effect	d)low visualization effect
5	Fire safe roofing is a mitigation approach in ----------	
	a) Fire hazards	**b) Wildfire hazard areas**
	c)Tsunami affected areas	d) cyclone affected areas
6.	Specific Disaster Management Software is ---------- **(DesInventar)**	
7.	The National Disaster Management Authority (NDMA), headed by---------- the, is the Apex Body for Disaster Management in India.	
	a)President of India	**b)Prime Minister of India**
	c) Minister, MoEF	d) None of the above
8.	Disaster management Act was enacted in the year ----------	
	a)2005	b)2004
	c)2002	d)2001
9.	Flood Control aims	
	a)Flood reduction	b)Flood Diversion
	c)Flood Proofing	**d) all the above**
10.	---------- is a meteorological phenomena in which an area of low pressure characterized by inward spiraling winds that rotate counter clockwise in the northern hemisphere and clockwise in the southern hemisphere of the earth.	
	a)Thunderstorm	**b) Cyclone**
	c)Tsunami	d)Storm
11.	On an average, every year ---------- cyclones form in the Bay of Bengal **(about 5-6 tropical)**	
12.	The type of cyclone generally occurs outside the tropics, in the middle latitudes of the planet described as **---------- ("mid-latitude cyclones" or "post-tropical cyclones)**	
13	GIS is used for	
	a)tracing missing persons	b)co-ordinating donor groups
	c) finding locations of camps and shelter	d)all the above
14	-----was mandated to review the financial arrangement of disaster management.(**twelfth finance**	

	commission of India).	
15	National disaster management authority(NDMA) is headed by---	
	a)prime minister	b)finance minister
	c)president	d)home minister
16	Circulation of air in counter clockwise direction in the northern hemispherewith 1000-2000 km/hr spanning is called	
	a)polar cyclone	b)tropical cyclone
	c)sub tropical cyclone	d)all the above