DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

COURSE MATERIALS

MCN 301: DISASTER MANAGEMENT

VISION OF THE INSTITUTION

To mould true citizens who are millennium leaders and catalysts of change through excellence in education.

MISSION OF THE INSTITUTION

NCERC is committed to transform itself into a center of excellence in Learning and Research in Engineering and Frontier Technology and to impart quality education to mould technically competent citizens with moral integrity, social commitment and ethical values.

We intend to facilitate our students to assimilate the latest technological know-how and to imbibe discipline, culture and spiritually, and to mould them in to technological giants, dedicated research scientists and intellectual leaders of the country who can spread the beams of light and happiness among the poor and the underprivileged.

ABOUT DEPARTMENT

- Established in: 2002
- Course offered : B.Tech in Electronics and Communication Engineering

  M.Tech in VLSI
- Approved by AICTE New Delhi and Accredited by NAAC
- Affiliated to the University of Dr. A P J Abdul Kalam Technological University.

DEPARTMENT VISION

Providing Universal Communicative Electronics Engineers with corporate and social relevance towards sustainable developments through quality education.

DEPARTMENT MISSION

1) Imparting Quality education by providing excellent teaching, learning environment.

2) Transforming and adopting students in this knowledgeable era, where the electronic gadgets (things) are getting obsolete in short span.

3) To initiate multi-disciplinary activities to students at earliest and apply in their respective fields of interest later.

4) Promoting leading edge Research & Development through collaboration with academia & industry.

PROGRAMME EDUCATIONAL OBJECTIVES

PEOI. To prepare students to excel in postgraduate programmes or to succeed in industry / technical profession through global, rigorous education and prepare the students to practice and innovate recent fields in the specified program/ industry environment.

PEO2. To provide students with a solid foundation in mathematical, Scientific and engineering fundamentals required to solve engineering problems and to have strong practical knowledge required to design and test the system.

PEO3. To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.

PEO4. To provide student with an academic environment aware of excellence, effective communication skills, leadership, multidisciplinary approach, written ethical codes and the life-long learning needed for a successful professional career.

PROGRAM OUTCOMES (POS)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1: Ability to Formulate and Simulate Innovative Ideas to provide software solutions for Real-time Problems and to investigate for its future scope.

PSO2: Ability to learn and apply various methodologies for facilitating development of high quality
System Software Tools and Efficient Web Design Models with a focus on performance optimization.

PSO3: Ability to inculcate the Knowledge for developing Codes and integrating hardware/software
products in the domains of Big Data Analytics, Web Applications and Mobile Apps to create innovative career path and for the socially relevant issues.

COURSE OUTCOMES
MCN 301

MCN 301	DISASTER MANAGEMENT	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		Non - Credit	2	0	0	Nil	2019

Preamble: The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: **Understand**).
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: **Understand**).
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: **Understand**).
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: **Apply**)
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: **Understand**).
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2
CO1		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

SYLLABUS

MCN 301 Disaster Management

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.

Disaster risk assessment –approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management

Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

Disaster response- objectives, requirements; response planning; types of responses.

Relief; international relief organizations.

Module 4

Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling

Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India.

The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Book

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
2. M. M. Sulphey, Disaster Management, PHI Learning, 2016
3. UNDP, Disaster Risk Management Training Manual, 2016
4. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

Teaching Plan

	Module 1	5 Hours
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	**5 Hours**
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	**5 Hours**
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour

3.4	Disaster response- objectives, requirements. Disaster response planning; types of responses.	1 Hour
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	**5 Hours**
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept – Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	**5 Hours**
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5.5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	**10**	**10**	**20**
Understand	**25**	**25**	**50**
Apply	**15**	**15**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

QUESTION BANK

MODULE I				
Q:NO:	**QUESTIONS**	**CO**	**KL**	**PAGE NO:**
1	Enumerate the concept of greenhouse effect with example	CO1	K3	4
2	Compare risk assessment and risk mapping in terms of disaster management	CO1	K2	8
3	What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?	CO1	K2	12
4	What are disasters? What are their causes?	CO1	K2	16
5	Explain the following terms in the context of disaster management a) Resilience b) Crisis counselling	CO1	K2	23
6	Explain the different types of cyclones and the mechanism of their formation	CO1	K2	30
7	Explain the composition of lithosphere. Also explain the types of rocks	CO1	K2	31
8	What is a hazard? How is it classified?	CO1	K2	33
9	What do you mean by the term risk? Explain the terms preparedness and mitigation	CO1	K3	35
10	Define disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy	CO1	K2	37

MODULE II				
1	Classify the different types of Hazards	CO2	K5	49
2	List the applications of Hazard mappings	CO2	K4	51
3	What is hazard mapping? What are its objectives?	CO2	K2	52
4	What is participatory hazard mapping? How is it conducted? What are its advantages?	CO2	K2	53
5	Explain the types of vulnerabilities and the approaches to assess them	CO2	K3	54
6	Discuss in details about participatory hazard mapping, and list its advantages	CO2	K3	62
7	Explain the different disaster response actions in detail	CO2	K2	65
MODULE III				
1	Summarize the phases of disaster risk management.	CO3	K2	99
2	Explain disaster response relief	CO3	K1	102
3	Compare and contrast prevention, mitigation and preparedness in disaster risk reduction	CO3	K4	103
4	Explain Disaster response in detail with the types of response	CO3	K1	105
5	Define the term "relief". List any 3 international relief organizations.	CO3	K2	107
6	Illustrate the factors that decide the nature of disaster response.	CO3	K4	110
7	Write a short note on international relief organizations.	CO3	K2	111
8	Discuss in detail about the objectives & requirements of disaster response.	CO3	K4	113
MODULE IV				
1	Distill participatory stakeholders' engagement.	CO4	K4	126
2	Extract how Crisis counselling is important in DRR	CO4	K2	135
3	Categorize the stakeholder participation in different levels	CO4	K2	138
4	Conclude the importance of communication with stakeholders and its barriers	CO4	K4	141
5	Categorize structure and non-structural measures	CO4	K4	143

6	Conclude the importance of communication with stakeholders and its barriers	CO4	K4	146
7	Paraphrase why assessing capacity is important	CO4	K2	147
8	Explain the levels of stakeholder participation in the context of disaster risk reduction.	CO4	K2	149
9	List the steps to an effective communication.	CO4	K2	162
10	Explain the benefits and costs of stakeholder participation in disaster management.	CO4	K2	170
11	What are the steps to effective disaster communication? What are the barriers to communication?	CO4	K2	171
12	Summarize about Crisis counselling.	CO4	K2	175
	MODULE V			
1	Explain common disaster types in India	CO5	K1	151
2	What are Tsunamis? How are they caused?	CO5	K2	153
3	Explain the conditions necessary for the development of a cyclone.	CO5	K2	154
4	Elaborate the human made disaster	CO5	K3	156
5	Prioritize about the disaster management act 2005	CO5	K5	157
6	Explain the guiding principles and priorities of action according to Sendai framework of disaster risk reduction.	CO5	K2	158
7	Explain briefly about the legislations in India on disaster management	CO5	K3	162
8	Write a short note on targets of Sendai framework for disaster risk reduction.	CO5	K2	166

MODULE I

What is Disaster Management?

- Disaster management refers to the conservation of lives and property during natural or human-made disasters.
- Disaster management plans are multi-layered and are planned to address issues such as floods, hurricanes, fires, mass failureof utilities, rapid spread of disease and droughts.
- Disaster management can be of either natural disasters or man-made disasters.

Lithosphere

- Earth has four concentric zones.
- The innermost zone is the 'Inner core. This zone is a solid mass of iron which has a radius of about 1,216 km, coveringthe inner core is the outer core.
- This is a layer of molten liquid containing nickel and iron. It isabout 2,270 km thick.
- The outer core is covered by solid 'Mantle', which is about2,900 km thick.
- The outermost hardened exterior zone is known as Crust. The crust varies in thickness from about 5 km. The crust and the mantle which is hard and brittle is lithosphere
- Lithosphere is the outer layer (oceanic and continental) of earth that includes the crust and solid part of the mantle.
- Lithosphere interacts with atmosphere, hydrosphere and biosphere and forms Pedosphere.
- Pedosphere has both biotic and abiotic components.
- There are two types of lithosphere, the oceanic lithosphere which is about 5 km to 8 km thick composed of basalt andthe continental lithosphere which is 30 km to 40 km thick.
- Earth has seven major plates, which includes Africa.
  Antarctica, Australia, Eurasia, North America, South America and Pacifica, and a number of minor ones.
- A few important minor plates include Adria. Arabia.
  Caribbean. Nazca, Philippines, etc.
- These plates are composed of oceanic and continental lithosphere. They move independently over the mantle relative to one another, below the outer rigid lithosphere.
- This area known as asthenosphere is about 100 km to 200 kmthick, they move with at restricted independence from the seven large plates.
- The plates periodically reorganise themselves with new plateboundaries being formed, while certain others closing up.

- In addition to these movements, the plates also change inshape.
- The plates have three different motions
  1. They are Moving apart, thereby creating divergentboundaries
  2. Gliding horizontally along each other, thereby creating wrench and transform boundaries
  3. Moving towards one another, and creating convergentboundaries

Composition of Lithosphere

- The lithosphere contains minerals, rocks and soil.
- It has more than 100 chemical elements and most of them arerare.
- More than 99 percentage of the volume includes elements likeoxygen, silicon, aluminum, iron, calcium, sodium, potassium and magnesium.

Elements of Earth's Crust

S. No.	*Elements*	*Per cent*
1	Oxygen	46.6
2	Silicon	27.7
3	Aluminum	8.1
4	Iron	5.0
5	Calcium	3.6
6	Sodium	2.8
7	Potassium	2.6
8	Magnesium	2.1

- Only a few elements are present in pure forms in the earth's crust called native elements, they include copper, gold, lead, mercury, nickel, platinum and silver.
- These elements contained in ores are found in different combinations as minerals.
- Minerals are naturally occurring, inorganic, crystalline solids that have definite chemical compositions.
- Certain minerals are composed of single element. For instance, diamond and graphite composed of only carbon.

Rocks

- Lithosphere has various types of rocks
- Rocks are naturally occurring hard and consolidated inorganicmaterials, composed of one or a large number of minerals.
- Certain other materials, like coal and limestone are developed from plant and animal remains.
- There are various types of rocks. They are:
  1. Igneous Rocks
  2. **Sedimentary Rocks**

3. Metamorphic Rocks

Igneous Rocks

- These rocks are formed by solidification of magma in theinterior, or lava on the surface of earth.
- Igneous rocks are composed of primary minerals, which arepredominantly silicates.
- Igneous rocks sometimes overlap with sedimentary andmetamorphic rocks.

Sedimentary Rock

- Sedimentary rocks are formed by the precipitation from solutions, and consolidation of remnants of biotic componentslike plants and animals.
- These rocks contain both original primary minerals (Quartz,Mica) and altered as well as newly synthesised secondary minerals (Clay, calcite, gypsum).

Metamorphic Rocks

- Also known as Thermal rocks they are formed from pre-existing rocks (igneous or sedimentary) due to change in the temperature and pressure in solid state is known as metamorphic rocks.
- These rocks are formed when magma intrudes throughpre-existing igneous or sedimentary rocks.
- All types of pre-existing rocks could undergo metamorphism.
- Further, igneous and metamorphic rocks get weathered and form sediments. These sediments get deposited and lithified into sedimentary rocks.

Soil

- Soil is the surface layer of the land
- It is a natural body that contains a variable mixture of brokenand weathered materials and decaying organic matter, which covers the earth in a thin layer.
- It takes long period of time for the soil to form through thenatural process.
- The formation takes place from the weathering anddecomposition of rocks and minerals.
- Soil is a dynamic layer of earth's crust which is constantly changing and developing. The upper limit of soil is air or water and its lateral margins grade to deep water or barrenareas of rock or even ice

Different Types of Soil

S.No.	Soil	Details
1	Volcanic ash	Volcanic ash is fine grained, and has the property of weathering relatively easily. Plants invade a new deposit of volcanic ash quickly and colonise it very fast. This could happen even within a few years' time. The soils that result from volcanic ash, known as Andisols, are fine textured. It is fertile and normally rich in organic matter and plant nutrients. These soils are likely to be found in places where there are active and recently extinct volcanoes. It is estimated that these soils cover approximately 124 million ha of land (0.84 per cent of earth's surface).
2	Granite	Granite is a coarse-grained rock. It has about 25 per cent quartz and 65 per cent orthoclase. It may also have small amounts of mica and hornblende. Soils that develop from granite are usually sandy in nature. They are normally low in nutrient content, with characteristics like being friable, permeable, acidic, and low in base status. This soil has very little cohesion or consolidation, and is highly susceptible to erosion.
3	Limestone	Limestone rocks mainly contain calcite. They also have considerable quantities of impurities of other carbonates, silt, clay, quartz, iron, and so on. Soils that result from limestone are clayey. It could also be in the form of clay loams and sandy loams.
4	Sandstone	Sandstone mostly consists of sand sized quartz. It could also have impurities such as feldspar and mica, and other agents, like silica, iron, and lime. Soils that are formed from sandstone are not fertile, usually coarse textured and acidic in nature. However, the characteristics of sandstone soils are dependent on the particular type of sandstone—whether grain size or mineralogical composition.
5	Basalt	Basalt is fine textured in nature. It is rich in ferromagnesian and calcic plagioclase minerals. Basalt gets weathered relatively easily to form fine-grained clay minerals. The soils that originate from Basalt are fine textured in nature. It has good amount of the minerals and has a high base status.

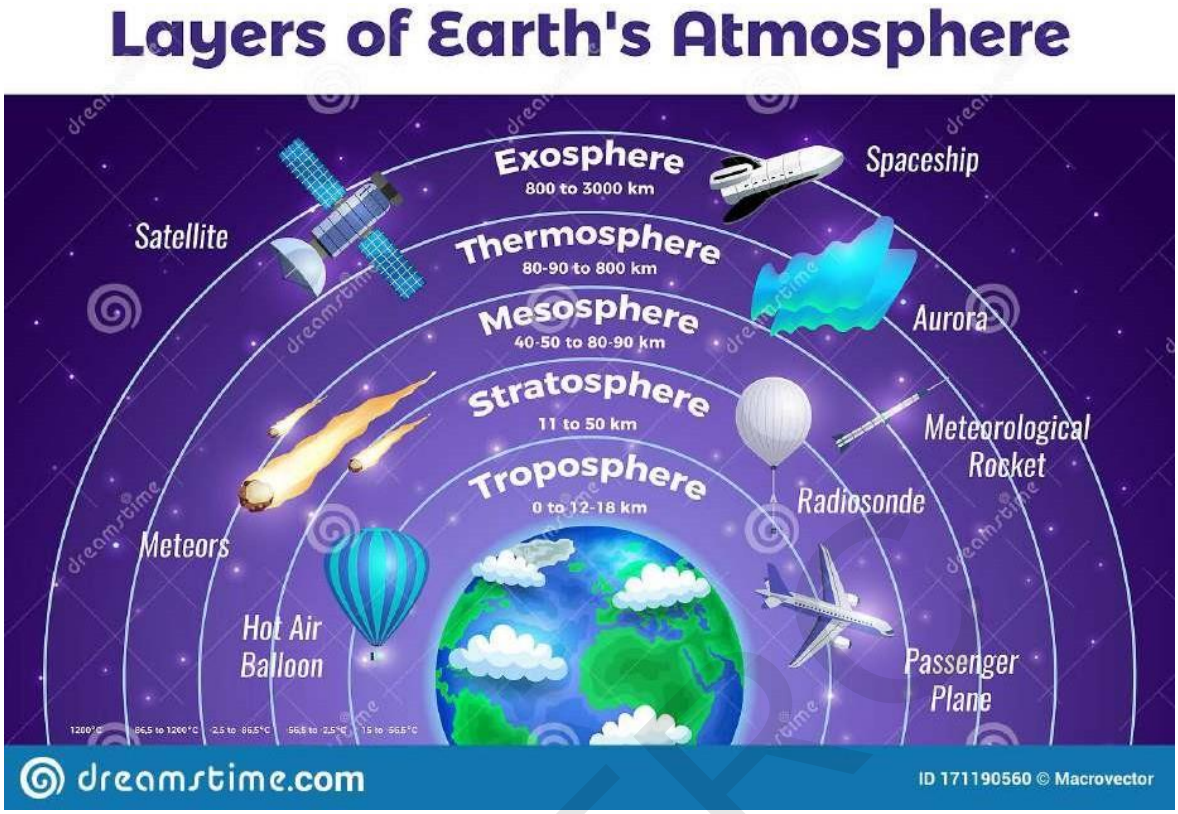
- Soil accomplishes various functions, which include thefollowing:

- 1. It provides mechanical support to the plant
- It has the ability of holding water as it has the property of porosity. This ability makes soil a reservoir of water
- 3. Soil provides micro and macro nutrients, as well as ideal pH required for the growth of the micro-organisms, plants andanimals.
- 4. Soil prevents excessive leaching of nutrients.
- 5. Soil houses bacteria that fix nitrogen and other elements; fungi, protozoa and other micro-organisms. These organisms aids in the decomposition of organic matter

Layers of Atmosphere

Based on the temperature, the atmosphere is dividedinto four parts

1. **Troposphere**
2. **Stratosphere**
3. **Mesosphere**
4. **Thermosphere**



1. Troposhere

- The bottom dense part, containing 70 percent of the mass, close to the ground is troposphere.
- It reaches up to 11 km from the ground. Clouds, storms, fogand haze are found only in troposphere.
- The temperature in this layer decreases at about -6.4°C/kmwith height.
- This decrease of temperature with altitude is called lapse rate.
- The boarder of troposphere is called Tropopause. Tropopause acts like a lid over troposphere.
- Temperature stops decreasing with height from tropopause.

2. Stratosphere

- This is a clear layer above troposphere that extends to a height of about 50 km from earth's surface.
- This layer does not have clouds, storms or dust. Clouds are not formed since water vapour is absent.
- Ozonosphere is an important layer found within stratosphere.

  Ozone (O_3) is found in this layer.
- Ozone absorbs and prevents the harmful ultraviolet radiations from reaching earth, thereby protecting life.
- The maximum concentration of ozone occurs at 22 km fromthe ground level.
- Above the stratosphere, there is a small layer called stratopause where temperature neither increases nor decreaseswith height.

3. **Mesosphere**

- The portion of the atmosphere above stratosphere, between50 km and 80 km is known as mesosphere.
- It starts from the edge of Stratopause.
- Though the temperature in mesosphere near stratosphere ishigher by about 10°, it falls to -75°C at 80 km.
- The density of air at this height is about 1/1000 as that ofsea level.
- Mesosphere plays a crucial role in radio communication asionisation occurs here.
- The sunlight passing through this layer converts individual molecules to charged ions. These ionised particles are concentrated as a zone in this layer, which is named D-layer. The D-layer reflects radio waves transmitted from earth.
- Just above the mesosphere is a small layer called Mesopause,where temperature is stable.

3. Thermosphere

- Thermosphere extends from 80 km to about 60,000 km fromearth. Here the temperature increases to about 2000°C.
- The property of thermosphere is radically different from theothers. Ions are abundant in thermosphere.

In thermosphere that most of the approaching meteoroidsburn up before reaching earth.

Ozone Layer

Ozonosphere is an important layer found within stratosphere. Ozone (O3) is found in this layer. Ozone absorbs and prevents the harmful ultraviolet radiations from reaching earth, thereby protecting life. Without Ozone layer, life would not have been possible on earth. The maximum concentration of ozone occurs at22 km from the ground level.

Depletion Of Ozone

Due to human activities ozone layer is becoming thin. Thethinning of this layer is called ozone depletion.

*** Ozone Oxygen Cycle**

- The ozone layer is located in the lower part of thestratosphere between 15 km and 35 km.
- Concentration of ozone is the maximum at about 25-30 km.
- The level of ozone is maintained at this level byOzone-Oxygen Cycle.
- When ultra-violet radiation that spread out from the sun strikes the oxygen molecule (O2), it splits the molecule intotwo individual oxygen atoms (O+0).
- The oxygen atoms, thus produced, combines with O2 molecule and produce ozone molecule (O3).

- This reaction is aided by either Nitrogen (N2) or Oxygen, which absorbs the excess

energy that is liberated. Ozone thus formed will be split by ultra-violet rays into a molecule of oxygen (O2) and an atom of oxygen (0).

- It is through this repeated circular ozone and oxygen formation that the concentration of ozone is maintained in thestratosphere.
- The concentration of ozone in the atmosphere is determinedby the rate of its formation and destruction in the above manner.
- Due to severe depletion of ozone in the atmosphere 'ozone holes' are created. Ozone holes, which were discovered in 1985, are overhead areas having less than 220 Dobson Units (DU). The chemistry of ozone depletion by CFCS, BFCS and Nitric oxides are now discussed.

- CFCS and BFCS are stable compounds in the atmosphere that have the property of living longer (50 to 100 years). Dueto their long life, they rise up to the stratosphere.
- Through the action of UV radiation from the Sun on these compounds, Chlorine (Cl) and Bromine (Br) radicals are released. These radicals act as catalysts, and initiate breakingdown of ozone molecules.
- It is estimated that a single such radical of either Cl or Br iscapable of breaking down over a lakh of ozone molecules.
- Due action, Ozone concentration is decreasing at a drastic rate of four percent per decade. As a result of the inherent long life of CFCs and BFCs, they continue to deplete ozonelayer in a recurrent manner.

Depletion by Nitric Oxide

- One molecule of nitric oxide (NO) combines with ozone (O_3);it gets oxidised to nitrogen dioxide (NO_2) and Oxygen (O_2).
- This NO_2 combines with another O3 molecule to become NO_3 (Nitrate) and O_2. The NO_2 and NO_3 then combine to form N_2O_5 (Dinitrogen pentoxide). Even the atomic oxygen
  (O) readily combines with NO_2 to yield NO_3.
- Due to this series of actions and reactions, ozone is completely utilised, and thereby depleted. Large quantities ofnitrogen are emitted by aircrafts that community decided to withdraw the operation of jet aircrafts that emit oxides of nitrogen. This step has also helped in reducing the depletion of ozone to a very large extent near stratosphere

Green House Effect

- Certain physical processes that takes place in the troposphere are responsible for the weather and climate of that particular place.
- To understand clearly about the process of green house effect,it is needed to know about Incoming solar radiation and theoutgoing radiation.

a) Incoming Solar Radiation

- Atmosphere behaves like a complex mega heat engine. A largenumber of processes like air movements (storms and cyclones), evaporation and formation of clouds, precipitation, etc. take place in the atmosphere.
- Only two in a billionth of the solar energy reaches Earth, of which only a small portion is responsible for the physical and

- Solar radiation contains X-rays, gamma rays, ultraviolet (UV)rays, visible light, infrared

rays, microwaves, radio waves etc.

- Of all the energy received by earth: UV, visible and infraredportions constitute over 95 per cent.
- The harmful UV radiation is prevented from reaching earth bythe ozone layer. The solar radiation which ultimately reaches the earth comprises mainly of visible light, which is composedof seven colours.
- While travelling through the atmosphere, a portion of the radiation energy is reflected by clouds, and some are scatteredand absorbed by gases and particles. The scattered radiation that reaches earth is called diffuse radiation.
- Only a small quantity of the scattered radiation (22 per cent)reaches earth's surface.

b) Outgoing Radiation

- If the entire energy that is received from sun retained in itsearth's surface, the planet would be very hot and would become an inhabitable place.
- The earth, after heating up of its surface, reflects a certain amount of energy. Some of this heat energy is transmitted tothe upper layers of air through conduction.
- The heat energy so emitted from the earth's surface is in theform of long wave radiation, and is called outgoing radiation.
- While a portion of the outgoing radiation is absorbed by certain gases in the atmosphere and retained as heat energyand the remaining energy escapes into the outer space.
- Gases capable of absorbing outgoing radiation are CO2, CO,water vapour, etc. They are called Green House Gases (GHG).

- Due to the effect of Green house gases, Earth is prevented from cooling down drastically. GHGS thus act like a blanketand provide earth with an ideal climate for life to flourish.

  This known as Greenhouse effect.
- The intensity of Greenhouse effect varies from place to place depending upon the concentration of GHGS.
- For instance, the quantity of vapor-and carbon dioxide is less in dry places like deserts. The usage of carbon dioxide and the release of oxygen is high in places were like forests where treesare in abundance.

Weather

- When radiation from insolation strikes earth, its top layer getsheated.
- The heat energy so created through the interplay of insolation and outgoing radiation is transferred to the overlying atmosphere through activities like conduction and convection.
- Due to this, as well as the movement of earth, air moves in alldirections-both horizontally and vertically. This movement ofair is the basis of weather.
- Weather is the atmospheric conditions that exist for a shortduration which can span over few hours to a number of days.Weather conditions can fluctuate very often.
- The average weather or atmospheric conditions over a fairly long period of time like months, years or even decades; in a particular area is called climate.
- Before discussing in detail about climate, certain other phrases, like temperature, humidity, precipitation, etc. shouldbe understood.

Temperature

- Temperature is the index of heat that is sensible. It indicates the kinetic energy of molecules, or the speed at which the molecules moves.
- While in air and water, molecules keep on moving and change their location very often and in solids the molecules involve ina vibration movement and not moving.
- The speed at which this vibration takes place is described astemperature.
- A body having higher temperature has the property of transmitting it to another one having lower temperature.
- Temperature is measured using thermometer, and is reportedin either Celsius, Kelvin or Fahrenheit scales.

Temperature Variation

The earth's temperature varies in an altitudinal and horizontal manner in the troposphere. A fair knowledge about this altitudinalvariation is ideal to understand more about weather and climates.

1. *Altitudinal Variation:*

    - In the troposphere, temperature decreases with height. It decreases at a rate of -6.4°C/km. This rate at which temperature decreases with height is called lapse rate. Thelapse rate is not uniform and it varies due to different conditions like pollution in the atmosphere.

2. Horizontal Temperature Variation

Temperature varies at different times of the day at different locations due to various reasons and factors. It also varies at different months and seasons of the year. A few reasons for thisvariation are discussed as follows:

(a) The hour of the day: More solar energy is received during the noon, when sun's rays strike vertically overhead; than hours inthe morning hours, when the rays strike at angles.

(b) Insolation: The phenomenon of day and night occurs as a result of the revolution and rotation of earth. Due to revolution one half of the globe is exposed to sunlight and the other half is indarkness. The temperature of any given area is based on the insolation of that area. The length of daylight and the angle at which the rays fall on earth also determine the amount of insolation and the temperature of that particular area.

(c) Distance from the Equator: The sun rays strike in perpendicular manner on the equator. Near to the poles it strikes at an angle. Due to this, areas farther away from equator will experience lesser temperature as compared to the areas near the equator.

(d) The tilt of the axis: The earth's axis is tilted at angle of 66½degrees to the plane of the ecliptic. This tilt is maintained throughout its orbit. This tilting of the axis leads to seasonal variations. Due to this, the months closer to June are summer months in this hemisphere. During this period, the northern hemisphere receives greater amount of solar energy, and hence, higher temperature. Places near to the equator receive more solar energy resulting in higher temperature

(e) Distance from the Equator: The heating of earth's surface differs according to the type of the surface in an area. For instance, rocky surfaces get heated rapidly, while water takes considerably long time to get heated up. In the same way, rocky surfaces loose heat rapidly as against water which loose heat slowly. In any given place, different types of surfaces exist. Hence,there will be a mixture of heating and cooling properties.

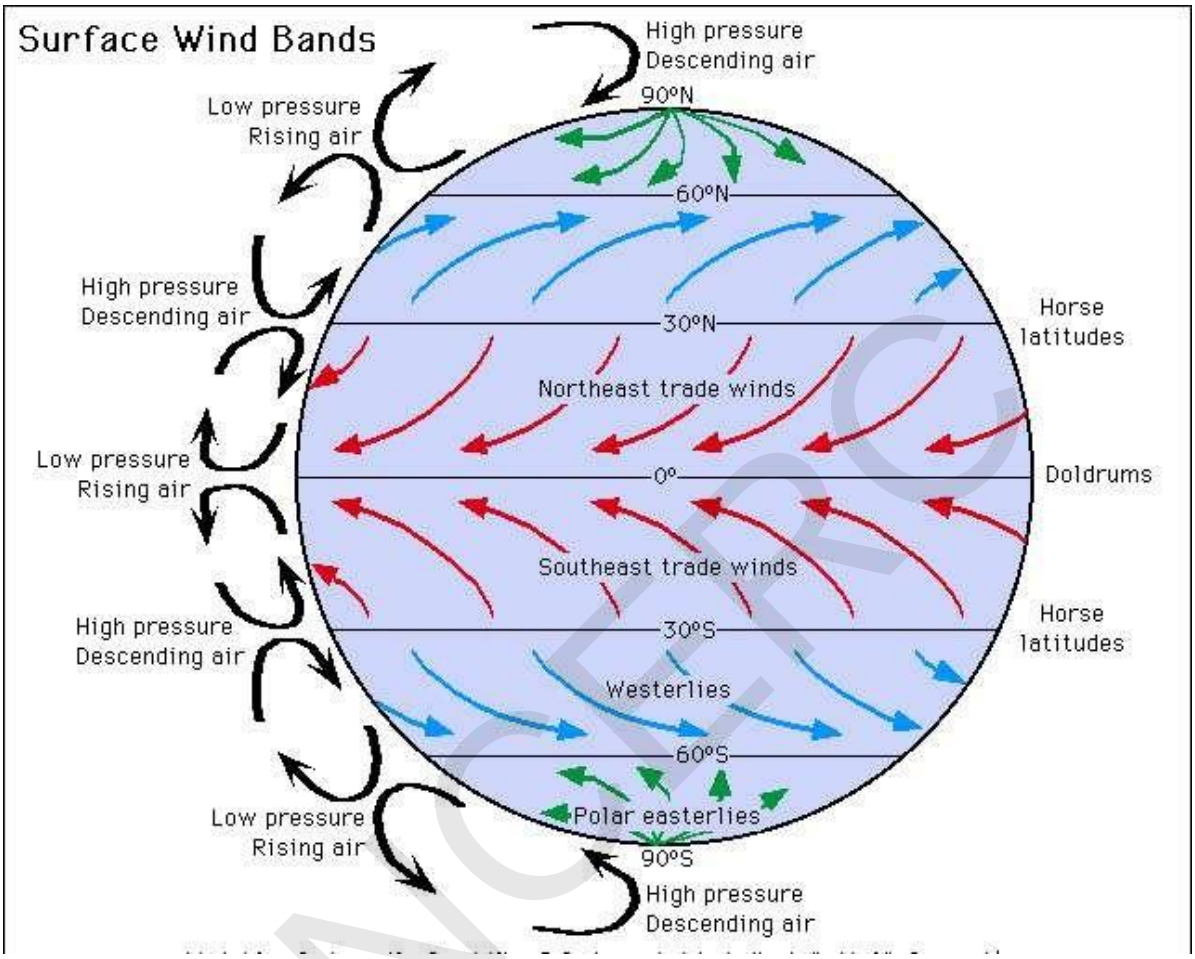
Cyclones

- The atmospheric pressure in a given area has an important role to play with respect to the formation of a cyclone. When a flow of air moves along curved isobars which is a net centripetal acceleration pulls it toward the centre of a curvature, making the air to rotate. Such wind (called gradient wind) is called **cyclone**
- If the movement of the gradient wind is in the anticlockwise direction in the northern hemisphere. it is called cyclone and anticyclone in southern hemisphere.
- In the southern hemisphere, the clockwise motion of gradient wind is called cyclone and anticyclone in northern hemisphere.
- During a cyclone, the surface air moves towards the centre having low pressure and hence converges. The converged air has the property of ascending in the centre within the lowpressure area.
- The reverse happens in a high pressure area. Air tends to sinkin the centre of a high pressure area during anticyclones.

Cyclones	Anti cyclones
It is a low pressure system with surroundings of high pressure.	It is a high pressure system with surroundings of low pressure.
It blows anti clockwise in the Northern Hemisphere.	It blows clockwise in the Northern Hemisphere.
It blows clockwise in the Southern Hemisphere.	It blows anti clockwise in the Southern Hemisphere.
It is associated with cloudy skies, heavy rainfall with stormy winds.	It is associated with clear skies, mild winds and dry conditions.
It can cause great damage to lives and property if precautions are not taken.	The weather is settled and pleasant.

Atmospheric Circulations:

- When Earth rotates on its axis, the rotation causes the deflection in the wind flow due to Coriolis force.
- Coriolis force is a force which is produced due to the rotationof the earth.
- In addition to this, a low pressure belt is formed over thetropical regions, since the equatorial region is heated throughout the year. This belt is called the Inter-Tropical Convergent Zone (ITCZ). This zone is also known as doldrums.
- This is not a conspicuous belt, but a discontinuous one that fluctuates in its position and intensity.
- Even with disruptions like weather fronts and storms, there isa consistent pattern to how air moves around our planet's atmosphere. This pattern, called atmospheric circulation.
- This is caused because the Sun heats the Earth more at the equator than at the poles. It's also affected by the spin of theEarth.
- In the tropics, near the equator, warm air rises. When it gets about 10-15 km (6-9 miles) above the Earth surface it startsto flow away from the equator and towards the poles.
- Air that rose just north of the equator flows north. Air thatrose just south of the equator flows south.
- When the air cools, it drops back to the ground, flows backtowards the Equator, and warm again. Now the warmed air rises again, and the pattern repeats. This pattern, known as convection, happens on a global scale. It also happens on a small scale within individual storms.


Surface Wind Bands
High pressure
Descending air
90°N
Low pressure
Rising air
60°N
High pressure
Descending air
30°N
Horse
latitudes
Northeast trade winds
Low pressure
Rising air
0°
Doldrums
Southeast trade winds
High pressure
Descending air
30°S
Horse
latitudes
Westerlies
60°S
Low pressure
Rising air
Polar easterlies
90°S
High pressure
Descending air

The Indian Monsoon

Monsoon is a regional wind that blows towards land at a certain season and blow from the landmasses during other season. Thesewind blows in the opposite direction in summer and winter.

Though monsoon winds blow over all parts of the world, it iswell-developed over India and the South-east Asian regions. The Indian subcontinent has two types of winds.

1.South-West Monsoon

2.North East Monsoon

1. South-West Monsoon

- The south-east trade winds originate from the southern hemisphere in the Indian Ocean. When these winds cross theequator, they get deflected towards the right by the Coriolis force, becoming the south-west trade winds. These winds gather large quantities of moisture as they pass over the Indian Ocean.
- As the SW monsoon winds approaches the Indian Peninsula,they are diverted into two- the Arabian Sea Branch and theBay of Bengal Branch.
- When the moisture laden Arabian Sea branch reaches the south-western side of India, they are blocked by the WesternGhats.
- When the mountain range blocks the horizontal flow, the windascends along the slope of the mountain range, gets cooled down and form clouds. These clouds then results in precipitation.
- Kerala gets the south-west monsoon mostly during early Juneevery year.
- These winds then take a west turn and continue their journey, and spread over the northern parts of India bringing in rains tothese areas.
- Monsoon winds normally reach Delhi in the first week of July and could last till end September/early October.

2. South-West Monsoon

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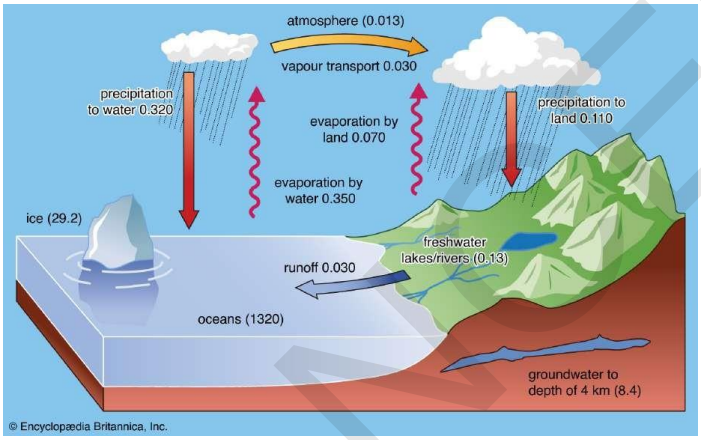
3. North-East Monsoon https://www.keralanotes.com/

- The Inter-Tropical Convergent Zone (ITCZ) moves to the south of the equator, when the position of the sun shifts to the southern hemisphere. This leads to the reversal of winds, and the winds start blowing from the north-eastern direction towards the ITCZ. These winds are known as the north-east monsoon winds or the north-east trade winds.
- Since North-East winds originate mainly from the land massesof the north-east region of India, they are relatively dry.
- When these winds pass over the Bay Bengal towards south, they gather moisture and cause rainfalls over parts of Odisha,Andhra Pradesh and Tamil Nadu.
- Cyclone formation is common over Bay of Bengal during the north-east monsoon season. The cyclones also bring in abundant rainfall over Odisha, Andhra Pradesh, Telenganaand Tamil Nadu.

Hydrosphere



Hydrosphere

- Hydrosphere forms over 70 per cent of the earth's surface . Interms of area, it comes to 3,62,000 km^2. Water is found in the oceans as well as on land. Life is made possible on earth due to the availability of water.
- The hydrosphere has a direct influence on weather and climate conditions on Earth. This occurs due to the importantrole played by the worldwide oceanic circulations.
- The average depth of oceans is around 3.7 km. The floor of the oceans has mountain ranges and valleys, isolated volcanic peaks, and vast plains. Many of these mountain ranges andvalleys exceed in size of their counterparts on land.

As on date , less than 10 per cent of the ocean floor has beensurveyed

- Water has a number of unique properties like high heat capacity, dissolving capacity, etc. These properties are made possible due to its molecular structure. A water molecule consists of two atoms of Hydrogen that are bound to an oxygen atom.

Oceans (Water in Oceans)

- Water in oceans is saline in nature. This salinity occurs due to the dissolved materials (mainly salts) contained in it. The mean salinity of sea water is around 34.7 g/kg. The lowest value being 33 and highest being 36 g/kg .
- Though sea water contains a mixture of several dissociated salts, NaCl is the most important one. Additional salts are always added to the oceans through various processes.
- However,seawater salinity is stable due to various mechanisms that remove salt from the oceans. Salt is spreaded to the atmosphere when wind blows sprays of sea water.
- The salt particles in the atmosphere enable water molecules tostick to it, and this falls on the land with rain and snow.

Water in oceans is constantly in movement in regular patterns due to the activity of winds. These movements of water in oceans are called ocean circulations or ocean currents. These currents arise due to the interplay of wind and water.

- Oceans as Moderator of Climate Oceanic circulations have aprofound and significant influence in heating up the globe, and hence, its climate. When water moves up from the colderand deeper parts of the ocean to the warmer surface, the heatis carried with it .
- Due to the interplay of various factors, the ocean water movesaround the globe , and with it the heat or cold is transferred . This heat transfer plays a major role in impacting earth's climate.
- When extremes of incidents, like rainfall or droughts occur, the normal path of the ocean current can be disturbed andclimate change could occur.

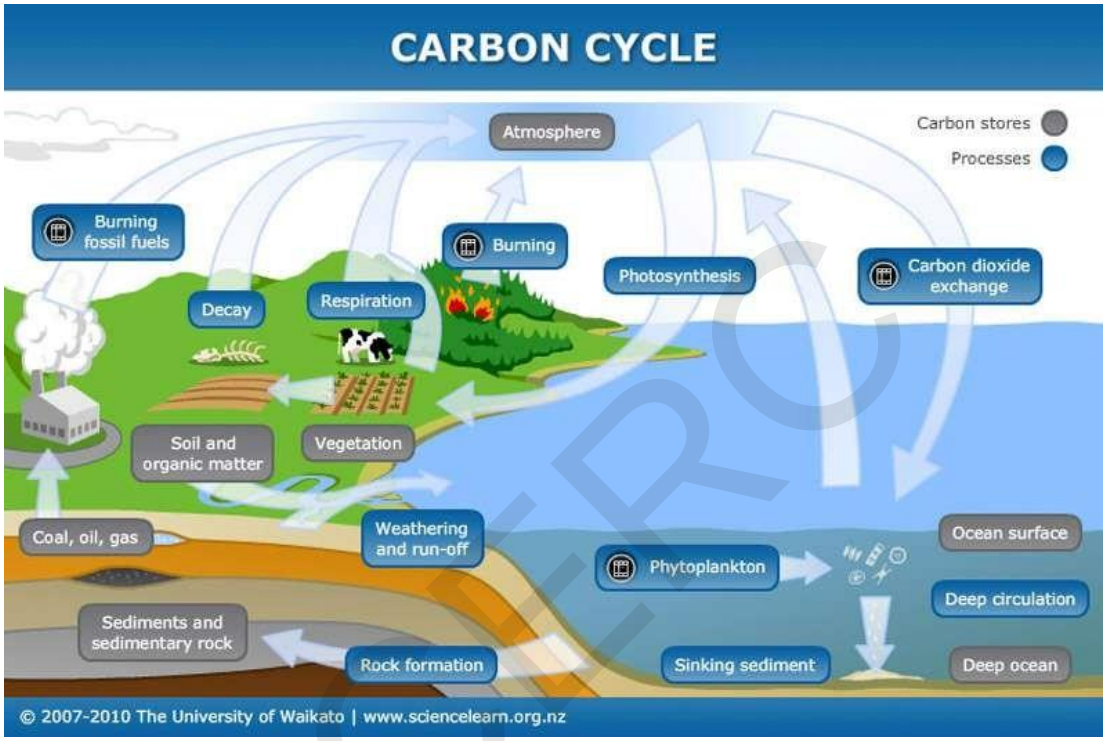
b) Oceans as Heat Reservoir

- Oceans play a role of a heat reservoir, moderating extremetemperatures.
- The water in the upper portion of oceans store higher heat than in the entire atmosphere.
- During spring and summer seasons, the oceans are cooler than the nearby lands. During winters oceans are warmer than the land masses.
- Due to this temperature difference in sea and land, there isheat energy transfer from land to water and vice-versa.

c) Oceans as Carbon cycle

- The oceans are the largest carbon reservoirs of Earth.

  Periodically. it gives off large amounts of carbon into the atmosphere. Through certain biological and chemical exchange processes it plays an important role in carbon cycle.



c) Oceans and Sea Ice

- The sea ice plays an important element in the Earth's climate system, The polar ice extends between 17 and 27 million km2,depending on the seasons. It covers around one-tenth of the land area and 6.5 per cent of the oceans.
- Of the total ice, about 90 per cent is located in the Antarcticas ice shelf. nine per cent in the Greenland ice sheet and thebalance in the various glaciers around the world.
- It is estimated that if all the ice in Greenland and Antarcticais to suddenly melt, the sea would rise to an approximate height of 70 m.

Water on Land

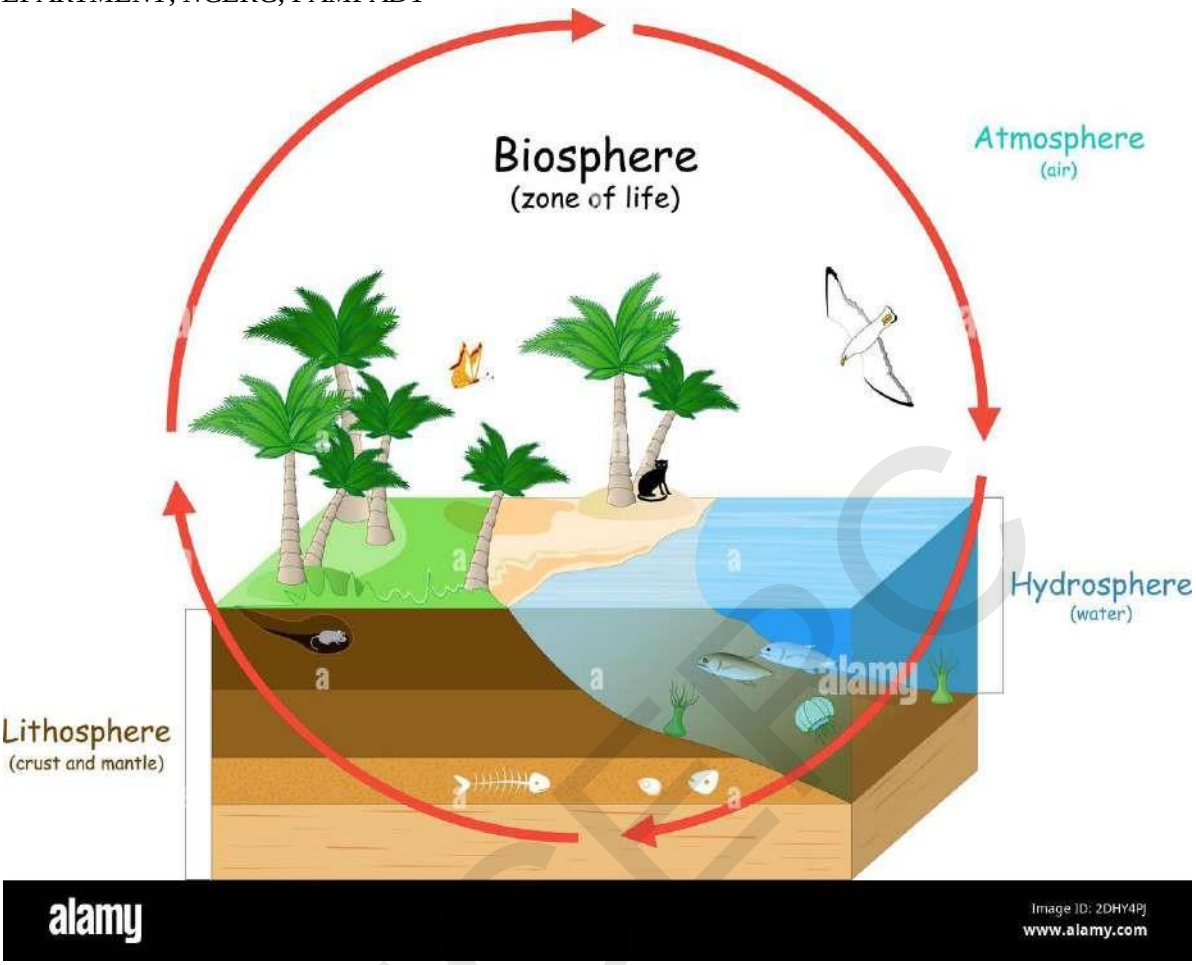
- Fresh water constitutes the basis for life on land. On land,water is found in all the three states.
- In liquid form. the water is found in lakes, rivers and streamsand also as ground water and soil moisture.
- The water found in these sources is fresh in nature.

- In solid form water is found as glacial ice, ice caps and groundice.
- The fresh water in earth is perpetually being interchanged between the surface of the earth and atmosphere by a processof evaporation and precipitation. This interchange is known aswater cycle or hydrological cycle.

- In the hydrological cycle, solar energy causes water from theoceans to evaporate and change to atmosphere vapour.
- Evaporation also takes place from inland water bodies likelakes, rivers, streams, etc.
- The evaporated water rises to the upper layers of the atmosphere, where it is cooled and condensed. The condensedwater falls back to the earth as precipitated form.
- Rain, snow and dew are different forms of precipitation.
- The water that falls on the earth runs along the ground and flows into rivers and in turn returns to the sea. A part of therainwater that falls on the land drip into the ground is knownas ground water.The ground water is used by human beings and plants.

Biosphere

- Biosphere is an important realm of Earth. The term biosphere' was first coined by the geologist Eduard Suess in 1875. More insights about biosphere were provided in the early 20th century by the ecologists Henry Cowles and Frederic Clements. Kirkham (2007) provided a comprehensive description of biosphere he referred it as: the totality of life on earth and itsinterdependency on abiotic environmental factors.


Biosphere
(zone of life)
Atmosphere
(air)
Hydrosphere
(water)
Lithosphere
(crust and mantle)
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- Biosphere consists of the complex interdependency between biotic and abiotic environmental components.
- Basically, biosphere is a thin envelop that encircles most of theearth, and supports life. It is the global sphere in which the biota interacts with lithosphere, atmosphere and hydrosphere.
- It is totally dependent on, and involves complex interactionsbetween the atmosphere, hydrosphere, and lithosphere.
- Biosphere is the spherical terrestrial layer that comprises of the lower part of the atmosphere. the seas and the upper layers of the soil wherein living organisms exist naturally.
- All forms or life including human beings dwell in biosphere. The health of the biosphere is determined by the availability of oxygen, moisture, temperature, air pressure and soil.

Components of Biosphere

Biosphere is a giant ecosystem that consists of two majorecosystems:
(a) Terrestrial ecosystem
b) Aquatic ecosystem

a) Terrestrial ecosystem

The terrestrial ecosystem consists of plants, animals, microorganisms their dependencies and interdependencies with thenon-living items around it on the land. A terrestrial ecosystem is made up of either natural ecosystem or artificial/man-made ecosystem.

b) Aquatic ecosystem

- Aquatic ecosystem consists of marine and fresh water ecosystem. While seas and oceans form the marine ecosystem; the rivers, pond, lakes, and wetlands form fresh water ecosystem. Aquatic ecosystems provide human beings with a wide range of services.
- Some of the services include the availability of water for dayto day uses, foods like fish and crustaceans, breaking down: of chemical and organic wastes, recreation, etc. The aquatic ecosystem provides the human beings with a wealth of natural

Definition and Key

A sudden occurrence of an accident that causes huge loss of life and property is called as a disaster. It is also called as a calamity.**Types of Disasters**

- **1. Natural Disaster:** A disaster caused by natural factors called as a natural disaster e.g., earthquake, flood, cyclone etc.
- **2. Man-made disaster:** A disaster caused due to the human activities e.g: wars, fire accidents, industrial accidents etc.

Hazards:

A hazard can be defined as a potentially damaging physical event, social and economic disruption or environmental degradation. Typical examples of hazards can be absence of rain (leading to drought) or the abundance thereof (leading to floods). Chemical manufacturing plants near settlements and incorrect agricultural techniques,

can also been seen as hazards which could lead to possible disasters. Hazards can bethe creation of man or the environment.

Exposure:

Exposure refers to people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.

Vulnerability:

Vulnerability refers to the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. 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.

Risk:

There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. 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.

Risk Assessment:

A risk assessment is a process to identify potential
analyze what could happen if a hazard occurs.

Disaster risk assessments include: the identification of hazards; a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability, including the physical, social, health, environmental and economic dimensions; and the evaluation of theeffectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios.

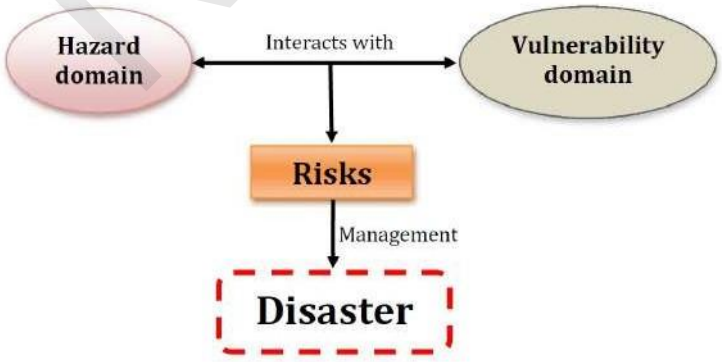


Figure 1.3.1: Conceptual relationships between hazard, vulnerability, risk and disaster

Risk Mapping:

Risk mapping is a process of analyzing the hazard, vulnerability and capacity through a scientific methodology. The process of risk map preparation includes analysis of several variables and parameters which are sub-sets of base categories; hazard, vulnerability and capacity. Hence, preparation of multi hazard riskmap is a combination of all risk elements on several hazards. Thisprocess is important in risk map preparation and obviously in disaster management field for appropriate implementation of disaster risk reduction activities.

Capacity:

Capacity refers to all the strengths, attributes and resources available within a community, organization or society to manage and reduce disaster risks and strengthen resilience.

It is important to emphasize people's capacity to anticipate, cope with, resist and recover from disasters, rather than simply focusingon the vulnerability that limits them.

Resilience:

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 fordevelopment.

Disaster Risk Reduction:

Disaster risk reduction involves structural and non-structuralmeasures.

Structural measures include the use of physical or engineering solutions (such as ocean wave barriers or earthquakeresistant buildings) to avoid disaster or reduce its impacts.

Non-structural measures involve the use of policies, laws, education and awareness creation, and practices to avoid or reducethe impacts of disaster.

Early Warning System (EWS):

EWS is a socio-technical system designed to generate and circulate meaningful warning information in a timely manner to enable a target system take a proactive response to a hazardous threat inorder to avoid disaster or reduce its impacts.

We emphasize "socio-technical" because an early warning system comprises all the steps from detection of the threat, through communication to target community or people, to the ability of thetarget to understand and respond appropriately to the warning.

Disaster Preparedness:

It consists of the knowledge and capacities of institutions, communities and individuals to effectively anticipate, respond to, and recover from the impacts of likely, imminent or active hazardevents or conditions.

Disaster Prevention:

Disaster Prevention is the elimination or reduction of the likelihood of occurrence of natural hazard event, or their adverse impacts.

Examples of disaster prevention actions include flood protectionembankments.

Disaster Mitigation:

It refers to a set of measures to reduce or neutralize the impact ofnatural hazards by reducing social, functional, or physical vulnerability.

Disaster Response:

Disaster response (relief) is the provision of assistance or intervention through the emergency services during or immediately after a crisis in order to save lives, reduce further impacts on health and public safety and to meet the basic subsistence needs ofaffected populations.

Damage Assessment:

Damage Assessment is the process for determining the nature andextent of the loss, suffering, and/or harm to the community resulting from a natural, accidental or human-caused disaster. Damages are normally classified as:

- **Severe:** The target facility or object cannot be used for its intended purpose. Complete reconstruction is required.
- **Moderate:** The target facility or object cannot be used effectively for its intended purpose unless major repairs aremade.
- **Light:** The target facility or object can be used for intendedpurpose but minor repairs would be necessary.

Damage Assessment:

- Crisis counselling is the process of alleviating the emotional and psychological disturbances of persons affected by disaster in order to restore a sense of control and mastery and to aid the process of recovery and reconstruction.
- Normally, disasters overwhelm the physical and psychological capacity of people to cope. This can lead to emotional and psychological disturbances which can affect a person's ability to make right decisions or adopt reasonable responsive actions.
- Crisis counselling addresses these problems and is a crucial part of recovery and reconstruction.

Needs Assessment:

- Needs assessment is a process of estimating the financial, technical, and human resources needed to implement the agreed-upon programs of recovery, reconstruction, and riskmanagement.
- Post-damage needs assessment is normally a rapid, multi-sectoral assessment that measures the impact of disasters on the society, economy, and environment of thedisaster-affected areas.

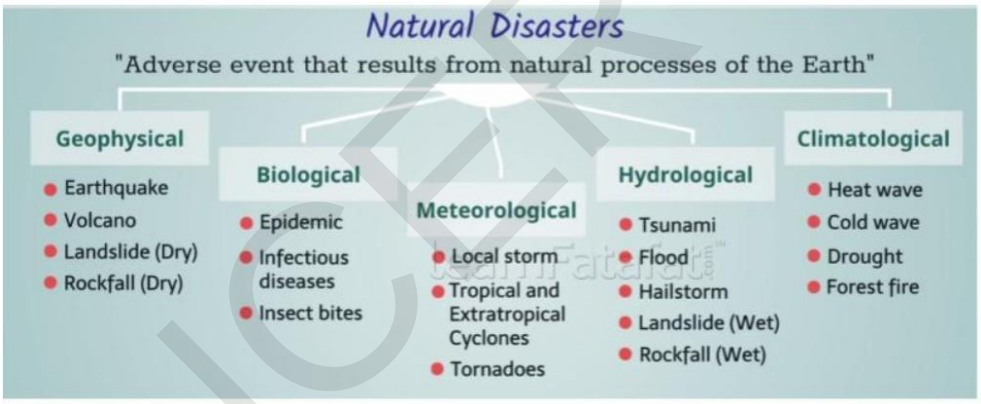
MODULE II

Hazard

A hazard can be defined as a potentially damaging physical event, social and economic disruption or environmental degradation.

Types of Hazards

- 1. Geophysical Hazard
- 2. Hydrological Hazard
- 3. Meteorological Hazard
- 4. Climatological Hazard
- 5. Biological Hazard
- 6. Extraterrestrial Hazard



- **1. Geophysical hazard**: A. This term can be used interchangeably with the term geological hazard.
- **2. Hydrological hazard:** A hazard caused by the occurrence, movement, and distribution of the surface and subsurface freshwater and saltwater.
- **3. Meteorological hazard:** A hazard caused by short-lived, micro- to mesoscale extreme weather and atmospheric conditions that last from minutes to days.
- **4. Climatological hazard:** A hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability.
- **5. Biological hazard:** A hazard caused by the exposure to living organisms and/or the toxic substances or vector-borne diseases that they may carry.
- **6. Extraterrestrial hazard:** A hazard caused by asteroids, meteoroids, and comets as they pass near earth, enter the earth's atmosphere, and/or strike the earth, or change in interplanetary conditions that affect the earth's

Hazard Mapping

Hazard mapping involves a graphical representation of the location, magnitude and temporal characteristics of hazards on 2 or 3 dimensional surfaces. The objective of this it to represent thespatial and temporal characteristics of the hazard as well as its magnitude using graphical symbols.

Data Requirements of Hazard Mapping

Spatial characteristics such as location, distribution and dimension; temporal and magnitude are the major data requirements for hazard mapping. Such information can be obtained through the following sources:

1. **Base Maps**: **Base maps**

datasuchaselevation,roads,waterbodies,culturalfeaturesand utilities. Creation of a base map is a time-consuming activity. It is therefore desirable to use an existing map. It mustalsohavesufficientgeographicreferenceinformation toorient the user to the location of the hazard.

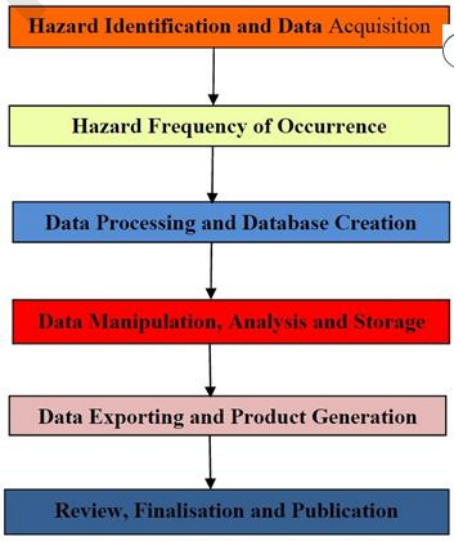
Remotely Sensed Images: Satellite images are increasingly becoming preferred sources of readily available information of locations or events on the earth's surface compared to conventional ground survey methods of mapping that are labour intensive and time consuming.

GeoEye, QuickBird and ALOS-PRISM are preferred sensors for visual mapping as they are of high spatial resolutions.

Field Data: Through the advances of technology, ground surveying methods using electronic survey systems like Total Station, the global positioning systems (GPS) and Laser Scanners, have all greatly increased opportunities for datacapture in the field.

Hazard Mapping Using Geographic InformationSystem (GIS)

- GIS is increasingly being utilized for hazard mapping andanalysis, as well as for the application of disaster risk managementmeasures. Thenature and capability of GISprovides an excellentbasis for processingandpresenting hazard information in the form of maps.
- GIS is very useful in arranging a high volume of data necessaryto produce a hazard map. The flowchart represents the general procedure for the mapping of hazards in GIS.



Vulnerability

Vulnerability was defined as the degree to which a systemis exposed and susceptible to the adverse effectsof a given hazard.
Vulnerability = (Exposure) + (Resistance) +Resilience Exposure: at risk property and population Resistance: Measures taken to prevent, avoid or reduceloss Resilience: Ability to recover prior state or achievedesired post-disaster state.

Types of Vulnerability

Physical vulnerability

- This refers to the potential losses to physical infrastructure such as roads, bridges, railways, radio andtelecommunicationmast and other features in the built environment.
- Also includes impacts on the human population in termsofinjuries or deaths.

Social vulnerability

- Social vulnerability refers to losses as experienced bypeopleand their social, economic, and political systems
- Vulnerability refers to the extent to which elements of societysuch as children, the aged, pregnant and lactating women, single parents, physically and mentally challenged, the poor and destitute, social class, caste, ethnicity, gender, family systems, political systems, economic systems and cultural values degrade after being exposed to a hazardouscondition.

Economic vulnerability

- This refers to the potential impacts of hazards on economic assets and processes and includes vulnerability of differenteconomic sectors.

- **Ecological/environmental vulnerability**

- This refers to the degree of loss that an ecosystem will sustain to its structure, function and composition as aresultof exposure to a hazardous condition.

- **Vulnerability Assessment**

- This refers to the quantification of the degree of lossorsusceptibility to an element at risk.
- Variations exist in the method of quantification ofvulnerabilitybased on the following:

a. Type of vulnerability being measured

b. The scale at which vulnerability is being measured

c. The type of hazard.

Data needed for vulnerability assessment and theirusefulness

- Historical data on the magnitude of a hazard and the levelofdamage it caused
- Socio-economic data such as level of education, social networks, sanitation, income level, access to land, accesstotechnology etc
- Level of exposure to hazardous conditions
- Data on policies, institutions and processes whichinfluencecapacity of individuals, households and communities

Approaches to Physical VulnerabilityAssessment

- There are a wide variety of ways to measurephysicalvulnerability.
- Two main methods are the empirical and analytical methods.
- The analytical methods rely on the use of geotechnical engineering software and are often limited toindividualstructures
- The empirical methods can be applied to groups ofrelatedstructures.

Methods of measuring physical vulnerability

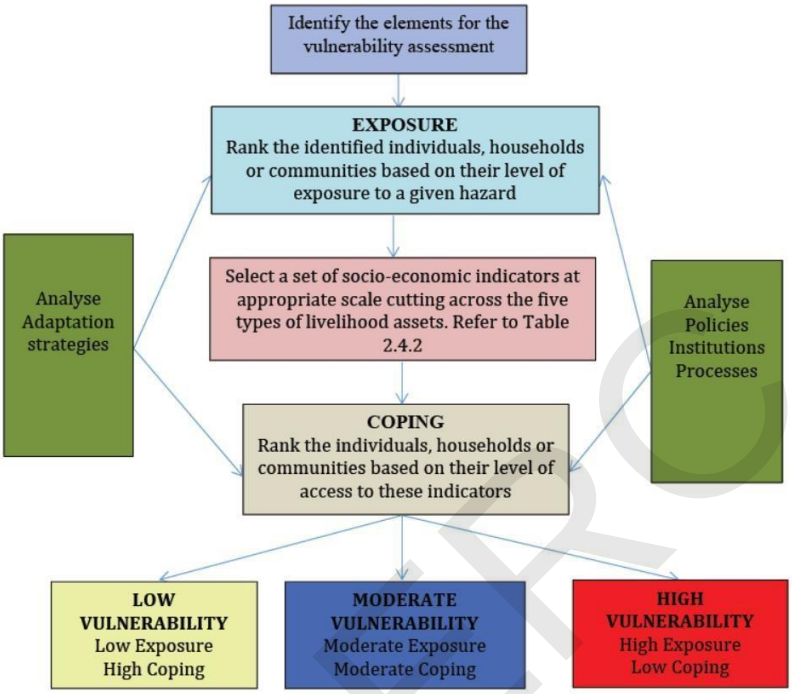
Group	Method	Description
	Analysis of observed damage	Based on the collection and analysis of statistics of damage that occurred in recent and historic events. Relating vulnerability to different hazard intensities.
Empirical methods	**Expert opinion**	Based on asking groups of experts on vulnerability to give their opinions, e.g. the percentage damage they expect for the different structural types having different intensities of hazard. This is meant to come to a good assessment of the vulnerability. Method is time consuming and subjective. Re-assessments of vulnerability after building upgrading or repair are difficult to accommodate.
	Score Assignment	Method using a questionnaire with different parameters to assess the potential damages in relation to different hazard levels. The score assignment method is easier to update, e.g. if we think about earthquake vulnerability before and after application of retrofitting.

Methods of measuring physical vulnerability

Analytical models	**Simple Analytical models**	Studying the behaviour of buildings and structures based on engineering design criteria, analysing e.g. seismic load and to derive the likelihood of failure, using computer based methods from geotechnical engineering. Using, e.g. shake tables and wind tunnels, as well as computer simulation techniques.
	Detailed Analytical methods	Using complex methods. It is time consuming, needs a lot of detailed data and will be used for assessment of individual structures.

- **Methods of Measuring Socio-economic Vulnerability**

Socio-economic vulnerability is indicator-based and can be assessed by analysing the level of exposure and coping mechanismsof individuals, households and communities.



Socio-economic indicators

Human Capital	Natural Capital	Social Capital	Physical Capital	Financial Capital
Health	Land and produce	Networks and connections	Infrastructure • Transport - roads, vehicles, etc. • Secure shelter & buildings water supply & sanitation	Savings
			• Energy communications	
Nutrition	Water & aquatic resources	Patronage	Tools and technology • Tools and equipment for production • Seed, fertiliser, pesticides • Traditional technology	Credit/debt - formal, informal, NGOs
Education	Forest products	Neighbourhoods		Remittances
Knowledge and skills	Wildlife	Kinship		Pensions
Capacity to work	Wild foods & fibres	Relations of trust and mutual support		Wages
Capacity to adapt	Biodiversity	Formal and informal groups		Dividends
	Environmental services	Common rules and sanctions		Return on Investments

- **Methods of Representing Vulnerability**
- **Vulnerability indices**: Based on indicators of vulnerability
  - **Vulnerability table**: The relation between hazard intensityanddegree of damage can also be given in a table.
  - **Vulnerability curves**: These are constructed on the basis oftherelation between hazard intensities and damage data

➢ Relative curves: They show the percentage of property valueas the damaged share of the total value to hazard intensity.

➢ Absolute curves: Show the absolute amount of damage depending on the hazard intensity

➢ Fragility curves: Provide the probability for a particular groupof elements at risk to be in or exceeding a certain damage state undera given hazard intensity.

Disaster Risk Management:

Disaster Risk:

It is the probability of serious damage, deaths and injuries occurring as a result of a potentially damaging hazard interacting with vulnerable elements such as people andproperties

Disaster risk management:

It is a methodology to determine the likelihood and magnitudeof damageorotherconsequencesby analysing potentialhazards and evaluatingexistingconditionsofvulnerability that jointly could likely harm exposed people,properties, services, livelihoods and theenvironmentthey depend on.

Components of risk assessment

There are two main components:

- Risk analysis: The use of available information to estimate the risk caused by hazards to individuals or populations,propertyortheenvironment.Itcontainsthefollowing steps: Hazard identification, hazard assessment, elements at risk/exposure, vulnerability assessment and risk estimation.
- Risk evaluation: This is the stage at which values andjudgement enter the decision process by including the importance of the risk and associated social, environmental,

Contemporary approaches to risk assessments.
Multi- Hazard

- The same area may be threatened by different types ofhazards.
- Each of these hazard types has different areas thatmight be impacted by hazardscenarios.
- Each of the hazard scenarios also might have differentmagnitudes.

Multi-scetoral

- Hazards will impact different types of elements atrisk.

Multi-level

- Risk assessment can be carried out at different levels.
- Depending on the objectives of the risk study, it is possible to differentiate between national, regional, districtandlocalpolicies,plansandactivitiestoseehowtheyhavecontributedtoincreasedor reducedrisk,their strengths and weaknesses in dealing with risks, and what resources are available at the different levels to reduce risks.

Multi- stakeholder

- Risk assessment should involve the relevant stakeholders, which can be individuals, businesses, organisations and authorities.

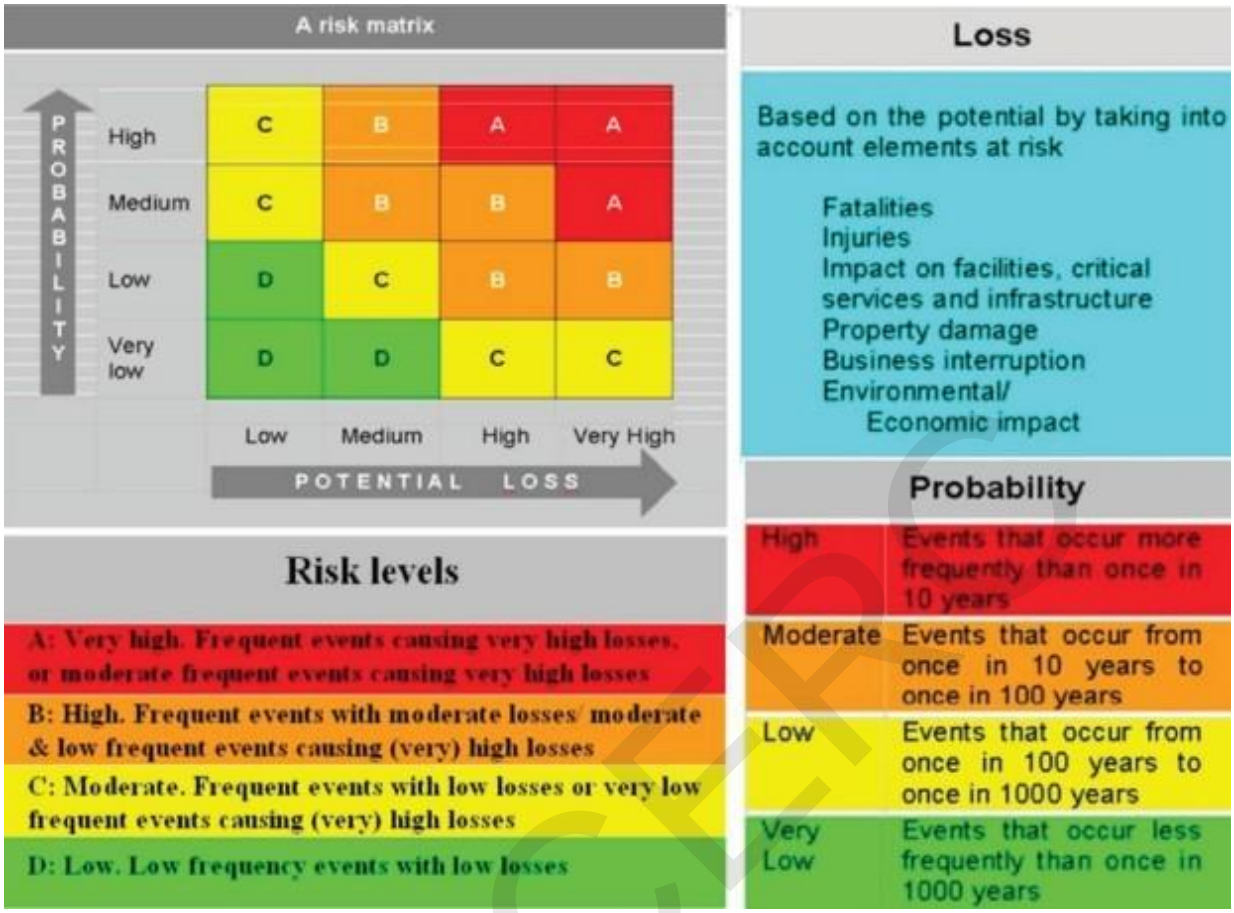
Multi-phase:

- Risk assessment should consider actions for response,recovery, mitigation and preparedness.
- This involves qualitative descriptions or characterizationofriskintermsofhigh,moderateandlow.

Qualitative Methods:

- These are usedwhenthehazardinformationdoesnot allow ustoexpresstheprobabilityofoccurrence, oritisnot possible to estimate the magnitude.
- Riskmatricescanbeconstructedtoshowqualitative risk.
- Ariskmatrixshowsonitsy-axisprobabilityofaneventoccurring,whileonthe x-axis potential loss.

Potential Hazards



Risk assessment matrix

A. Hazards	B. Hazard Likelihood **0 low – 5 is high**	C. Impact Severity **(Vulnerabilities/ Resources) 0 is low – 5 is high**	D. Risk Score **B x C** E. Priority	E. Priority

In Column B, the likelihood of occurrence of this event (between 0 low to 5 high)

HAZARDS	1	2	3	4	5
B. Likelihood	Very low	Low	Medium	High	Very high

In Column C, enter the severity of the impact you expect. This would be based on your understanding of the various vulnerabilities and the measures your community has already taken to reduce them.

Vulnerability	1	2	3	4	5
C. Impact severity	Minor	Controllable	Critical	Devastating	Terminal

In Column D, Multiply your likelihood by impact rating. Column B x C. This would give you your risk score

Risk score	1-3	4-8	9-14	15-19	20-25
Description	Very low	Low	Medium	High	Very high

In Column E, convert your risk scores into simple priority scores. 3-Low, 2-medium, 1-high

Risk score	1-3	4-8	9-14	15-19	20-25
Priority level	3	3	2	1	1
Description	Low		Medium	High	

Semi-quantitative methods:

- These techniques express risk in terms of risk indices.
- These are numerical values, often ranging between 0 and1.
- The main difference between qualitative and semi- quantitative approaches is the assignment of weights under certain criteria which provides
- These semiquantitative estimation for risk assessment is found useful in the following situations:
  - As an initial screening process to identify hazards and risks
  - When the level of risk does not justify the time and effort
  - Where the possibility of obtaining numerical data is limited
- The semi-quantitative approach could be adapted to cover larger areas.
- Semi-quantitative risk can also be conceptualizes:
- It allows incorporating the multi-dimensional aspects of vulnerability, and capacity.

Risk = Hazard * Vulnerability / Capacity

Quantitative methods:

- This aims at estimating the spatial and temporal probability of

risk and its magnitude.

Risk = Hazard * Vulnerability * Amount of elements-at- risk

- The amount of elements-at-risk are characterized the way in which the risk is presented.
- The hazard component in the equation actually refers to the probability of occurrence of a hazardous phenomenon with a given intensity within a specified period of time.
- Vulnerability is limited to physical vulnerability of the

Different ways of expressing risk

General	Type	Principle	
Qualitative	**Qualitative**	Based on relative risk classes categorised by expert judgment. Risk classes: High, Moderate and Low	
	Semi-Quantitative	Based on relative ranking and weights assignments by a given criteria. Risk index: Ranked values (0-1, 0-10 or 0-100). (dimensionless)	
Quantitative	**Probability**	Probabilistic values (0-1) for having a predefined loss over a particular time period	
	Economic risk	Quantification of the expected losses in monetary values over a specific period of time	
		Probable Maximum Loss (PML)	Probable Maximum Loss (PML) The largest loss believed to be possible in a defined return period, such as 1 in 100 years, or 1 in 250 years
		Average Annual Loss (AAL)	Expected loss per year when averaged over a very long period (e.g., 1,000 years). Computationally, AAL is the summation of products of event losses and event occurrence probabilities for all stochastic events in a loss model.
		Loss Exceedance Curve (LEC)	Risk curve plotting the consequences (losses) against the probability for many different events with different return periods.
	Population risk	Quantification of the risk to population	
		Individual risk	The risk of fatality or injury to any identifiable (named) individual who live within the zone impacted by a hazard; or follows a particular pattern of life that might subject him or her to the consequences of a hazard.
		Societal risk	The risk of multiple fatalities or injuries in society as a whole: one where society would have to carry the burden of a hazard causing a number of deaths, injury, financial, environmental, and other losses.

MODULE 3

Disaster Risk Management

- 3 elements ➔ Prevention, Mitigation and preparedness
- These 3 elements with risk assessment and recovery constitutes Disaster Risk Management.
- Disaster risk management aims to decrease the risk by
  - ❖ Reducing exposure to hazard
  - ❖ Lessen the vulnerabilities
  - ❖ Increase the capacity
- Hence build resilience to disaster
- When disaster risks are assessed→ the next step is to consider a wide range of options available → to prevent the disaster from occurring, protect people, their assets and the environment, that it occurs.
- The knowledge gained from the assessment allows individuals and communities to anticipate the types of disaster that are likely to affect them, and to think of ways to reduce the impact or prevent it altogether

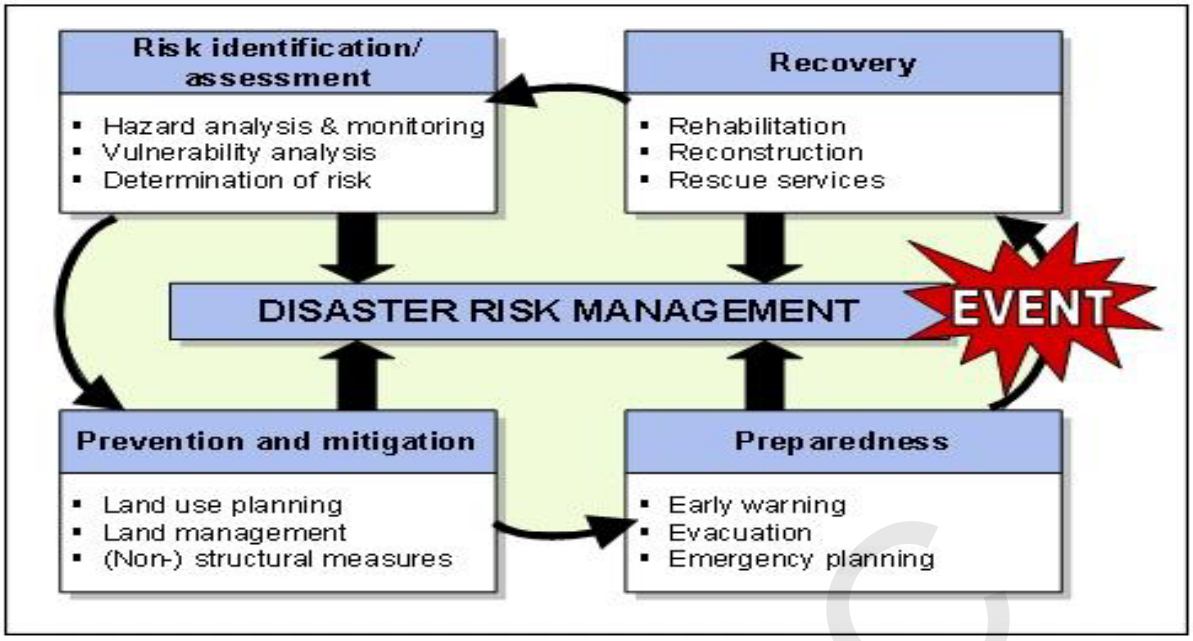
Definitions of Disaster Risk Management (DRM)

- The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.
- Various frameworks have been proposed to understand the phases and process of disaster risk management.

Disaster Risk Management Framework

- ➨ The disaster risk management process (cycle)

comprises the following main elements:



Elements of Disaster Risk Management

Risk identification and assessment:

- This involves determining and analyzing the potential, origin, characteristics and behavior of the hazard
- E.g. frequency of occurrence/magnitude of consequences.

Application of risk reduction measures in mitigation:

- Planning and implementation of structural interventions or nonstructural measures such as disaster legislation.

Disaster preparedness and emergency management:

- Activities and measures taken in advance to ensure effective response to the impact of a hazard, including measures related to timely and effective warnings as well as evacuation and emergency planning.

Recovery/Reconstruction:

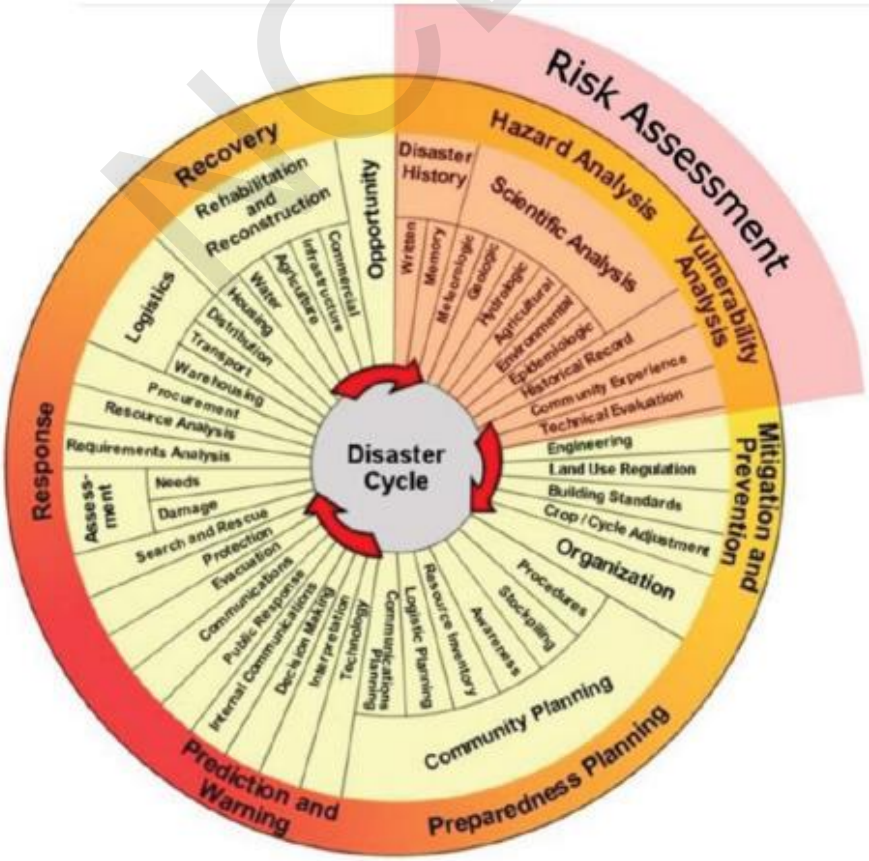
- Decisions and actions taken in the post-disaster phase with a view to restoring the living conditions of the affected population
- Disaster risk management measures:
  - Before (Risk analysis, prevention, preparedness)
  - During (emergency aid)
  - After a disaster (reconstruction)

- Sometimes disaster risk management includes only a part of disaster management, focusing on the before of the extreme natural event.
- A holistic approach to disaster risk management is needed in order to enhance resilience and reduce vulnerability to disasters.

DISASTER CYCLE

- Disaster Risk Management framework has several alternatives, which differ from it depending on the level of detail it provides.
- In figure, the disaster cycle is at the core and encompasses the usual elements of disaster risk management.
- Each of the core elements has been explained to show most of the factors that are not easily discernible at the macro-scale.
- Risk management must take disaster history into account, analyze hazards and also analyze the vulnerability of the population to specific risks.

THE TRADITIONAL DISASTER CYCLE



DISASTER RISK REDUCTION (DRR)

- The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including
  - Through reduced exposure to hazards
  - Lessened vulnerability of people and property
  - Wise management of land and the environment
  - Improved preparedness for adverse events.
- This means that DRR is limited in scope compared with DRM
- five (5) priority areas are underscored in the Hyogo Framework for Action.
  1. Governance
  2. Risk identification, assessment, monitoring and early warning
  3. Knowledge management and education
  4. Reducing underlying risk factors
  5. Preparedness for effective response and recovery
- The Hyogo framework for action was succeeded by the Sendai Framework for Disaster Risk Reduction 2015-2030 at the Third United Nations World Conference on DRR which took place in March 2015 in Sendai, Japan.

The four (4) cornerstones of Disaster Risk reduction:

Four parallel and complementary lines of actions can be considered to reduce exposure to disasters and achieve a more sustainable approach to development:

- 1. Community / stakeholder participation
- 2. Public policy actions
- 3. Safer construction and urban development
- 4. Development of a culture of prevention

Measures for Disaster Risk Reduction

- Prevention – take measures to prevent the disaster
- Mitigation – ensure the measures to reduce the intensity of the disaster.
- Preparedness – prepare to overcome the disaster.

DISASTER PREVENTION

Definition:

- Disaster Prevention is defined as those activities taken to prevent a natural phenomenon or potential hazard from having harmful effects on either people or economic assets.
- Broadly, disaster prevention refers to measures taken to eliminate the root causes that make people vulnerable to disaster.

The Basis of Disaster Prevention

- Planning of prevention hinges on two (2) issues:
    1. Hazard identification (identifying the actual threats facing a community)
    2. Vulnerability assessment (evaluating the risk and capacity of a community to handle the consequences of the disaster).
- Once these issues are put in order of priority, emergency managers can determine the appropriate prevention strategies.
- While natural hazards cannot be prevented, human hazards such as technological failures, hazards associated with industries and pollution based hazards can be prevented.
- Prevention has more to do with prohibiting man-made hazards such as chemical accidents, household fire etc., which are caused by human activities, errors or insufficient precautionary actions.
- However, mitigation and preparedness are considered as the key measures of risk reduction for natural hazards.

Types Of Disaster Prevention:

Disaster prevention may be considered as either primary or secondary.

- *Primary prevention* is to reduce, or avoid the risk of the event occurring, by getting rid of the hazard or vulnerability,

  e.g. to avoid overcrowding, deforestation, choked drainage and to provide services.

- *Secondary prevention* means to recognize promptly the event and to reduce its effects,

e.g. by staying alert to possible displacements of population; by being ready to provide immunization, food, clean water, sanitation and health care to the affected population.

DISASTER MITIGATION

Definition:

- Disaster mitigation refers to the lessening or limitation of the adverse impacts of hazards and related disasters.
- The adverse impacts of hazards often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions.
- Mitigation measures encompass engineering techniques and hazard-resistant construction as well as improved environmental policies and public awareness

PRIMARY OBJECTIVES OF DISASTER MITIGATION

The primary objectives of disaster mitigation are two (2) fold, namely

- Hazard likelihood reduction
- Risk consequence reduction.
- Hazard likelihood reduction
- This objective is only appropriate for a few natural hazards, as it is not possible to reduce the occurrence of many hazards.
- Eg: the likelihood of floods occurrence can be reduced by mitigation measures such as sea defence walls.

Risk consequence reduction

- This is a reduction in the impact of a hazard, via a reduction in exposure and/or vulnerability.
- It involves ensuring that the population, structures, or other systems are able to withstand such an event with as few negative consequences as possible.

Example: the construction of the erosion-resistant sea defence wall in Keta, Volta Region of Ghana.

- So in reducing both hazard likelihood and risk consequence,

- The primary aim is to decrease risk of death and injury to the population.
- The secondary aims are to decrease damage and economic losses inflicted on public sector infrastructure and to reduce private sector losses.

- Structural and non – structural disaster mitigation are mainly carried out by human beings.

TYPES OF DISASTER MITIGATION MEASURES

Broadly, disaster mitigation measures can be categorised into two:

Structural Mitigation Measures:

- This refers to any physical construction to reduce or avoid possible impacts of hazards, which includes engineering measures and construction of hazard-resistant and protective structures and infrastructure.

Non-structural Mitigation Measures:

- This refers to policies, awareness, knowledge development, public commitment, and methods and operating practices, including participatory mechanisms and the provision of information, which can reduce risk and related impacts.
- Structural and non-structural disaster mitigation measures are mainly carried out by human beings.
- However, nature through ecosystem functions also provides several mitigation measures as shown in next slide.

Hazard and disaster mitigation functions of ecosystems

Ecosystem	Hazard Mitigation
Mountain forests, vegetation on hillsides	Vegetation cover and root structures protect against erosion and increase slope stability by binding soil together, preventing landslides. Catchment forests, especially primary forests, reduce risk of floods by increasing infiltration of rainfall and delaying peak floodwater flows, except when soils are fully Saturated. Forests on watersheds are important for water recharge and purification, drought mitigation and safeguarding drinking water supply.

Hazard and disaster mitigation functions of ecosystems

Ecosystem	Hazard Mitigation
Wetlands, floodplains	Wetlands and floodplains control floods in coastal areas. Marshes, lakes and floodplains release wet season flows slowly during drought periods.
Coastal ecosystems (mangroves, saltmarshes, coral reefs, sand dunes)	Coastal wetlands, tidal flats, deltas and estuaries reduce the height and speed of storm surges and tidal waves. Coastal ecosystems protect against storm surges, flooding and other coastal hazards – combined protection by coral reefs, seagrass beds and sand dunes/ coastal wetlands/coastal forests is particularly effective.

Hazard and disaster mitigation functions of ecosystems

Ecosystem	Hazard Mitigation
Drylands	Natural vegetation management and restoration in drylands contributes to ameliorate the effects of drought and control desertification, as trees, grasses and shrubs conserve soil and retain moisture. Prescribed burning and creation of physical firebreaks in dry landscapes reduce fuel loads and the risk of unwanted large-scale fires.

DISASTER PREPAREDNESS

Definition:

- Disaster preparedness encompasses the knowledge and capacities developed by governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

Components Of A Comprehensive Disaster Preparedness Strategy Includes:

- Hazard, risk and vulnerability assessments
- Response mechanisms and strategies
- Preparedness plans
- Coordination
- Information management
- Early warning systems
- Resource mobilization
- Public education, training & rehearsals
- Community-based disaster preparedness

Types of Disaster Preparedness:

Target-Oriented Preparedness:

Preparedness plans may be target specific, for instance, we may require different types of planning for the vulnerable groups of women, children, elderly and disabled.

Task-Oriented Preparedness:

Specific groups jointly develop activities based on one of the community's plans to evaluate the community's capability to activate the preparedness plan in a real emergency. Eventually, these tasks enable the development of plan revisions, employee training and material resources to support readiness.

Disaster-Oriented Preparedness:

This addresses the likelihood of occurrence of a specific disaster. Emphasis is placed on structural and non-structural mechanisms.

Various levels of disaster preparedness in case of flooding is shown below:

Triggers	Early warning monitoring indicators	Responsible for early warning	Preventive and mitigating measures
Heavy rains	1) Weather forecasts 2) Information flow on the rainy season 3) Observation of the rise of river level	1) Gmet 2) Ministry of Information 3) NADMO	1) Use of media 2) Desilting of drainage systems 3) Clearing of waterways 4) Timely evacuation of population 5) Timely information flow on the rainy season
Opening of dams	1) Alert warning from Burkina Faso on the opening of dams 2) Rise of the water level in Burkina Faso	1) Volta River Authority 2) Ministry of Information 3) Ministry of Foreign Affairs 4) Ministry of Interior 5) NADMO 6) District Municipal and Metropolitan Assemblies	1) Timely flow of information on the opening of dams 2) Use of media 3) Use of voluntary groups by NADMO and red Cross 4) Evacuation plans and identification plans and identification of safer places
Choked drainage systems	1) Increment in human activities due to population increase resulting in unplanned settlements 2) No existing waste disposal sites	1) EPA 2) District and Metropolitan Assemblies 3) Ministry of Works and Housing	1) Establishment of an authority in charge of waste management 2) Clean up of drainage systems by District Assemblies

- Disaster preparedness provides a platform to design effective, realistic and coordinated planning, reduces duplication of efforts and increase the overall effectiveness of government, household and community member's disaster preparedness efforts.
- Disaster preparedness activities embedded with risk reduction measures can prevent disaster situations and also result in saving lives and livelihoods during any disaster situation, enabling the affected population to get back to normalcy within a short time period.
- Disaster preparedness is a continuous and integrated process resulting from a wide range of risk reduction activities and resources rather than from a distinct sectoral activity by itself.

DISASTER RESPONSE AND RELIEF

- Disasters manifest in many forms, and when they do, many lives are lost and properties damaged.
- Eventually, this situation disrupts various facets of life thus, the need of response.
- These responses may be directed at saving lives, reducing the health impact of the disaster, ensuring public safety, protecting and restoring

properties damaged by the disaster and meeting the basic subsistence requirement of people affected.

- This topic outlines the rationale for disaster response, the activities entailed in the response process, characteristics of disaster response, determinants of response, and the stages of disaster response.
- Disaster responses are the set of activities taken during a disaster or immediate following a disaster, directed towards saving life and protecting property.
- The activities that deal with the effect of disaster may include medical care, evacuation, search and rescue, provision of emergency water, food and shelter, debris removal and stabilization of unsafe buildings and landforms

The Objectives of Disaster Response

- It is aimed at providing immediate assistance to maintain life, improve health and support the morale of the affected population.
- It is focused at meeting the basic needs of the people until more permanent and sustainable solutions can be found.
- It depends on the adequacy of preparedness
- The success in responding appropriately depends on early planning, organization and training.
- Disaster response preparedness are the pre-disaster activities that are undertaken to minimise loss of life, injury and property damage in a disaster, and to ensure that rescue, relief, rehabilitation and other services can be provided following a disaster. •
- Preparedness for the first and immediate response is referred to as "emergency preparedness"

Factors that Determine the Nature of Disaster Response:

- The type of disaster
- The ability to take pre-impact actions
- The severity and magnitude of disaster
- The capability of sustained operations
- Identification of likely response requirements

The Ability to take Pre-Impact actions:

- Responses to disaster are operationalized in three main phases namely the "pre-during and post-disaster " situation.
- Disaster early warning system may provide timely warnings for anticipating impending disaster.
- Pre-impact responses (such as evacuation, shelter and other protective measures) may be carried out if time and conditions are favourable.

Requirement for Effective Response

- Information
- Resources

DISASTER RESPONSE PLANNING

- Roles and responsibilities are defined, policies and procedures are developed and generic tools for responses are identified and developed.

Types Of Disaster Responses:

- Search and rescue
- First aid and emergency medical care
- Evacuation
- Evacuation centre management
- Development of Standard Operation Procedure (SOPs)
- Immediate repair of community facilities and services
- Relief delivery
- Coordination and Communication
- Psycho-social counselling and stress debriefing
- Medical services

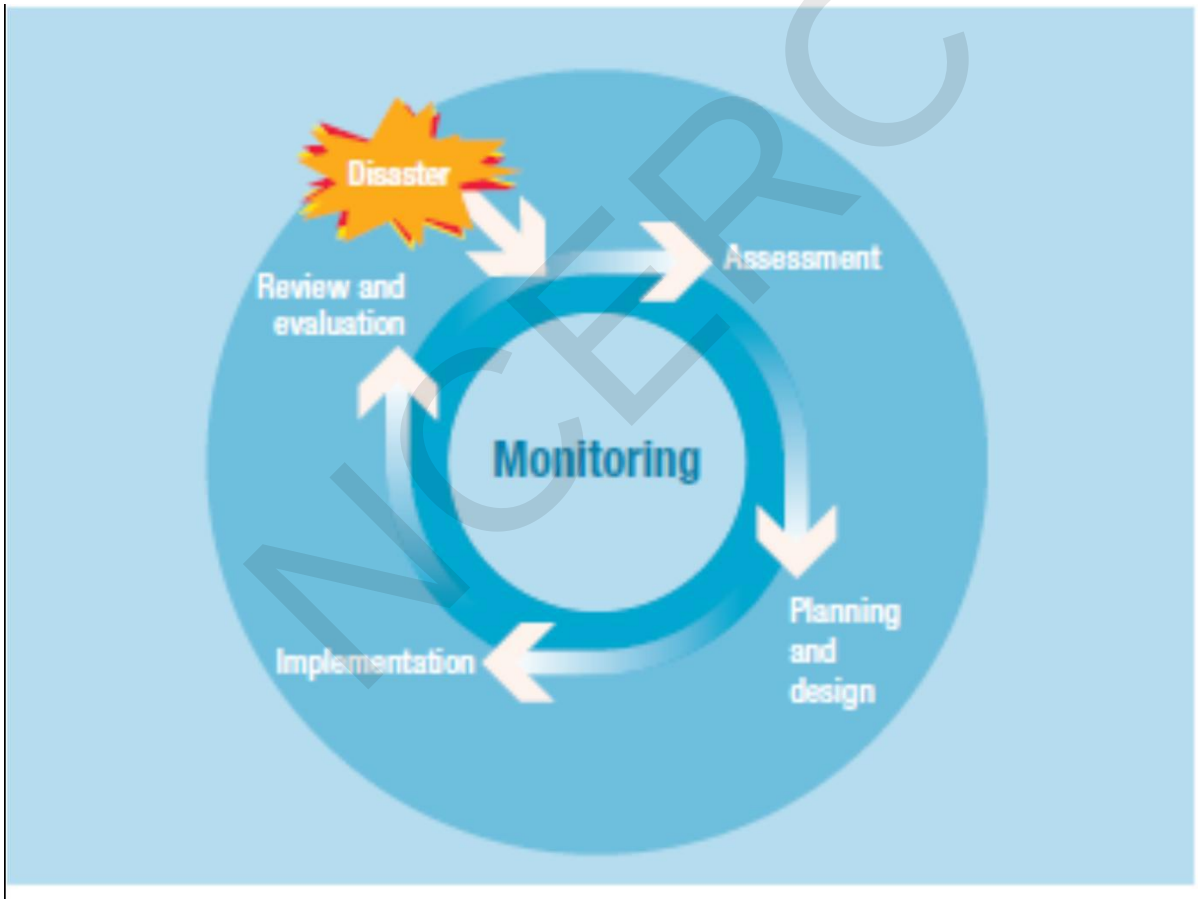
RELIEF

- It is defined as the provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected.

Relief can be of an :

- immediate,
- short-term,
- Protracted duration

PROJECT MANAGEMENT CYCLE



The List Of International Relief Response Organisations Is As Follows:

- Action Against Hunger (AAH),
- CARE,
- Caritas Internationalis,
- Catholic ReliefServices, (CRS - USCC),

- Emergency Nutrition Network (ENN),
- Doctors Without Borders,
- Food For The Hungry International (FHI),
- Food For The Hungry,
- Hunger
- Plus, Inc., Interaction,
- International Committee of the Red Cross (ICRC), International
- Federation of Red Cross and Red Crescent Societies (IFRC), International Organisation
- for Migration (IOM), International Rescue Committee (IRC), Lutheran World
- Federation, Mennonite Central Committee (MCC), Mercy Corps (MC)
- ETC…

MODULE IV

Participatory Stakeholder Engagement

Stakeholder 'participation', stakeholder 'engagement' and stakeholder 'involvement' is the interactions between two or more stakeholders in policy making, development projects, and decision making in disaster risk reduction (DRR) education.

'Stakeholder participation' is the process through which people with common interest (stakeholders) influence and share control over development initiatives, decisions and resources that affect them.

Stakeholder engagement is **the systematic identification, analysis, planning and implementation of actions designed to influence stakeholders**. A stakeholder engagement strategy identifies the needs of key groups and the sponsor plays a vital role in ensuring those business needs are met.

Stakeholder Engagement complements stakeholder Management
Both are needed for project success
Source: Laurence Davidson 2017

HOW STAKEHOLDER ANALYSIS IS DONE?

> Stakeholder analysis is done using either a grid method or salience model.

> The grid method uses two parameters about the stakeholders to analyse and create a grid.

> One of the most popular grids used is a "power-interest" grid.

> In this grid, every stakeholder will be judged based on their power and interest towards the project

> Accordingly all the stakeholders will be segregated into different quadrants of "high power – high interest", "high power – low interest", "low power – high interest", "low power – low interest" .

> This technique helps in putting the stakeholders at the right places so that appropriate strategies for each of them or each group can be worked out.

> Salience model is also used in some cases for conducting stakeholder analysis. Salience modeluses three parameters about each stakeholder to decide their position.

> The tree parameters used are "power", "urgency" and "legitimacy" of each stakeholder towards the project.Below are examples of a grid analysis and salience model analysis:

1 . Plan stakeholder engagement :

- Once the stakeholders are identified and prioritized based on their power and interest, it will be time to develop appropriate management strategies for each of them. A stakeholder engagement plan is developed.
- The stakeholder engagement plan includes another round of analysis of stakeholders to study their "current" position of engagement and the "desired" position of engagement which will bebeneficial for the project.
- A stakeholder engagement assessment matrix is prepared. Generally the stakeholders may fall in one of the five levels of engagement, namely, "Unaware", "Resistant",

"Neutral", "Supportive",and "Leading" h

- It is important to see the current levels of engagement of each stakeholder and ensure that they all become towards the project. This analysis helps in determining the exact steps and actions to be taken so that all stakeholders can be moved to their "desired" of engagement.

2 . Manage stakeholder engagement:

- Once appropriate stakeholder engagement strategies are developed, then the project manager and project team will start engaging with stakeholders with the intention of understanding their perspective towards project and seeking their support for successful completion of the project.
- Continuous and positive engagement and involvement of stakeholders is critical to project success.
- The project manager uses all the interpersonal and communication skills, social and cultural skills in this effort to engage the stakeholders.

3 . Monitor stakeholder engagement :

- It is important to keep assessing the actual stakeholder engagement and determine if that is as per required engagement level, if not the team will have to adjust some of the strategies so as to improve stakeholder engagement in the desired direction.

Forms of Stakeholder Participation:

The three basic forms of stakeholders are:

•***Primary stakeholders***:

Those directly affected (positively or negatively) by it. They include local populations as well as poor and marginalised groups. In disaster risk reduction, these stakeholders include homeowners, renters, homeless persons and community-based small-scale businesses.

•***Secondary stakeholders***:

These refer to those who are indirectly affected by it.They include the government, line ministry and project staff, implementing agencies, local governments, civil society based organisations, private sector firms, and other development agencies. The Ghana Police Service, National Fire Service, National Disaster Management Organisation (NADMO), Ghana Education Service (GES), Non-Governmental Organisations (NGOs), etc. are all part of this group.

•***Key stakeholders:***

This group can significantly influence, or are important to the success of the project through financial resources or power. Key stakeholders could include National Disaster Management Organisation (NADMO), Ministry of Local Government and Rural Development (MLGRD), Metropolitan, Municipal and District Assemblies (MMDAs), etc.

Basic Steps in Participatory Stakeholder Engagement

Generally, the most fundamental steps in stakeholder analysis can be enumerated as follows:

•Step 1: Identify key stakeholders;

•Step 2: Assess stakeholder interest and the potential impact of the new initiative

•Step 3: Assess stakeholder influences and importance and

•Step 4: Outline a stakeholder participation strategy

Step 1*: Key Stakeholders Identification*

The first step of stakeholder analysis is to identify relevant stakeholder groups. Keyquestions to ask in addressing this issue are:

- Who are the programme or project targeted beneficiaries?
- Who might be adversely impacted?

- Will the project impact (positively or negatively) on any vulnerable groups?
- Who are the projects main supporters and opponents?
- Who is responsible for carrying out planned activities?
- Who can contribute financial and technical resources?

Step 2: *Analysis of Stakeholder Interests and Programme/Project Impacts*

Once relevant stakeholder groups have been identified, the next step is to analyse their interests (overt and hidden) and to assess the potential impact of the proposed project on their interests. Key questions for participants to answer include:

- What are their key concerns and interests with respect to the project?
- What are stakeholders' expectations of the project?
- What conflicts might a group of stakeholders have with a particular projectstrategy?
- How do different groups of stakeholders relate to each other?
- Is there convergence/divergence between their interests and expectations?

Step 3: *Stakeholder Prioritisation*

The analysis of stakeholder interests and project impacts should allow the project team to categorise different groups of stakeholders and to determine the relative priority thatthe project should give to each stakeholder group's interest.

Key questions to engage the attention of participants are:

- Who are the project's targeted primary beneficiaries?
- What is the importance of each stakeholder group to the success of the project?
- What is the degree of influence of each stakeholder group over the project

Benefits and Cost of Stakeholder Participation

The potential benefits of increased stakeholder participation include the following:

- Improved programme/project design
- Improved means of verifying the relevance and appropriateness of proposed interventions;
- Increased uptake of project services and greater willingness to share costs;
- Enhanced sustainability as a result of increased stakeholder ownership;
- Opportunity to foresee and/or resolve potential obstacles, constraints andconflicts;
- Opportunity to generate social learning and innovations based on fieldexperience;
- Capacity-building of stakeholders and local institutions
- Improved means of ensuring that project benefits are distributed equitably;
- Strengthened working relations between stakeholders, government and civil society organisations and development partners.

Costs and Risks

The principal cost is the absence of stakeholder participation in programmes andprojects. Lack of stakeholder participation can lead to:

- Higher up-front costs in terms of time and resources;
- Danger of undertaking poorly planned activities due to limited time, capacity, commitment or resources;
- Lack of political will on the part of governments to allow wide stakeholder participation because they fear loss of power or influence;
- Difficulty in reaching out to marginalised groups and ensuring

that the true priorities

- Difficulty in identifying genuine representative nongovernmental organisations (NGOs) and civil society organisations(CSOs);
- Creation of unrealistic expectations;
- Aggravating conflicts between stakeholder groups with different priorities/interests;
- Weak capacity of beneficiary and intermediary organisations

Methods and Tools for Participatory Stakeholder Engagement

Participatory Meetings and Workshops

- you can use more than one idea in a session, and you should always leave time in the schedule to include participatory approaches and techniques to stimulate thinking, reflecting, discussing, and engaging

Panel Discussions

- Panellists build off each other's answers to elicit different opinions and deepen the discussion.
- The discussion can start with an overview presentation and brief comments from each panellist to frame the discussion and provide the audience with an understanding of the experience and viewpoint each panellist brings.
- The majority of the session time can then be spent in a question and answer format with questions from both the moderator and participants.
- Presentations can be effective when the goal is to make guidance, concepts, viewpoints or specific experience clear.
- When working with a presenter, be sure to provide clear guidance on the points you would like the presenter to focus on so he or she can minimise the time spent on project overview and maximise the time spent delving deeper into the key lessons learned or

Pyramid Schemes

- Participants are given a question or problem to think through on their own for a few minutes.
- They are then asked to join with a neighbour to discuss the topic in twos, then in a subsequent round in groups of four or six, then in groups of eight or twelve.
- Growing the groups larger provides the opportunity for friendly challenging of ideas and cross-fertilising the best of answers across groups.

Debates

- Speakers present opposing sides of an issue.
- This format can liven up a discussion topic that lends itself to debating pros and cons, multiple views, or conflicting opinions around an issue.
- As a variation, groups of participants can be assigned opposing sides of an issue and asked to formulate the key debate points as a group.

Round Table

- Participants form groups around a specific topic area in order to share experiences anddiscuss ideas.
- This format provides an informal setting for starting dialogue, sharing and discussion.
- Roundtables are similar to working sessions but generally are not as formal and may be used to simply start the discussion without the time allotted to work toward completing a joint project.

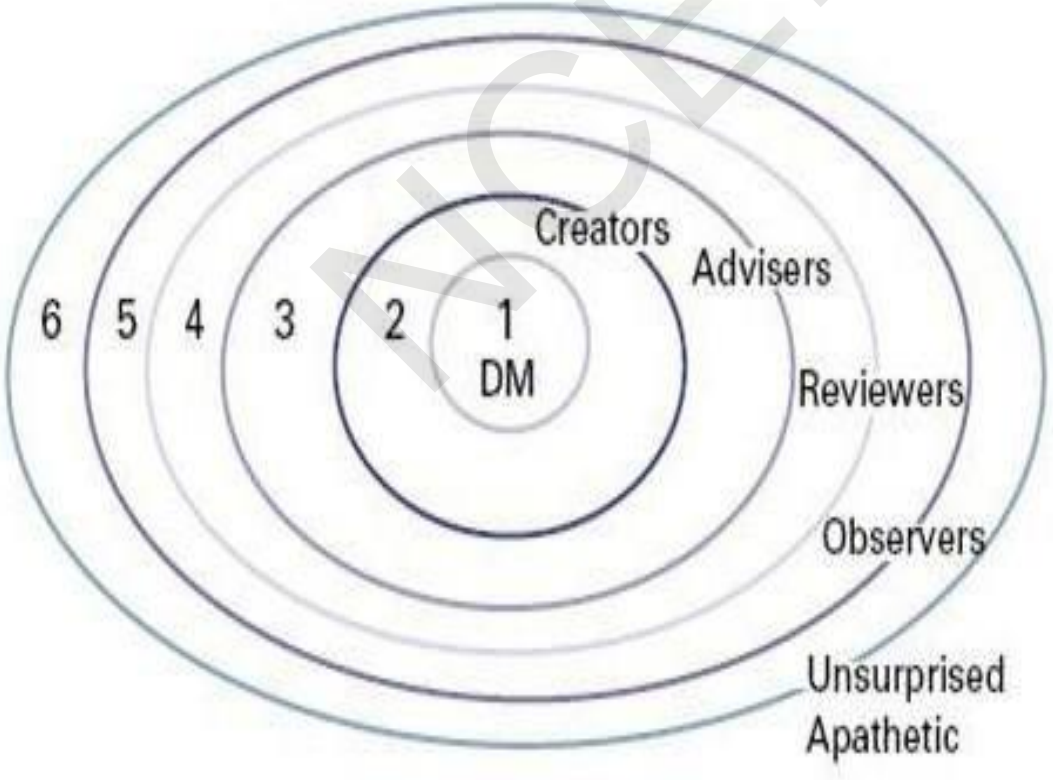
Levels of Stakeholder Participatio

- In designing the participatory process, the level of involvement of each stakeholder, depending on the given institutional framework, differs and should be defined.

- Different levels would require the involvement of different stakeholders.

- Experience shows that involving all stakeholders to participate fully in all decision-making stages is neither realistic nor useful in a given situation.

- Each stakeholder category has a specific role to play and can be said to have an orbit of influence with respect to a particular activity.



The decision-makers are at the centre of the orbit of influence on the decision-making process.

- Orbit 1 contains the stakeholders who are partners in decision-making. Final decisions must be made with their concurrence.

- Orbit 2 features the creators, who are deeply involved in the decision being made and in developing alternatives and are therefore constantly involved.

- Orbit 3 consists of the advisors, who are active but not constantly involved and are called upon periodically for advice.

- Orbit 4 features the reviewers, those who wish to be kept informed before a decision becomes a policy, rule, law or fait accompli. However, they do not feel the need to be active throughout the process.

- Orbit 5 contains the observers. These are people who do not want to be surprised. They watch and react only if an issue concerns them. However, they could be party to the process, but not entirely involved.

- The outer orbit holds those who are not seen in the process, but who will react if they are suddenly surprised and feel threatened.

Disaster communication

- Communication during and immediately after a disaster situation is an important.
- How do you communicate during a disaster ?
- For non-emergency communications, use **text messaging, e-mail, or social media** instead of making voice calls on your cell phone to avoid tying up voice networks.
- Disaster risk communication may take place through many different channels, including face-to face conversations, telephone calls, group meetings, mass media such as television, radio, Internet and interactive social media such as Twitter and Facebook.

Importance of Communication in Disaster Risk Reducing

1 . Communication promote preparedness for disasters:

- Being prepared can reduce fear, anxiety, and losses that accompany disasters.
- Communities, families, and individuals should know what to do in the event of a fire and where to seek shelter during a powerful storm.
- They should be ready to evacuate their homes and take refuge in public shelters and know how to care for their basic medical needs.
- People also can reduce the impact of disasters and sometimes avoid the danger completely.
- Have a list of emergency contacts (fire, police, ambulance, etc.) in your cell phone and near your home phone.
- Be sure every family member has emergency phone numbers and a cell phone.
- Teach children how and when to call 911 for help.
- Make sure everyone in your family knows how to send a text message.

2 . Communications provide early warnings signals of disasters

- Communication and dissemination systems ensuring people and communities receive warnings in advance of impending hazard events, and facilitating national and regional coordination and information exchange.
- Warnings must reach those at risk. Clear messages containing simple, useful and usable information are critical to enable proper preparedness and response by organizations and communities that will help safeguard lives and livelihoods.
- Trust is a big part of effective risk communication. If the information source cannot be trusted, those at risk may not respond proactively to the warnings – and it takes a long time to establish trust.
- Regional, national and local communication systems must be pre-identified and appropriate authoritative voices established.
- The use of multiple communication channels is necessary to ensure as many people as possible are warned, to avoid failure of any one channel, and to reinforce the warning message.
- There are numerous standards and protocols used by alerting authorities to transmit warnings.
- The Common Alerting Protocol is an international standard format for emergency alerting and public warning, developed by the International Telecommunication Union and promoted by a number of agencies.
- It is designed for “all-hazards”, that is, hazards related to weather events, earthquakes, tsunamis, volcanoes, public health, power outages, and many other emergencies.

3 . Communication facilitates proper response to disasters:

- It is impossible to plan communication without considering strategies, material design,and media activities which, in the case of the health sector, will provide the population with messages to protect themselves and improve their quality of life.

- When dealing with emergencies and disasters, communication planning becomes a complex and challenging undertaking.
- It involves the collection, organization, production, and dissemination of the information that makes it possible to make informed decisions and mobilize necessary resources.
- Sources and key shareholders must be identified and different audiences must be given priority.
- It is vital to create messages that will make health agencies visible and relevant to the population, the international community, donors, communications media, and organizations involved in international disaster response.

Steps to Effective Communication:

- Use standard terminologies when communicating-risks, disaster, coping, resilience, vulnerable, etc.
- Request and provide clarifications when needed- allow/encourage the beneficiaries to respond to issues they are not sure of.
- The communicator should also be well informed about the situation of thingswithin the community where the information is to be disseminated.
- Ensure statements are direct and unambiguous.
- Inform appropriate individuals when the mission or the plan changes.
- Communicate all information needed by those individual or teams external tothe team.
- Use non-verbal communication appropriately.
- Establish a calling tree so that everyone calls into one designated caller to check-in, and that person relays information to everybody else.

Barriers to Effective Communication:

- In emergency situations, communication breakdowns between potential victims and first responders can have dire consequences including unnecessary pain, misdiagnoses, drug treatment errors, unnecessarily long hospital stays and even death.
- Language barriers often exist when first responders and receivers have difficulty talking to people who speak a different language.
- Many areas have people who speak many different languages.Also, first receiver may come from other countries to help.
- In addition, communication may be difficult when people are under intense stress, which is inevitable during an emergency.
- Non-Focus on the issue at hand, not being attentive
- Avoid interruption, show interest in what is being said
- Avoid being judgemental but make provision for feedbacks
- Pay attention to non-verbal communication
- Be conscious of individual differences
- Keep stress in check but be assertive

Disaster communication methods:

1. Social Media:

> This feature allows users who are located within a certain distance of a natural disaster's occurrence, to log in and tell friends if they're safe and check to see if their loved ones have verified their safety as well.

2. Two-Way radio:

> A two-way radio (also known as walkie-talkies) is a pair of handheld devices that can connect with each other provided both are on the same frequency, within a certain distance.

> One user can talk while the other listens and vice-versa.

3. Citizens Band Radio:

> A CB radio is capable of short-distance communications on various frequencies.

> It is similar although more complex than a regular two-way radio as it contains more functionality.

4. Mobile Applications (Apps)

> Cell phone apps are not only fun for playing games and keeping the kids occupied on a long car ride, they can also help in a disaster setting.

a. Life360

Life360 is a free app that allows access to a specific user's location and also contains a messaging service feature. Automatic alerts can notify the user when a loved one arrives orchecks-in at specified destinations as well.

b. FEMA app

This application gives users access to preparedness tips such as survival advice, emergency checklists, and meeting locations that can be saved to a mobile device. It gives the user access to weather alerts from the National Weather Service tailored to a specific area.

5. Police Scanner

> This device allows the user to hear all emergency communication between officials in the police,rescue, fire, respondent, military, and aircraft industries.

> Although the user cannot broadcast on it, it does allow access to important information during an emergency situation.

6. Word-of-Mouth

> When all else fails, power is out, internet access is scarce, and devices are ruined or have not been purchased prior, it comes down to survival instincts.

7. Landline telephone

> Perhaps not the most popular option anymore, but having a landline telephone can be a life saver when access to a cellphone or other electronic device is limited or non-existence.

> Depending on the type of technology supplied by your provider, it is possible that a landline telephone will work, even when internet access is down.

8. Satellite phone (Satphones)

> Satellite phones are on the pricier side of the emergency devices spectrum, but are beneficial especially in remote territories where internet access is scarce at best.

> Some satellite phones have coverage in all parts of the world due to Satphone's reliance on orbiting satellites for their functioning versus standard cell phone towers.

9. Amateur Radio (HAM Radio)

> This product is similar to a CB radio besides that it requires the user to be a licensed American Amateur Radio operator; thus giving it a bit more authenticity to the information that is being regulated across the air waves.

CRISIS COUNSELLING

- At different points in life most people experience some kind of crisis.
- A crisis is defined as a situation or event in which a person feels overwhelmed or has difficulty coping.
- A crisis might be caused by an event such as the death of a family member, the loss of a job, or the ending of a relationship.
- During such times people experience a wide range of feelings, and each person's response to a crisis is different and it is normal to feel frightened, anxious, or depressed at such atime.
- Crisis counseling involves providing support and guidance to an individual or a group of people such as a family or community during a crisis.
- The purpose of crisis counseling is to decrease emotional pain, provide emotional support, make sure that the person in crisis is safe, and help develop a plan for coping with the situation.
- Sometimes it also involves connecting a person to other community or health services that can provide long-term support.

Characteristics of Effective Crisis Counsellors

Effective crisis counsellors should possess characteristics such as:

- ***Non-judgemental***: willing to listen all through to the client without casting judgement on those in crisis.
- ***Non-Reactive***: does not react to client's outbursts or threats but be completely supportive when client shows strong emotions.
- ***Specific Training***: receive specific skills and techniques in crisis counselling thatare quite different from normal counselling.
- ***Self-Awareness***:: knows him/her self and empathise with clients without becoming personally involved or emotional when people who have gone personal experiences come to them.

Steps in Crisis Counselling

Step One – Define the Problem

- In this phase, we help others figure out what the problem is that we are trying to solve.
- During a time where fear and anxiety can be overarching and long-reaching, this phase is helpful in focusing people on exactly what is the specific issue they want to solve, or at least minimize/mitigate.

Step Two – Ensure Safety

- While this phase really colors the other steps in the process, it is important at the very beginning to emphasize to oneself and to others that the safety of the people around us is our overriding concern
- The safety of those that we lead, manage, and support must be paramount

throughout the entire process from both the minds of the people that are providing this leadership, and the minds of the people that they are helping.

Step Three – Provide Support

- During crisis intervention, it is important to communicate that one party is here to assist the other. The phrase used by the authors is, "Here is one person who really cares about you."
- This demonstration of support has psychological factors of both reassuring the person and allowing them to enter a calmer state where they can help solve the problem with you, and it demonstrates the unconditional positive regard one party has for the other.

Step Four – Examine Alternatives

- As we know, anxiety is the enemy of creative thinking. During this challenging time, there will be new problems to solve in new ways, and, by helping figure out what the alternatives are, as leaders we can help our teams be as clear-headed as possible.
- This is best accomplished, however, by proceeding through the previous three phases to get everyone in the state of mind where the creative thinking can be as productive as possible.

Step Five – Make a Plan

- At this point, the alternatives have been weighed and the most likely approach has been decided upon.
- This should be done collaboratively with a group. In most cases, individual decisions are better informed when others are let in.
- A thorough weighting of theoptions usually arrives at best conclusions.

Step Six – Obtain Commitment

- In this phase, individuals are given assignments, and leaders need to make sure that they understand what is being asked of them.
- This is often a good place to ask staff to briefly summarize the plan back to you to make sure that it is understood and theappropriate nuance has beenadded.

Capacity Building: Concept – Structural and Non-structural Measures

- Capacity building is an ongoing process that equips officials, stakeholders and the community to perform their functions in a better manner during a crisis/disaster.
- In the process of capacity building, we must include elements of human resource development, i.e., individual training, organizational development such as improving the functioning of groups and organizations and institutional development.
- Some examples of capacity are: permanent houses, ownership of land, adequate food and income sources, family and community support in times of crisis, local knowledge, good leadership etc.
- Structural solutions include engineered solutions such as redesigning buildings and designing physical barriers to disaster events to reduce damage.
- Non-structural solutions include social solutions such as early warning, evacuation planning, and emergency response preparedness.

D1sa ste r anag em e n t

Earthquake

StructuraJ ti ation
Preparing ie ineered structures
Retrofitting of existi build ing s

Non struct:ural ti ation

i Enlon:ing Building codes
iL Pub'lic awareness
iii. Reduoe possible damage by secondary effects lke fire, floods.

Disaster a ina g e im e n t

Landslide

tructur I 1tg 11011

i. Draina , e corriections
i.. Engineered s:true11ures

o s rue ui iti ion

i. Hazard mappi .
ii. 1a t i regula tioris
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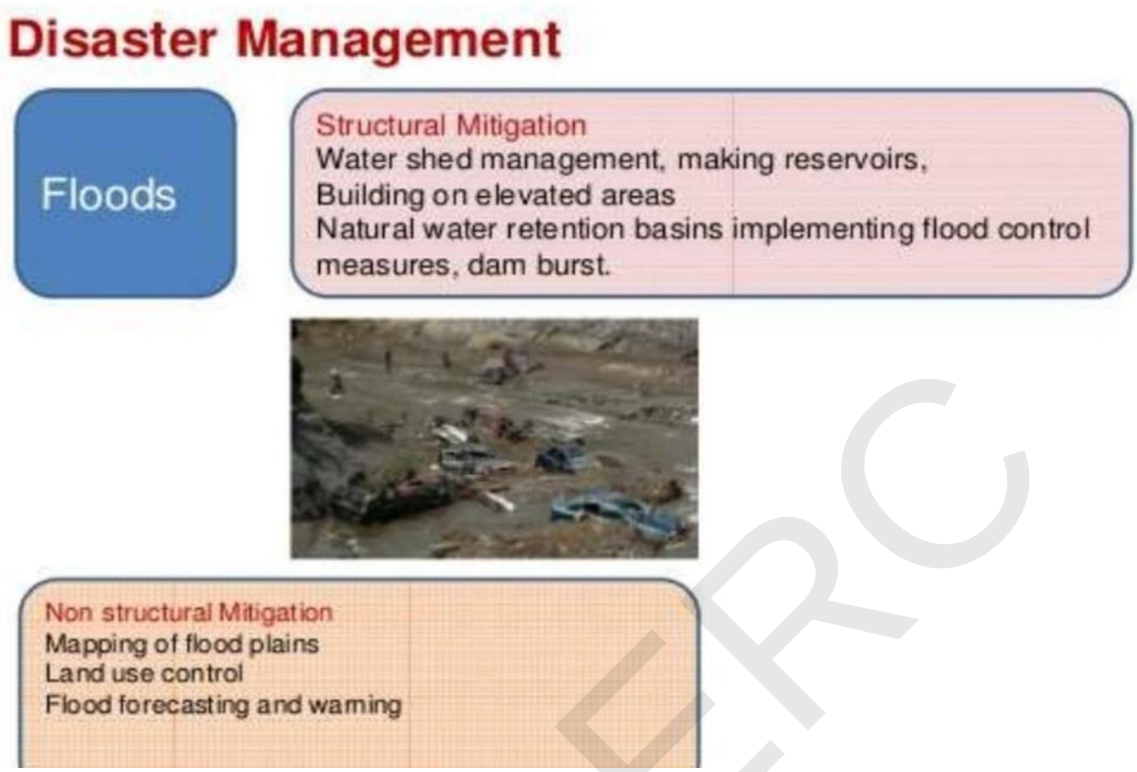

FLOOD RISK REDUCTION STRUCTURAL MEASURES:

- Storage reservoir or basins to restrict overflow.
- Retarding basins to lower the flow of flooding
- Levees and floodwalls to confine floodwaters
- Improvement of channel capacity
- Some structural measures such as Flood Embankment, Channel Improvement, River Training, Coastal Embankment etc. to combat the flood sufferings.

FLOOD RISK REDUCTION NON STRUCTURAL MEASURES:

- Raised community areas with basic human needs.
- Home placed at higher elevations and built with flood resistant materials.

- Floodplain zoning
- Changes in cropping pattern
- Training and Public Awareness
- Institutional Arrangements
- Flood Warning System
- Local Disaster Action Plans

CAPACITY ASSESSMENT

- A Capacity Assessment is an analysis of desired capacities against existing capacities; this generates an understanding of capacity assets and needs, which informs the formulation of a capacity development response
- Assessing institutions and capacity is a central element of preparing and implementing any kind of support. It is also prerequisite for deciding if and how donor support to CD is feasible.
- The traditional instruments used by development partners have had a very mixed record of success. Sometimes the instruments are the problem.
- Sometimes the problem is the way in which the instruments are used the instruments at donors' disposal are simply not relevant to the situation at hand.
- It is both complex and delicate to assist others in developing capacity.

Why assessing capacity is important?

Assessing capacity serves as input in different processes and may support interlinked decisions on:

- Strategic and operational choices about overall levels focus areas, operational modalities and timing of aid. Weak capacity may imply that fewer funds can be effectively used, andthat more focus on capacity development is required.

- Selection of key capacity issues to be included in the ongoing policy dialogue, in monitoring, or as indicators.
- Decision about if and how development partners can support capacity development (CD) processes of partners.

How to assess capacity?

> There are many different ways to assess organisational or system capacity, and there are numerous tools and instruments that can be used to diagnose different aspects of organisational or system capacity.

> There is, however, no single approach which can claim superiority or much less objectivity.

> Nevertheless, there is a set of issues that should be kept in mind when considering capacity assessments:

Self-assessments are the best point of departure:

- Partner-lead assessments engaging staff can foster buy-in to subsequent CD processes, while external assessments often are perceived to be judgmental, disenfranchising those being assessed.

Avoid approaches which focus only on identifying "capacity gaps"

- According to a pre-defined normative model for "good capacity" or "best practice".
- Such models tend to overlook the existing capacity assets which are likely to be a good starting point for futurecapacity development.
- Gap assessments tend to have a one-sided focus on weaknesses, and they tend to lead to predictable solutions: sending in TA to "fix" capacity problems and "close" or "bridge" capacity gaps. Such approaches rarely work.

Look beyond single organisations:

- Particularly in sector wide approaches, it is important not to stay inside the "tower" of e.g. a central ministry, and see capacity issues from that view only.
- Front-line service providers, central level cross cutting ministries, oversight institutions and non-state actors are likely to shape and condition the dynamics of CD.

STRENGTHENING CAPACITY FOR REDUCING RISK

> Strengthening Capacities for Disaster Risk Reduction has been developed against the backdrop of the United Nations Development Programme's (UNDP's) longstanding commitment to supporting developing and high-risk countries through its programmes and services for capacity developmentand disaster risk reduction.

> The objective of this component is to enhance the capabilities of the implementing entities in managing disaster risks, enhancing preparedness, and achieving resilient recovery.

1. Capacity building for disaster management:

To finance strengthening of the disaster management systems in the region by augmenting the capacity of stakeholders and institutions.

The activities will include:

- Capacity building of the state disaster management authority by strengthening its institutional and organizational structure, staffing, and resources and funding of training programs and regular drills for the emergency operations center staff and Disaster Management Officers at various levels;
- Strengthening the Disaster Response Force;

- Setting up a Decision Support System (DSS) and Emergency Operation Centers to integrate and analyze information from multiple sources in an integrated geo-spatial system.

2. Technical support for risk reduction and response preparedness :

To finance activities such as:

- Preparation of a Hydro-meteorological Resilience Action Plan focusing on extreme weather events to develop resilience solutions/recommendations and a robust, fail safe EWS in the regionincluding optimum use of strengthened networks and facilities;
- River Morphology Study for some key rivers impacted by the disaster and to analyze and identify critical protective infrastructure works needed for river bank strengthening;
- Urban vulnerability assessment study with specific focus on seismic risk mitigation to undertake detailed urban vulnerability analysis and model various risks for effective mitigation planning and disaster response preparedness;
- Upgrading design guidelines and material specification for construction in seismic zones in order to carry out an update of current construction design standards and material specifications toalign them with national and international bestpractices;
- Disaster Risk Financing and Insurance (DRFI) to work out options to increase the resilience of the PIE's financial response capacity to secure cost-effective access to adequate funding for emergency response, reconstruction, and recovery

MODULE 5

COMMON DISASTER TYPES IN INDIA

High Power Committee on Disaster Management identified 31 types of disasters. Tsunami has been added in 2005 in this list. List of various disasters

i. Water and Climate related disasters

a) Floods and drainage management

b) Cyclones

c) Tornadoes and Hurricanes

d) Hailstorms

e) Cloud burst

f) Heat wave and Cold wave

g) Snow avalanches

h) Droughts

i) Sea erosion

j) Thunder and lighting

k) Tsunami

ii. Geological related disasters

a) Landslides and mudflows

b) Earthquakes

c) Dam failure/Dam bursts

d) Mine disasters

iii. Chemical, industrial and nuclear related disasters

a) Chemical and industrial disasters

b) Nuclear disasters

iv. Accident related disasters

a) Forest fires

b) Urban fires

c) Mine flooding

d) Oil spills

e) Major building collapse

f) Serial bomb blasts

g) Festival related disasters

h) Electrical disasters and fires

i) Air, road and rail accidents

j) Boat Capsizing

k) Village fire

v. Biological related disasters

a) Biological disasters and epidemics

b) Pest attacks

c) Cattle epidemics

d) Food poisoning

Natural Disasters

(A) **Drought In India** : In India around 68 percent of the agriculture land country is prone to drought in varying degrees. Of the entire area 35 percent receives rain falls between 750 mm and 1125 mm which is considered drought prone while 33 percent, which receives rainfalls between less than 750 mm is considered to be chronically drought prone. The primary cause of any drought is deficiency of rainfall and in particular, the timing, distribution and intensity of this deficiency in relation to existing reserves. A prolonged period of relatively dry weather leading to drought is a widely recognized climate anomaly. Drought can be devastating as water supplies dry up, crops fail to grow, animals die, and malnutrition and ill health become widespread The environmental effects of drought, including Stalinization of soil and groundwater decline, increased pollution of freshwater ecosystems and regional extinction of animal species.

(B) **Floods:** India is one of the most flood prone countries in the world. The principal reasons for flood lie in the very nature of natural ecological systems in this country, namely, the monsoon, the highly silted river systems and the steep and highly erodible mountains, particularly those of the Himalayan ranges. The average rainfall in India is 1150 mm with significant variation across the country. The annual rainfall along the western coast and Western Ghats, Khasi hills and over most of the Brahmaputra valley amounts to more than 2500 mm. Most of the floods occur during the monsoon period and are usually associated with tropical storms or depressions, active monsoon conditions and break monsoon situations. Flood destructions have always brought miseries to numerous people, especially in rural areas. Flood results in the outbreak of serious epidemics, specially malaria and cholera. Simultaneously, scarcity of water also arises. It has a drastic effect on agricultural Figure 2: Flood Hazard Map of INDIA produce. Sometimes, water remains standing over large areas for long span of time hampering the

Rabi crops. Floods occur in almost all rivers basins in India. The main causes of floods are heavy rainfall, inadequate capacity of rivers to carry the high flood discharge, inadequate drainage to carry away the rainwater quickly to streams/ rivers. Landslides blocking streams; typhoons and cyclones also cause floods. Flash floods occur due to high rate of water flow as also due to poor permeability of the soil. Areas with hardpan just below the surface of the soil are more prone to floods as water fails to seep down to the deeper layers.

(C) **Cyclones:** The major natural disaster that affects the coastal regions of India is cyclone and as India has a coastline of about 7516 kms, it is exposed to nearly 10 percent of the world‟s tropical cyclones. About 71 percent of this area is in ten states (Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Puducherry, Andhra Pradesh, Orissa and West Bengal) Figure 3. The islands of Andaman, Nicobar and Lakshadweep are also prone to cyclones. On an average, about five or six tropical cyclones form in the Bay of Bengal and Arabian sea and hit the coast every year. Out of these, two or three are severe. When a cyclone approaches to coast, a risk of serious loss or damage arises from severe winds, heavy rainfall, storm surges and river floods. The effect of a storm surge is most pronounced in wide and shallow bays exposed to cyclones such as in the northern part of Bay of Bengal.

(D) **Heat Wave:** Extreme positive departures from the normal maximum temperature result in a heat wave during the summer season. The rising maximum temperature during the pre-monsoon months often continues till June, in rare cases till July, over the northwestern parts of the country. Decrease in the Diurnal Temperature Range (DTR) due to urbanisation is a new factor leading to human mortality and discomfort. Increased minimum temperatures in summer do not allow the necessary nocturnal cooling to neutralize the high maximum temperature during a heat wave epoch.

(E) **Cold Wave and Fog** Occurrences of extreme low temperature in association with incursion of dry cold winds from north into the sub continent are known as cold waves. The northern parts of India, specially the hilly regions and the

adjoining plains, are influenced by transient disturbances in the mid latitude westerlies which often have weak frontal characteristics. These are known as western disturbances. The cold waves mainly affect the areas to the north of 20°N but in association with large amplitude troughs, cold wave conditions are sometimes reported from states like Maharashtra and Karnataka as well. UP and Bihar rank the highest in terms of casualties from cold wave and this could be due to poor level of development and lack of shelters to the outdoor workers and farmers

(F) **Earthquake:** India has been divided into four seismic zones according to the maximum intensity of earthquake expected. The entire Himalayan Region is considered to be vulnerable to high intensity earthquakes of a magnitude exceeding 8.0 on the Richter Scale, and in a relatively short span of about 50 years, four such major earthquakes have occurred in the region: Shillong, 1897 (M8.7); Kangra, 1905 (M.8.0); Bihar–Nepal, 1934 (M 8.3); and Assam–Tibet, 1950 (M 8.6). Scientific publications have warned that very severe earthquakes are likely to occur anytime in the Himalayan Region, which could adversely affect the lives of several million people in India.

(G) **Landslides:** Landslides constitute a major natural hazard in our country, which accounts for considerable loss of life and damage to communication routes, human settlements, agricultural fields and forest lands. Based on the general experience with landslides, a rough estimate of monetary loss is of the order of ` 100 crore to ` 150 crore per annum at the current prices for the country as a whole. Landslides mainly affect the Himalayan region and the western ghats of India. Landslides are also common in the Nilgiri range. It is estimated that 30 percent of the world's landslides occur in the Himalayas. The Himalayan Mountains, which constitute the youngest and most dominating mountain system in the world, are not a single long landmass but comprises a series of seven curvilinear parallel folds running along a grand arc for a total of 3400 kilometers. Due to its unique nature, the Himalayas have a history of landslides that has no comparison with any other mountain range in the world. Landslides are also common in the western gate. In the

Nilgiris, in 1978 alone, unprecedented rains in the region triggered about one hundred landslides which caused severe damage to communication lines, tea gardens and other cultivated crops. A valley in Nilgiris is called "Avalanches Valley". Scientific observation in north Sikkim and Garhwal regions in the Himalayas clearly reveal that there is an average of two landslides per sq. km. The mean rate of land loss is to the tune of 120 meter per km per year and annual soil loss is about 2500 tones per sq km.

(H) **Tsunami:** A tsunami (in Japanese „tsu" means harbor and „nami" means wave) is a series of water waves caused by the displacement of a large volume of a body of water, usually an ocean. In the Tamil language it is known as "Aazhi Peralai". Seismicity generated tsunamis are result of abrupt deformation of sea floor resulting vertical displacement of the overlying water. Earthquakes occurring beneath the sea level, the water above the reformed area are displaced from its equilibrium position. The release of energy produces tsunami waves which have small amplitude but a very long wavelength (often hundreds of kilometer long). It may be caused by nonseismic event also such as a landslide or impact of a meteor.

Tsunami Sources for India :

For a tsunami to hit Indian coast, it is necessary that earthquake of magnitude > 7 should occur. Two such possible zones are

- Andaman-Sumatra
- Makran

Man-Made Disasters

(A) **Industrial and Chemical Disaster: Industrial disaster**: Industrial disasters are disasters caused by chemical, mechanical, civil, electrical or other process failures due to accident, negligence or incompetence, in an industrial plant which may spill over to the areas outside the plant or with in causing damage to life, property and environment. New industries are also coming up at a rapid rate.

Chemical disaster: Chemical disasters are occurrence of emission, fire or explosion involving one or more hazardous chemicals in the course of industrial activity (handling), storage or transportation or due to natural events leading to serious effects inside or outside the installation likely to cause loss of life and property including

adverse effects on the environment. "Chemical accident or emergency can result in extensive damage to the environment with considerable human and economic costs. Chemical and industrial emergencies may arise in a number of ways, such as

- Explosion in a plant
- Accidents in storage facilities of chemicals
- Accidents during the transportation of chemicals, misuse of chemicals
- Improper waste management
- Accidents in treatment plants
- Technological system failures
- Failures of plant safety design
- Arson and sabotage
- Human error

(B) **Stampede In stampede**: In Stampede, the term mob or crowd is used to refer to a congregated, active, polarized aggregate of people, which is basically heterogeneous and complex. Its most salient features include homogeneity of thought and action among its participants and their impulsive and irrational actions. Incidents of stampedes can occur in numerous socio-cultural situations. These stampede incidents can be categorized into the following types, where the causes and the impact are described in the incident. Though the list is not exhaustive, it provides a fair idea about various types of situations where stampedes can occur:

- Entertainment events
- Escalator and moving walkways
- Food distribution
- Processions
- Natural disasters
- Power failure
- Religious events
- Fire incidents during religious/other events
- Riots
- Sports events
- Weather related

(C) **Road Accidents** : The rapid expansion of road transport has brought with it the challenge of addressing adverse factors such as the increase in road accidents. Road accidents are a human tragedy. It involves high human suffering and monetary costs in terms of premature deaths, injuries, loss of productivity etc. Most deaths and injuries due to road accidents are invisible to society. They are a hidden epidemic. In India, motor vehicles including two wheelers are growing at a faster rate then the economic and population growth.

(D) **Rail Accidents** :"Railway Disaster is a serious train accident or an untoward event of grave nature, either on railway premises or arising out of railway activity, due to natural or human-made causes, that may lead to loss of many lives and /or grievous injuries to a large number of people, and/or severe disruption of traffic etc, necessitating large scale help from other government/non-government and private organizations." The preparation of Disaster Management Plan on Indian Railways and on the Zonal Railways in coordination with the different Departments of the Railway, other Central/State Govt. agencies, NGOs, private agencies, etc. has to be done by the Safety Department in the railway Board, on the Zonal Railway and Divisions. Railway Board has approved the nomination of GMs, AGMs or CSOs (when GM/ AGM are not available) for declaring an untoward incident as a Railway Disaster.

(E) **Air Accidents**: Air accidents are by and large of four types; mid-air collisions, forced landings, crash due to technical snags and air-crash in mountainous terrain due to poor visibility. While air accidents can occur at any time and at any place, areas within about 30 – 40 kms. radius of airports are most vulnerable. Experience shows that a majority of air accidents occur either during take-off or landing near major airports where flight paths get congested. In addition, air accidents also take place at remote inaccessible places like forests, hilly and mountainous regions, high seas, etc. Causes of air accidents are either human failure of pilots, air traffic controllers or technical failures of on board, landing instruments. In rare cases, it may also be the result of terrorist activities.

(F) **Mine Disasters** Mines Act, 1965 defines Disaster as an act Accident (unexpected event) causing loss of more than 10 lives. A mining accident is an accident that

occurs in the process of mining minerals. The Act categories an accident involving loss of lives less than 10 major accident. Thousands of miners die from mining accidents each year, especially in the process of coal mining and hard rock mining. One of the greatest mining disasters in Indian mines occurred on 27 December 1975 due to water in rush from old abandoned incline working to a deep shaft mine working of Chasnallah Colliery leading to death of 375 miners. Following types of mining disasters, losses and impacts are classified by the DGMS. • Side fall (slope failure) disaster in opencast mines,

- Roof and side falls in underground mines,
- Collapse of mine pillars,
- Air Blast,
- Failure of rope haulage,
- Accident due to electricity,
- Mine fires,
- Accidents due to explosive,
- Inundations,
- Explosions in mines.
- Rock burst and bumps,

G) Epidemics Infectious diseases are a major public health problem in India. While many infectious diseases like tuberculosis and malaria are endemic, some of them occasionally attain epidemic proportion. An epidemic refers to an increase, often sudden, in number of cases of a disease in a community clearly in excess of what is normally expected in that population. Epidemics are public health emergencies which disrupt routine health services and are major drain on resources. Epidemics include viral infections disease (mengitis, measles, dengue, polio, typhoid fever etc.) and Bacterial infectious diseases (cholera, diarrhea etc.) The main causes for epidemic are non availability of clean and hygienic drinking water contamination of drinking water sources, lack of awareness about sanitation, unhygienic food, and overcrowding, biological conditions in addition to ecological factors.

LEGISLATIONS IN INDIA ON DISASTER MANAGEMENT

1. RESPONSIBILITIES

While the primary responsibility of disaster management rests with the States, the Central Government supports the efforts of State Governments by providing logistical and financial support.

On behalf of the Central Government, DM Division in the Ministry of Home Affairs co-ordinates with disaster affected State Government(s), concerned line ministries/departments, National Disaster Management Authority (NDMA), National Disaster Response Force (NDRF), National Institute of Disaster Management (NIDM) and the Directorate General of Fire Services, Home Guards and Civil Defence, and Armed Forces for effective disaster risk reduction. The Division is responsible for legislation, policy, capacity building, prevention, mitigation, response and long term rehabilitation. Major responsibilities of the Disaster Management Division, MHA are as follows:

- Resource mobilization for relief and response to natural disasters except drought, hail storms, cold and frost waves and pest attack
- Operation of control room and situation reports
- Multi-hazard Early Warning Systems
- Matters related to State Disaster Response Fund and National Disaster Response Fund
- All matters related to disaster response, preparedness, prevention, mitigation and capacity building
- International cooperation in disaster management
- Post-disaster/long term rehabilitation and reconstruction
- All administrative and budget matters related to NDMA, NDRF and NIDM
- Strengthening of fire and emergency services
- All matters related to Fire Services, Civil Defence and Home Guards including Director General of (Fire Services, Civil Defence & Home Guards), National Civil Defence College (NCDC) and National Fire Service College (NFSC)

- Administration of the Disaster Management Act, 2005
- Provides secretarial support to NEC, HLC and NPDRR.

NATIONAL DISASTER MANAGEMENT POLICY

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

Disaster Management

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

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

Objectives

The objectives of the national policy on disaster management are:

- Promoting a culture of prevention, preparedness and resilience at all levels through knowledge, innovation and education.
- Encouraging mitigation measures based on technology, traditional wisdom and environmental sustainability.
- Mainstreaming disaster management into the developmental planning process.

- Establishing institutional and techno-legal frame works to create an enabling regulatory environment and a compliance regime.
- Ensuring efficient mechanism for identification, assessment and monitoring of disaster risks.
- Developing contemporary forecasting and early warning systems backed by responsive and failsafe communication with information technology support.
- Promoting a productive partnership with the media to create awareness and contributing towards capacity development.
- Ensuring efficient response and relief with a caring approach towards the needs of the vulnerable sections of the society.
- Undertaking reconstruction as an opportunity to build disaster resilient structures and habitat for ensuring safer living.
- Promoting productive and proactive partnership with media in disaster management.

The Disaster Management Act 2005

This Act may be called the Disaster Management Act, 2005.

It extends to the whole of India.

It shall come into force on such date as the Central Government may, by notification in the Official Gazette appoint; and different dates may be appointed for different provisions of this Act and for different States, and any reference to commencement in any provision of this Act in relation to any State shall be construed as a reference to the commencement of that provision in that State.

Definitions.-In this Act, unless the context otherwise requires,-

"Affected area" means an area or part of the country affected by a disaster;

"Capacity-building" includes-

- Identification of existing resources and resources to be acquired or created;
- (Acquiring or creating resources identified under sub-clause (i);
- Organization and training of personnel and coordination of such training for effective management of disasters;

"Central Government" means the Ministry or Department of the Government of India having administrative control of disaster management;

"Disaster" means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area;

"Disaster management" means a continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient for-

Prevention of danger or threat of any disaster;

- Mitigation or reduction of risk of any disaster or its severity or consequences;
- Capacity-building;
- Preparedness to deal with any disaster;
- Prompt response to any threatening disaster situation or disaster;
- Assessing the severity or magnitude of effects of any disaster;
- Evacuation, rescue and relief;
- Rehabilitation and reconstruction;
- "District Authority" means the District Disaster Management Authority constituted under sub-section (1) of section 25;
- "District Plan" means the plan for disaster management for the district prepared under section 31;
- "Local authority" includes panchayati raj institutions, municipalities, a district board, cantonment board, town planning authority or Zila Parishad or any other body or authority, by whatever name called, for the time being invested by law, for rendering essential services or, with the control and management of civic services, within a specified local area;
- "Mitigation" means measures aimed at reducing the risk, impact or effects of a disaster or threatening disaster situation;
- "National Authority" means the National Disaster Management Authority established under sub-section (1) of section 3;

- "National Executive Committee" means the Executive Committee of the National Authority constituted under sub-section (1) of section 8;
- "National Plan" means the plan for disaster management for the whole of the country prepared under section 11;
- "Preparedness" means the state of readiness to deal with a threatening disaster situation or disaster and the effects thereof;
- "Prescribed" means prescribed by rules made under this Act;
- "Reconstruction" means construction or restoration of any property after a disaster;
- "Resources" includes manpower, services, materials and provisions;
- "State Authority" means the State Disaster Management Authority established under sub-section (1) of section 14 and includes the Disaster Management Authority for the Union territory constituted under that section;
- "State Executive Committee" means the Executive Committee of a State Authority constituted under sub-section (1) of section 20;
- "State Government" means the Department of Government of the State having administrative control of disaster management and includes Administrator of the Union territory appointed by the President under article 239 of the Constitution;
- "State Plan" means the plan for disaster management for the whole of the State prepared under section 23.

With effect from such date as the Central Government may, by notification in the Official Gazette appoint in this behalf, there shall be established for the purposes of this Act, an authority to be known as the **National Disaster Management Authority.**

The National Authority shall consist of the Chairperson and such number of other members, not exceeding nine, as may be prescribed by the Central Government and, unless the rules otherwise provide, the National Authority shall consist of the following:-

1. The Prime Minister of India, who shall be the Chairperson of the National Authority, ex officio;
2. Other members, not exceeding nine, to be nominated by the Chairperson of the National Authority.

3. The Chairperson of the National Authority may designate one of the members nominated under clause (b) of sub-section (2) to be the Vice-Chairperson of the National Authority.
4. The term of office and conditions of service of members of the National Authority shall be such as may be prescribed.

Meetings of National Authority

- The National Authority shall meet as and when necessary and at such time and place as the Chairperson of the National Authority may think fit.
- The Chairperson of the National Authority shall preside over the meetings of the National Authority.
- If for any reason the Chairperson of the National Authority is unable to attend any meeting of the National Authority, the Vice-Chairperson of the National Authority shall preside over the meeting.

Appointment of officers and other employees of the National Authority.-The Central Government shall provide the National Authority with such officers, consultants and employees, as it considers necessary for carrying out the functions of the National Authority.

Powers and functions of National Authority

1. Subject to the provisions of this Act, the National Authority shall have the responsibility for laying down the policies, plans and guidelines for disaster management for ensuring timely and effective response to disaster.
2. Without prejudice to generality of the provisions contained in sub-section (1), the National Authority may -

    - Lay down policies on disaster management;
    - Approve the National Plan
    - Approve plans prepared by the Ministries or Departments of the Government of India in accordance with the National Plan;
    - Lay down guidelines to be followed by the State Authorities in drawing up the State Plan;

- Lay down guidelines to be followed by the different Ministries or Departments of the Government of India for the purpose of integrating the measures for prevention of disaster or the mitigation of its effects in their development plans and projects;
- Coordinate the enforcement and implementation of the policy and plan for disaster management;
- Recommend provision of funds for the purpose of mitigation;
- Provide such support to other countries affected by major disasters as may be determined by the Central Government;
- Take such other measures for the prevention of disaster, or the mitigation, or preparedness and capacity building for dealing with the threatening disaster situation or disaster as it may consider necessary;
- Lay down broad policies and guidelines for the functioning of the National Institute of Disaster Management.

The Chairperson of the National Authority shall, in the case of emergency, have power to exercise all or any of the powers of the National Authority but exercise of such powers shall be subject to ex post facto ratification by the National Authority.