NEHRU COLLEGE OF ENGINEERING AND RESEARCH CENTRE
(NAAC "A" Accredited)
(Approved by AICTE, Affiliated to APJ Abdul Kalam Technological University, Kerala)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE MATERIALS

MCN 301 DISASTER MANAGEMENT-2019 SCHEME

VISION OF THE INSTITUTION

To mold 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 Computer Science and Engineering

M.Tech in Computer Science and Engineering

M.Tech in Cyber Security

Approved by AICTE New Delhi and Accredited by NAAC

Affiliated to the University of Dr. A P J Abdul Kalam Technological University.

DEPARTMENT VISION

Producing Highly Competent, Innovative and Ethical Computer Science and Engineering Professionals to facilitate continuous technological advancement.

DEPARTMENT MISSION

1. To Impart Quality Education by creative Teaching Learning Process
2. To Promote cutting-edge Research and Development Process to solve real world problems with emerging technologies.
3. To Inculcate Entrepreneurship Skills among Students.
4. To cultivate Moral and Ethical Values in their Profession.
5.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Graduates will be able to Work and Contribute in the domains of Computer Science and Engineering through lifelong learning.
PEO2: Graduates will be able to Analyse, design and development of novel Software Packages, Web Services, System Tools and Components as per needs and specifications.
PEO3: Graduates will be able to demonstrate their ability to adapt to a rapidly changing environment by learning and applying new technologies.
PEO4: Graduates will be able to adopt ethical attitudes, exhibit effective communication skills, Teamwork and leadership qualities.

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 environmentalconsiderations.
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 andMobile Apps to create innovative career path and for the socially relevant issues.

COURSE OUTCOMES

C306.1	Define and use various terminologies in use in disaster management parlance and organize each of these terms in relation to the disaster management cycle. And understand System of Earth.	K3
C306.2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment.	K4
C306.3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk and discuss the various disaster response and relief; international relief organizations.	K4
C306.4	Identify factors that determine the nature of disaster response and discuss the various disaster response actions	K4
C306.5	Explain the various legislations and best practices for disaster management and risk reduction at national and international level	K2

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES & PSO

CO"S	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C306.1		2				2				2		2
C306.2	2	3	2		2	2	3			3		2
C306.3	2	3	2	2	2	2	3			3		2
C306.4	3	3	3		2	2	3					2
C306.5	3	3			2	2	3					2

CO PSO Mapping

CO"S	PSO1	PSO2	PSO3
C306.1	2		
C306.2	2		
C306.3	2		
C306.4	3		
C306.5	2		2

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

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

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. Explain the different types of cyclones and the mechanism of their formation
4. Explain with examples, the difference between hazard and risk in the context of disaster management
5. Explain the following terms in the context of disaster management (a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

Course Outcome 2 (CO2):

1. What is hazard mapping? What are its objectives?
2. What is participatory hazard mapping? How is it conducted? What are its advantages?
3. Explain the applications of hazard maps
4. Explain the types of vulnerabilities and the approaches to assess them

Course Outcome 3 (CO3):

1. Explain briefly the concept of „disaster risk"
2. List the strategies for disaster risk management „before", „during" and „after" a disaster
3. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy

Course Outcome 4 (CO4):

1. What is disaster prevention? Distinguish it from disaster mitigation giving examples
2. What are the steps to effective disaster communication? What are the barriers to communication?
3. Explain capacity building in the context of disaster management

Course Outcome 5 (CO5):

1. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
2. Explain the importance of communication in disaster management
3. Explain the benefits and costs of stakeholder participation in disaster management
4. How are stakeholders in disaster management identified?

Course Outcome 6 (CO6):

1. Explain the salient features of the National Policy on Disaster Management in India
2. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction
3. What are Tsunamis? How are they caused?
4. Explain the earthquake zonation of India

Model Question paper

QP CODE: **PAGES:3**

Reg No:_____ **Name :_____**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MCN 301

Course Name: Disaster Management

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. What is hazard mapping? What are its objectives?
4. Explain briefly the concept of „disaster risk"
5. List the strategies for disaster risk management „before", „during" and „after" a disaster
6. What is disaster prevention? Distinguish it from disaster mitigation giving examples
7. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
8. Explain the importance of communication in disaster management
9. What are Tsunamis? How are they caused?
10. Explain the earthquake zonation of India

Part B

Answer any one Question from each module. Each question carries 14 Marks

a. Explain the different types of cyclones and the mechanism of their formation [10]

b. Explain with examples, the difference between hazard and risk in the context ofdisaster management
[4]

OR

11. Explain the following terms in the context of disaster management [14]

(a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

12. a. What is participatory hazard mapping? How is it conducted? What are its advantages? [8]

b. Explain the applications of hazard maps [6]

OR

13. Explain the types of vulnerabilities and the approaches to assess them [14]

14. a. Explain the core elements of disaster risk management [8]

b. Explain the factors that decide the nature of disaster response [6]

OR

15. a. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy [6]

b. Explain the different disaster response actions [8]

16. a. Explain the benefits and costs of stakeholder participation in disaster management [10]

b. How are stakeholders in disaster management identified? [4]

OR

17. a. What are the steps to effective disaster communication? What are the barriers to communication? [7]

b. Explain capacity building in the context of disaster management [7]

18. Explain the salient features of the National Policy on Disaster Management in India [14]

OR

19. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction [14]

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

MODULE NOTES

MODULE 1 NOTES

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland waterbodies; 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 counseling, needs assessment.

MODULE 1

SYSTEMS OF EARTH AND KEY TERMS IN DISASTER MANAGEMENT

SYLLABUS:

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.

PERVIOUS KTU QUESTIONS(CE)

1. a) Explain the difference between Hazards and Disaster. (8)
   b. Define the terms Risk, Vulnerability and crisis. (7)
2. Explain the concept of „Green House effect. (8)
3. Explain the origin of Cyclones, types and its impacts. (10)
4. What is the purpose of Disaster Management? (5)
5. Explain the term Vulnerability with respect to earthquake. (7)
6. Explain the below terms. (10)

a. Exposure
b. Resilience
c. Disaster risk reduction
d. Capacity

7. What is disaster mitigation? (6)
8. Explain the below terms. (10)

a. Early warning Systems
b. Disaster Preparedness
c. Disaster Risk Management
d. Disaster Prevention

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 failure of 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, covering the inner core is the outer core. This is a layer of molten liquid containing nickel and iron. It is about 2,270 km thick. The outer core is covered by solid "Mantle", which is about 2,900 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

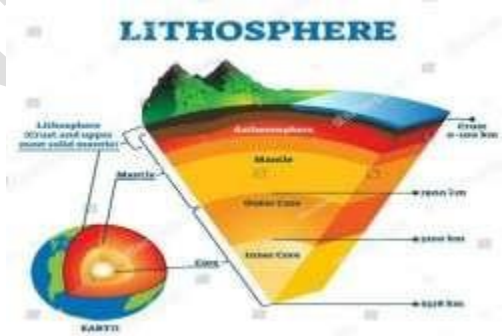


Fig 1: Structure of the earth and Lithosphere

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 Lithospheres:

1. The oceanic lithosphere which is about 5 km to 8 km thick composed of basalt.
2. The 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 km thick, they move with at restricted independence from the seven large plates.

The plates periodically reorganize themselves with new plate boundaries being formed, while certain others closing up. In addition to these movements, the plates also change in shape. The plates have three different motions:

1. They are Moving apart, thereby creating divergent boundaries
2. Gliding horizontally along each other, thereby creating wrench and transform boundaries
3. Moving towards one another, and creating convergent boundaries

Composition of Lithosphere

The lithosphere contains minerals, rocks and soil. It has more than 100 chemical elements and most of them are rare. More than 99 percentage of the volume includes elements like oxygen, silicon, aluminum, iron, calcium, sodium, potassium and magnesium. 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. Below table shows elements present in earth 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

ROCKS

Lithosphere has various types of rocks. Rocks are naturally occurring hard and consolidatedinorganic materials, 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 the interior, or lava on the surface of earth. Igneous rocks are composed of primary minerals, which are predominantly silicates. They sometimes overlap with sedimentary and metamorphic rocks.

Sedimentary Rocks

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

Metamorphic Rocks

Also known as Thermal rocks as 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 through pre-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 broken and 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 the natural process. The formation takes place from the weathering and decomposition 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 barren areas of rock or even ice.

Soil accomplishes various functions, which include the following:

1. It provides mechanical support to the plant.
2. 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 and animals.
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 matte

Different types of soil are given below:

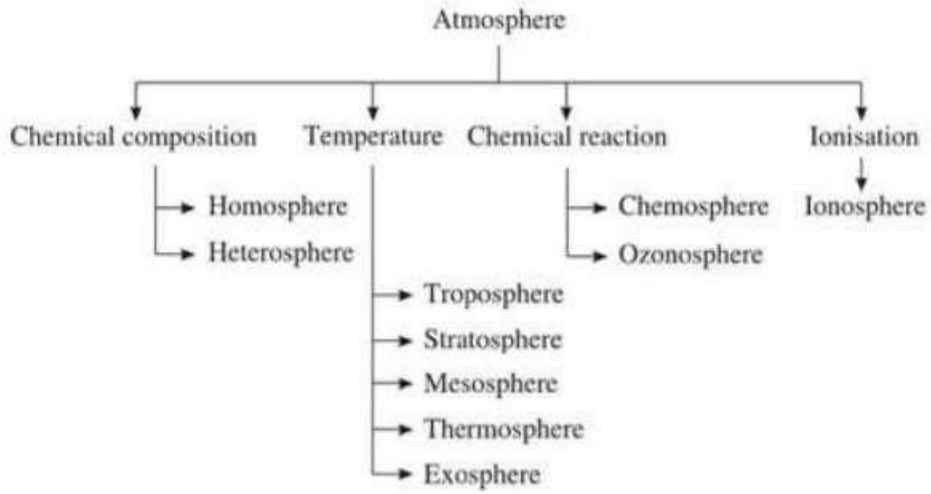
S. No.	Soil	Details
1	Volcanic ash	Volcanic ash is fine grained, and has the property of weathering relatively easily. Plants invade a new deposit of volcanic ash quickly and colonise it very fast. This could happen even within a few years' time. The soils that result from volcanic ash, known as Andisols, 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.

LAYERS OF ATMOSPHERE

Atmosphere is the various gases that encircle the earth. The gases contained in the atmosphere include nitrogen, oxygen, argon, carbon dioxide, neon, etc., The below table shows the composition of gases present in the atmosphere.

S. No.	Gas	Per cent
1	Nitrogen	78.80
2	Oxygen	20.95
3	Argon	0.93
4	Carbon dioxide	0.03
5	Neon	0.0018
6	Helium	0.00052
7	Methane	0.00015
8	Krypton	0.00011
9	Hydrogen, carbon monoxide, ozone, etc.	Less than 0.0001

Atmosphere contains water vapor, certain other fine materials like soot, dust of rock and soil, sores, pollens and salt grains from sea water. The atmosphere is divided in to a number of concentric layers that extend from sea level to outer space. Atmosphere is classified in to various types as shown below:



Based on chemical composition atmosphere is divided in to two.

1. **Homosphere**

   Homosphere Extends to a distance of about 88Km from the surface of earth. It consists of gases like nitrogen, oxygen, argon and carbon dioxide. This layer is homogeneous in composition.

2. **Heterosphere**

   The atmosphere lies above homosphere is heterosphere. The air composition is not uniform. The lower most layer have the heaviest molecules and upper layer has the lightest elements. Based on the gases present, heterosphere is further divided to four.

   a. **Molecular Nitrogen Layer**(88Km-200Km)
   b. **Oxygen Layer** (200Km-1125Km)

c. **Helium Layer** (1125Km-3540Km)
d. **Hydrogen Layer** (3540Km-9660Km)

Based on the temperature, the atmosphere is divided into four parts.

1. **Troposphere**

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, fog and haze arefound only in troposphere. The temperature in this layer decreases at about -6.4°C/km with 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**

Stratosphere 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 vapors are absent in these regions. Ozonosphere is an important layer found within stratosphere. Ozone layer is found in this layer. Ozone absorbs and prevents the harmful ultraviolet radiations from reaching earth, thereby protect the life on earth. The maximum concentration of ozone occurs at 22 km from the ground level. Above the stratosphere, there is a small layer called stratopause where temperature neither increases nor decreases with height.

3. **Mesosphere**

The portion of the atmosphere above stratosphere, between 50 km and 80 km is known as mesosphere. It starts from the edge of Stratopause. Though the temperature in mesosphere near stratosphere is higher by about 10°, it falls to -75°C at 80 km. The density of air at this height is about 1/1000 as that of sea level. Mesosphere plays a crucial role in radio communication as ionisation 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.

4. **Thermosphere**

Thermosphere extends from 80 km to about 60,000 km from earth. Here the temperature increases to about 2000°C. The property of thermosphere is radically different from the others. Ions are abundant in thermosphere. In thermosphere that most of the approaching meteoroids burn up before reaching earth.

5. **Exosphere**

The region beyond thermosphere is called exosphere. It consists of only hydrogen and helium atoms. This region has very high temperature due to solar radiation.

Base on the chemical reaction atmosphere is classifies in to two.

1. Chemosphere
A region of the upper atmosphere between altitudes of 40 and 80 km in which chemical processes driven by sunlight are significant. The chemosphere overlaps the upper stratosphere and the mesosphere

2.Ozonosphere
In this region intense chemical reaction takes place with the help of oxygen. Ozone layer is present in this region.

OZONE LAYER

Ozonosphere is an important layer found within stratosphere. Ozone 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 at 22 km from the ground level.

Depletion of ozone layer

Due to human activities ozone layer is becoming thin. The thinning of this layer is called ***ozone depletion***.
The ozone layer is located in the lower part of the stratosphere 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 by Ozone-Oxygen Cycle. When ultra-violet radiation that spread out from the sun strikes the oxygen molecule, it splits the molecule into two individual oxygen atoms. The oxygen atoms, thus produced, combines with Oxygen (02) molecule and produce ozone molecule (03). This reaction is aided by either Nitrogen 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 and an atom of oxygen (O). It is through this repeated circular ozone and oxygen formation that the concentration of ozone is maintained in the stratosphere. The concentration of ozone in the atmosphere is determined by 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.

Depletion by CFCs and BFCs

CFCS and BFCS are stable compounds in the atmosphere that have the property of living longer (50 to 100 years). Due to 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 breaking down of ozone molecules. It is estimated that a single such radical of either Cl or Br is capable 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 ozone layer in a recurrent manner.

Depletion by Nitric Oxide

One molecule of nitric oxide (NO) combines with ozone; it gets oxidised to nitrogen dioxide and Oxygen. This NO2 combines with another O3 molecule to become NO3 (Nitrate) and O2. The NO2 and NO3 then combine to form N2O5 (Dinitrogen pentoxide). Even the atomic oxygen(O) readily combines with NO2 to yield NO3. Due to this series of actions and reactions, ozone is completely utilised, and thereby depleted. Large quantities of nitrogen 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.GREENGREEN HOUSE EFFECT

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

Incoming Solar Radiation

Atmosphere behaves like a complex mega heat engine. A large number 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 biological processes. 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 infrared portions constitute over 95 per cent. The harmful UV radiation is prevented from reaching earth by the ozone layer. The solar radiation which ultimately reaches the earth comprises mainly of visible light, which is composed of seven colours. While travelling through the atmosphere, a portion of the radiation energy is reflected by clouds, and some are scattered and 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.

Outgoing Solar radiation

If the entire energy that is received from sun retained in its earth‟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 to the upper layers of air through conduction. The heat energy so emitted from the earth‟s surface is in the form 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 energy and the remaining energy escapes into the outer space. Gases capable of absorbing outgoing radiation are carbon dioxide, carbon monoxide, water vapour, etc. They are called Green House Gases (GHG). Due to the effect of Greenhouse gases, Earth is prevented from cooling down drastically. GHGS thus act like a blanket and 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 vapour-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 trees are in abundance.

WEATHER

When radiation from insolation strikes earth, its top layer gets heated. 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 all directions-both horizontally and vertically. This movement of air is the basis of weather. Weather is the atmospheric conditions that exist for a short duration 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**.

TEMPERATURE

Temperature is the index of heat that is sensible. It indicates the kinetic energy of molecules, or the speed at which the molecules move. While in air and water, molecules keep on moving and change their location very often and in solids the molecules involve in a vibration movement and not moving. The speed at which this vibration takes place is described as temperature. A body having higher temperature has the property of transmitting it to another one having lower temperature. Temperature is measured using thermometer, and is reported in either Celsius, Kelvin or Fahrenheitscales. The earth‟s temperature varies in an altitudinal and horizontal manner in the troposphere

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. The lapse rate is not uniform and it varies due to different conditions like pollution in the atmosphere.

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 this variation are :

(a) The hour of the day:

More solar energy is received during the noon, when sun‟s rays strike vertically overhead; than hours in the 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 in darkness. 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 66½ degrees 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.

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 low-pressure area. The reverse happens in a high-pressure area. Air tends to sink in the centre of a high-pressure area during anticyclones.

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 rotation of the earth. In addition to this, a low-pressure belt is formed over the tropical 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 is a consistent pattern to how air moves around our planet‟s atmosphere. This pattern, called ***atmospheric circulation***.

MCN 301 DISASTER MANAGEMENT

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 the Earth. In the tropics, near the equator, warm air rises. When it gets about 10-15 km (6-9 miles) above the Earth surface it starts to flow away from the equator and towards the poles. Air that rose just north of the equator flows north. Air that rose just south of the equator flows south. When the air cools, it drops back to the ground, flows back towards 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.

The Indian Monsoon

Monsoon is a regional wind that blows towards land at a certain season and blow from thelandmasses during other season. These wind blows in the opposite direction in summer and winter. Though monsoon winds blow over all parts of the world, it is well-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**

South-West Monsoon

The south-east trade winds originate from the southern hemisphere in the Indian Ocean. When these winds cross the equator, 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 the Bay of Bengal Branch. When the moisture laden Arabian Sea branch reaches the south-western side of India, they are blocked by the Western Ghats. When the mountain range blocks the horizontal flow, the wind ascends along the slope of the mountain range, gets cooled down and form clouds. These clouds then result in precipitation. Kerala gets the south-westmonsoon mostly during early June every year. These winds then take a west turn and continue their

journey, and spread over the northern parts of India bringing in rains to these areas. Monsoon winds normally reach Delhi in the first week of July and could last till end September/early October.

North-East Monsoon

Since North-East winds originate mainly from the land masses of 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, Telangana and Tamil Nadu.

HYDROSPHERE

Hydrosphere forms over 70 per cent of the earth‟s surface. In terms 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 important role 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 and valleys exceed in size of their counterparts on land. As on date less than 10 per cent of the ocean floor has been surveyed.

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 spread to the atmosphere when wind blows sprays of sea water. The salt particles in the atmosphere enable water molecules to stick to it, and this falls on the land with rain and snow.

a) Oceans as moderator of climate

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 a profound and significant influence in heating up the globe, and hence, its climate. When water moves up from the colder and deeper parts of the ocean to the warmer surface, the heat is carried with it. Due to the interplay of various factors, the ocean water moves around the globe, andwith 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 and climate change could occur.

b) Oceans as Heat Reservoir

Oceans play a role of a heat reservoir, moderating extreme temperatures. 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 is heat energy transfer from land to water and vice-versa.

c) Oceans as Carbon Reservoir

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.d) 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 Antarctic as ice shelf. nine per cent in the Greenland ice sheet and the balance in the various glaciers around the world. It is estimated that if all the ice in Greenland and Antarctica is 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 streams and also as ground water and soil moisture. The water found in these sources is fresh in nature. In solid form water is found as glacialice, ice caps and ground ice. The fresh water in earth is perpetually being interchanged between the surface of the earth and atmosphere by a process of ***evaporation and precipitation***. This interchange is known as water cycle or hydrological cycle. In the hydrological cycle, solar energy causes water from the oceans to evaporate and change to atmosphere vapour. Evaporation also takes place from inland water bodies like lakes, rivers, streams, etc. The evaporated water rises to the upper layers of the atmosphere, where it is cooled and condensed. The condensed water 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 the rainwater that falls on the land drip into the ground is known as ground water. The ground water is used by human beings and plants.

BIOSPHERE

Biosphere is an important realm of Earth. The totality of life on earth and its interdependency on abiotic environmental factors. Biosphere consists of the complex interdependency between biotic and abiotic environmental components. Basically, biosphere is a thin envelop that encircles most ofthe earth, 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 interactions between

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 major ecosystems:

(a) Terrestrial ecosystem

(b) Aquatic ecosystem

a) Terrestrial ecosystem

The terrestrial ecosystem consists of plants, animals, microorganisms their dependencies and interdependencies with the non-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 day to 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 resources.

DISASTER MANAGEMENT

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

Disaster is a result from the combination of ***hazard, vulnerability & insufficient capacity*** or measures to reduce the potential chances of risk. A disaster happens when a hazard impacts on the vulnerable population and causes damage, casualties and disruption. For e.g.: earthquake in an uninhabited desert cannot be considered a disaster, no matter how strong the intensities produced. An earthquake is disastrous only when it affects people, their properties & activities. Thus, disaster occurs only when hazards and vulnerability meet.

Types of Disasters

a) Natural Disaster
A disaster caused by natural factor is called as a natural disaster.
E.g.: Earthquake, flood, cyclone etc.

b) Man-made disaster
A disaster caused due to the human activities.
E.g.: Wars, fire accidents, industrial accidents etc.

HAZARD

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 topossible disasters. Hazards can be the creation of man or the environment.

Natural hazards

Natural hazards are hazards which are caused because of natural phenomena (hazards with meteorological, geological or even biological origin). Examples of natural hazards are cyclones, tsunamis, earthquake and volcanic eruption which are exclusively of natural origin.
Landslides, floods, drought, fires are socio-natural hazards since their causes are both natural and manmade.

Manmade hazards

Manmade hazards are hazards which are due to human negligence. Manmade hazards are associated with industries or energy generation facilities and include explosions, leakage of toxic waste, pollution, dam failure, wars or civil strife etc.

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 is a "measure of the expected losses due to a hazard event occurring in a given area over a specific time period. Risk is a function of the probability of particular hazardous event and the losses each would cause."

The level of risk depends upon:
- Nature of the hazard
- Vulnerability of the elements which are affected
- Economic value of those elements

A community/locality is said to be at „risk" when it is exposed to hazards and is likely to be adversely affected by its impact. Risk can be calculated using the following equation.

Risk = Probability of Hazard x Degree of Vulnerability.

There are different ways of dealing with risk, such as:

a. **Risk Acceptance** means an informed decision to accept the possible consequences and likelihood of a particular risk.

b. **Risk Avoidance** is an informed decision to avoid involvement in activities leading to risk realization.

c. **Risk Reduction** refers to the application of appropriate techniques to reduce the likelihood of risk occurrence and its consequences.

d. **Risk Transfer** involves shifting of the burden of risk to another party. One of the most common forms of risk transfer is Insurance.

Risk Assessment

A risk assessment is a process to identify potential hazards and 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 the effectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios.

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 risk map is a combination of all risk elements on several hazards. This process is important in risk map preparation and obviously in disaster management field for appropriate implementation of disaster risk reduction activities.

Elements at risk during/after disaster are:
• People
• Livestock
• Rural housing stock
• Houses
• Crops, trees, telephone, electric poles
• Boats, looms, working implements
• Personal property
• Electricity, water and food supplies
• Infrastructure support

Disaster Risk Reduction

Disaster risk reduction involves structural and non-structural measures. Structural measures include the use of physical or engineering solutions (such as ocean wave barriers or earthquake resistant 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 reduce the impacts of disaster.

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 focusing on the vulnerability that limits them. The classifications are:

a. Physical Capacity
People whose houses have been destroyed by the cyclone or crops have been destroyed by the flood can salvage things from their homes and from their farms. Some family members have skills, which enable them to find employment if they migrate, either temporarily or permanently.

b. Socio-economic Capacity
Rich people have the capacity to recover soon because of their wealth. In fact, they are seldom hit by disasters because they live in safe areas and their houses are built with stronger materials. However, even when everything is destroyed, they have the capacity to cope up with it.

Hazards are always prevalent, but the hazard becomes a disaster only when there is greater vulnerability and less of capacity to cope with it. In other words the frequency or likelihood of a hazard and the vulnerability of the community increases the risk of being severely affected.

MITIGATION

Mitigation embraces measures taken to reduce both the effect of the hazard and the vulnerable conditions to it in order to reduce the scale of a future disaster. Therefore, mitigation activities can

be focused on the hazard itself or the elements exposed to the threat. Examples of mitigation measures which are hazard specific include water management in drought prone areas, relocating people away from the hazard prone areas and by strengthening structures to reduce damage when a hazard occurs. In addition to these physical measures, mitigation should also aim at reducing the economic and social vulnerabilities of potential disasters.

a. Structural mitigation: Dams, windbreaks, terracing, hazard resistant buildings.
b. Non-structural mitigation: Education programs and policies, e.g., land-use, zoning, crop diversification, building codes, forecasting and warning.

DISASTER RESILIENCE

Disaster resilience is the ability of individuals, communities, organisations and states to adapt to and recover from hazards, shocks or stresses without compromising long-term prospects for development. Disaster resilience is determined by the degree to which individuals, communities and public and private organisations are capable of organizing themselves to learn from past disasters and reduce their risks to future ones, at international, regional, national and local levels.

The core elements of disaster resilience are as follows:
a. ***Context***: It deals with whose resilience is being built such as a social group, socio-economic or political system, environmental context or institution.
b. ***Disturbance***: These disturbances take two forms Stresses and Shocks.
c. ***Capacity To Respond***: The ability of a system or process to deal with a shock or stress depends on sensitivity and adaptive capacity. Sensitivity is the degree to which a system will be affected by, or will respond to, a given shock or stress. This can vary considerably for different factors within a system. For example, women accounted for up to 80% of those who died during the 2004 Indian Ocean tsunami, and death rates among women were almost four times higher than those among men in the 1991 Bangladesh cyclone. Limited mobility, skills set and social status exacerbated sensitivity to the shock. Adaptive capacity means how well the system can adjust to a disturbance or moderate damage, take advantage of opportunities and cope with the consequences of a transformation.
d. ***Reaction***: A range of responses are possible, including: bounce back better, where capacities are enhanced, exposures are reduced, and the system is more able to deal with future shocks and stresses; bounce back, where pre-existing conditions prevail; or recover, but worse than before, meaning capacities are reduced. In the worst-case scenario, the system collapses, leading to a catastrophic reduction in capacity to cope with the future.

Shocks

Shocks are sudden events that impact on the vulnerability of the system and its components. There are many different types of disaster-related shocks that can strike at different levels. These include disease outbreaks, weather-related and geophysical events including floods, high winds, landslides, droughts or earthquakes. There can also be conflict-related shock such as outbreaks of fighting or violence, or shocks related to economic volatility.

Stresses

Stresses are long-term trends that undermine the potential of a given system or process and increase the vulnerability. These can include natural resource degradation, loss of agricultural production, urbanisation, demographic changes, climate change, political instability and economic decline.

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 in order to avoid disaster or reduce its impacts. The term „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 the target 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 protection embankments. Disaster Mitigation: It refers to a set of measures to reduce or neutralise the impact of natural 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 of affected populations.

DAMAGE ASSESSMENT

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

a. **Severe**: The target facility or object cannot be used for its intended purpose. Complete reconstruction is required.
b. **Moderate**: The target facility or object cannot be used effectively for its intended purpose unless major repairs are made.

c. **Light**: The target facility or object can be used for intended purpose but minor repairs would be necessary.

EMERGENCY

Emergency is a disruption of the functioning of society, causing human, material or environmental damages and losses which do not exceed the ability of the affected society to cope using only its own resources. Emergency is a situation in which normal operations cannot continue and immediate action is required so as to prevent a disaster. Example – forest fire, oil spills, road accidents, outbreak of epidemics etc.

When an emergency or a disaster affect a city or a region, efforts are conducted initially to care for the wounded, to restore lifelines and basic services, and subsequently to restore livelihoods and to reconstruct communities. Such efforts can be structured in three phases:

i. **Response phase**: where activities such as search & rescue, rapid damage and needs assessments, and the provision of first aid are conducted; followed by the opening and management of temporary shelters for those left homeless as well as the provision of humanitarian assistance to those affected.
ii. **Rehabilitation phase**: where basic services and lifelines are restored, even on a temporary basis, including the road network and other essential facilities including bridges, airports, ports and helicopter landing sites.
iii. **Recovery phase**: where reconstruction efforts are carried out on the basis of a more precise assessment of damage and destruction of infrastructure. In addition, efforts are conducted to reconstruct infrastructure when needed and to restore the livelihoods of those affected.

CRISIS COUNSELLING

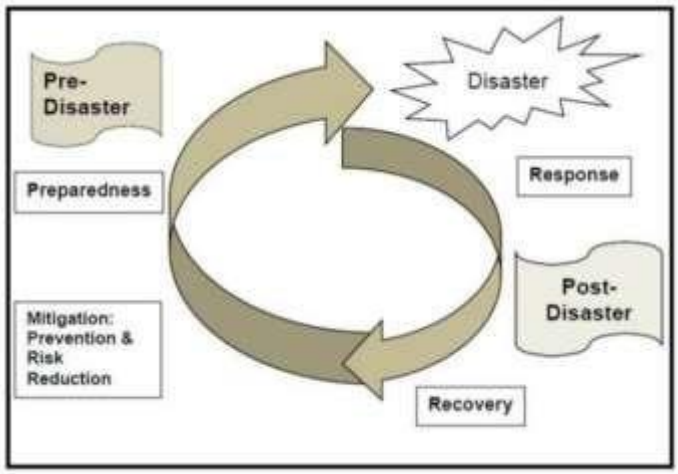
Crisis counselling is the process of alleviating the emotional and psychological disturbances of persons affected by disaster in order to restore a sense of control and mastery and to aid the process of recovery and reconstruction. Normally, disasters overwhelm the physical and psychological capacity 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 programmes of recovery, reconstruction, and risk management. Post-damage needs assessment is normally a rapid, multi-sectoral assessment that measures the impact of disasters on the society, economy, and environment of the disaster-affected areas.

DISASTER MANAGEMENT CYCLE

Disaster Risk Management includes sum total of all activities, programs and measures which can be taken up before, during and after a disaster with the purpose to avoid a disaster, reduce its impact or recover from its losses.



The steps involved in Disaster management Cycle

The different approaches involved are:

a. ***Before A Disaster (Pre-Disaster):***
Activities taken to reduce human and property losses caused by a potential hazard. E.g.: Carrying out awareness campaigns, strengthening the existing weak structures, preparation of the disaster management plans at household and community level etc. Such risk reduction measures taken under this stage are termed as mitigation and preparedness activities.

b. ***During A Disaster (Disaster Occurrence)***:
Initiatives taken to ensure that the needs and provisions of victims are met and suffering is minimized. Activities taken in this stage are called emergency response activities.

c. ***After A Disaster (Post-Disaster)***:
Initiatives taken in response to a disaster with a purpose to achieve early recovery and rehabilitation of affected communities, immediately after a disaster strikes. These are called as response and recovery activities.

MODULE 2 NOTES

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

Disaster risk assessment –approaches, procedure

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 the spatial and temporal characteristics of the hazard as well as its magnitude using graphical symbols.

Hazard can be categorised based on their origin, that is, whether they are natural, human-induced or technological.

Natural hazards

Natural hazards are phenomena experienced in the physical environment which are harmful to humans and caused by forces for which there is no control.
Examples of natural hazards are floods, earthquakes, volcanic eruptions and hurricanes.

Human-induced hazards

Human-induced hazards are changes of natural processes within the earth‟s system caused by human activities which accelerate or aggravate damaging events. Oil spills, atmospheric pollution, and major armed conflicts are some of such hazards.

Technological hazards

Technological hazards are dangers caused by technological or industrial accidents, infrastructure failures or certain human activities. Nuclear activities and radioactivity, dam failures, transport, industrial or technological accidents (explosions, fires, spills).

Hazards can be single (such as volcanoes and earthquakes), sequential (such as flood) or combined (such as earthquake accompanied by tsunami) and, as a result, causing a flood or torrential rains leading to landslides in their origin. Each hazard is categorized by:

- Location
- Intensity
- Occurrence
- Probability
- Duration
- Distance
- Speed of onset
- Spatial dispersion
- Temporal spacing

DATA REQUIREMENTS OF HAZARD MAPPING

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

Base maps

Base maps represent topographic layers of data such as elevation, roads, water bodies, cultural features and utilities. Creation of a base map is a time-consuming activity. It is therefore desirable to use as a base, an existing map or orthophoto where possible. An adequate base map must be plan metric, that is, a representation of information on a plane in true geographic relationship and with measurable horizontal distances. It must also have sufficient geographic reference information to orient 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. Depending on the sensor type or capabilities (spatial resolution, spectral resolution, radiometric resolution and temporal resolution), different images may be obtained from different service providers to feed into the information extraction process.

RADARSAT, TerraSAR-X, ALOS and LIDAR, for instance, are some of the sensors that produce Digital Elevation Model (DEM) depicting topography. 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 data capture in the field.

CARTOGRAPHIC REPRESENTATION OF HAZARD

Maps are the most operative way to convey actual and relative location. Maps can be simply defined as flat geographic portrayals of information through the use of symbols. Such approaches help hazard maps not to just convey the existence of natural hazards, but also to note their location, severity, and likelihood of occurrence in an accurate, clear, and convenient way. The application of cartography in hazard mapping will eventually lead to the creation of following.

Base map

Base map which contains sufficient geographic reference information to orient the user to the location of the hazard.

Scale and coverage

Scale and coverage which draw the relationship between linear measurement on the map and the actual dimension on the ground. Small-scale maps show less detail for a large area and areapplicable for regional development planning. Large-scale maps, on the other hand, reveal more detail for a small area and are more suitable for local or community level development planning. The scale used for a hazard map is dependent upon not only the hazard information to be shown,but also upon the scale of the base map. Therefore, the choice of scale for a hazard map may consider the following issues: o Number of hazards to be displayed at a go; o The hazard elements necessary to be displayed; o Range of relative severity of hazards to be shown; o The area ofinterest to cover; o The use of the map with other planning documents and; and o Function of the map, for example, whether it is to be an index or detail map.

Types of symbols

On a hazard map, symbols are used to represent reality. Symbols are selected for their legibility and clarity and/or map production characteristics. Location, for instance, can be depicted using one of these basic geometric symbols – point, line or an area. Points are more preferred for displaying volcanoes, while areas have been used for showing flooding.

APPROACHES TO HAZARD MAPPING

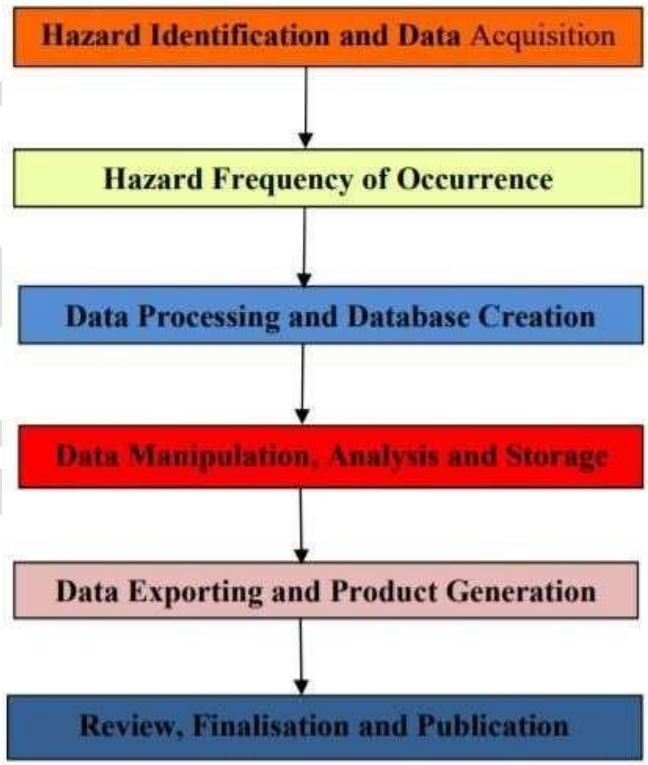
Many approaches to hazard mapping have been developed. In all such approaches used, the key factors of consideration in the spatial analysis (valuation of likelihood losses of hazards) are appreciating that:

- All components of a hazard assessment vary in space and time
- As the consequences of hazards are usually large, it is prudent to include vulnerability and risk reduction strategies in the process.

Geographic Information System (GIS) mapping and ***Participatory mapping*** are the approaches discussed.

Hazard Mapping Using Gis

GIS is increasingly being utilised for hazard mapping and analysis, as well as for the application of disaster risk management measures. The nature and capability of GIS provides an excellent basis for processing and presenting hazard information in the form of maps. GIS is very useful in arranging a high volume of data necessary to produce a hazard map. The three-dimensional representation available in modern GIS offers opportunity to model hazard. GIS also provides various methodologies in creating and analysing hazards. The flowchart represents the general procedure for the mapping of hazards in GIS.



Participatory mapping

Participatory mapping is a technique that allows for the integration of local level participation and knowledge in the map production and decision taken process. It is an interactive process that draws on local people‟s knowledge and allows them to create visual and non-visual data to explore social problems, opportunities and questions.

In participatory mapping, the main objectives are to:

- Collect evidence assets of the study area and issues during the mapping process
- Interpret the study area mapping experience and related experience to answer questions that have been developed about the study area
- Develop a presentation that synthesises the participatory mapping experience and presents the conclusion and possible questions for further investigation.

Conducting Participatory Mapping

Whenever participatory mapping is to be conducted, the foremost issue of consideration is the „goal of the work‟ which outlines the nature and essence of activities to be done. Once the goal has been decided, the next stage is the organisation of activities of participatory mapping in two blocks – preparation and implementation. The preparation involves „scouting‟ and „designing survey instrument, materials and directions. The implementation may be organised into sessions (usually four) - preparation of participants or people involved in the participatory mapping activity; undertake participatory mapping field trip; make presentations and carry out debriefing exercises.

Utilisation of Participatory Mapping

Participatory mapping is a powerful tool that increases stakeholder involvement and provides a means for participants to express their ideas in an easily understandable visual format. Participatory mapping is commonly used in the following ways:

- To create maps that represent resources, hazards, community values, usage (e.g., for recreation or other visitor use), perceptions, or alternative scenarios
- To gather traditional knowledge and practices and to collect information (hazards, environmental, socioeconomic, visitor use, etc.) for assessments or monitoring
- To identify data gaps.
- To inform other data collection methods (e.g., formal surveys, interviews, etc.)
- To evaluate existing programmes, plans and activities
- To facilitate the decision-making process
- To assist with data gathering for research
- To empower stakeholders
- To conduct trend analysis
- To educate stakeholders about issues and interrelationships of resources outside their immediate areas of concern A participatory mapping method includes community mapping with paper maps and conversion of community paper maps into GIS maps.

APPLICATIONS OF HAZARD MAPS

Hazard maps have various applications that may be broadly captured as in spatial planning, risk reduction measures, instruments used in emergency planning and raising Disaster risk Management:

- Spatial planning:
  Hazard maps provide a basis for communal and district spatial planning processes (e.g., definition of hazard zones in development plans and formulation of building regulations)
- Risk reduction measures:
  Hazard maps assist in the localisation and dimensioning of hazard protection measures (e.g., flood protection structures, avalanche barriers, etc.)
- Instruments used in emergency planning:
  Hazard maps indicate where the biggest risks arise and the events most likely to occur. This information can be used as a source of orientation in emergency planning.
- Raising awareness among the population:
  Hazard maps help to demonstrate potential risks to the population and to increase awareness of eventual protective measures.

VULNERABILITY ASSESSMENT

The concept of vulnerability was defined as the degree to which a system is exposed and susceptible to the adverse effects of a given hazard. It is also defined as vulnerability as "Exposure to risk and an inability to avoid or absorb potential harm". Both vulnerability and its antithesis, resilience, are determined by ***physical, environmental, social, economic, political, cultural and institutional factors***"

Vulnerability = (Exposure) + (Resistance) + Resilience

Exposure: at risk property and population

Resistance: Measures taken to prevent, avoid or reduce loss; and Resilience: Ability to recover prior state or achieve desired post-disaster state.

Types of Vulnerability

Physical vulnerability

This refers to the potential losses to physical infrastructure such as roads, bridges, railways, radio and telecommunication mast and other features in the built environment. Physical vulnerability also includes impacts on the human population in terms of injuries or deaths. Vulnerability is analysed per group of constructions (i.e., structural types) having similar damage performance. It is an intrinsic quality of a structure and it does not depend on location.

Social vulnerability

Social vulnerability refers to losses as experienced by people and their social, economic, and political systems. In this context, vulnerability refers to the extent to which elements of society such 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 hazardous condition. Levels of exposure to hazards, access to financial, social, natural, physical and human capital as well as policies, institutions and processes will influence the degree to which individuals, groups of persons or systems will degrade.

Economic vulnerability

This refers to the potential impacts of hazards on economic assets and processes (i.e., business interruption, loss of productive capacity, secondary effects such as increased poverty and job loss) and includes vulnerability of different economic sectors. Economic vulnerability is usually combined with social vulnerability during assessments.

Ecological/environmental vulnerability

This refers to the degree of loss that an ecosystem will sustain to its structure, function and composition as a result of exposure to a hazardous condition. This includes degradation, biodiversity loss and loss of productivity.

VULNERABILITY ASSESSMENT

This refers to the quantification of the degree of loss or susceptibility to an element at risk. The assessment is essential when conducting a risk assessment. Vulnerability assessments have not always been a part of risk assessment, but in recent times, they have become indispensable due to the recognition that disasters occur as a result of interactions between hazards and vulnerable elements. Variations exist in the method of quantification of vulnerability based on the following:

a. Type of vulnerability being measured, that is, it is physical, social, economic or ecological.
b. The scale at which vulnerability is being measured, whether at the individual, household or community level.
c. The type of hazard. Different hazard types call for different methods of quantification as not all methods of vulnerability quantification are used for the different hazard types.

Data needed for vulnerability assessment and their usefulness

- Historical data on the magnitude of a hazard and the level of damage it caused to specific elements such as buildings built from sand or wood.
- Socio-economic data such as level of education, access to pipe borne water, access to secure shelter, social networks, sanitation, income level, access to credit, access to land, access to technology etc. The emphasis here is on the level of access that an individual, household or community has to various assets.
- Level of exposure to hazardous conditions
- Data on policies, institutions and processes which influence capacity of individuals, households and communities.

APPROACHES TO PHYSICAL VULNERABILITY ASSESSMENT

There are a wide variety of ways to measure physical vulnerability. Two (2) main methods can be distinguished. These are the ***empirical and analytical methods*** as shown below table.

- The ***analytical methods*** rely on the use of geotechnical engineering software and are often limited to individual structures.
- The ***empirical methods*** can be applied to groups of related structures.

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.
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.

Table 1: Methods of measuring physical vulnerability

METHODS OF MEASURING SOCIO-ECONOMIC VULNERABILITY

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

Analysis of exposure and coping is done taking into consideration policies and processes and adaptation strategies of affected individuals, households and communities as shown in Figure 2.

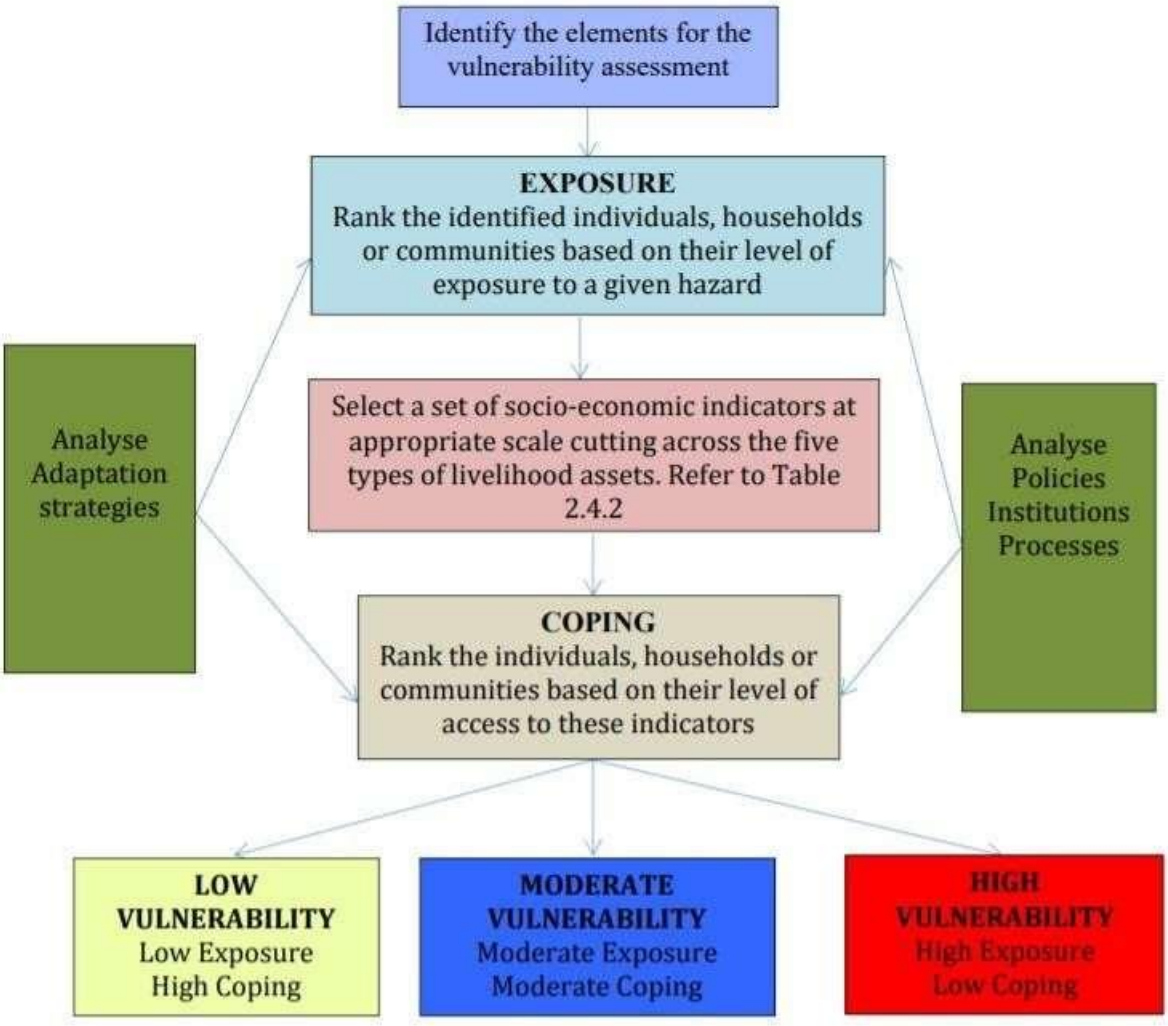


Fig 2: Method for assessing socio-economic vulnerability

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

Table 2: Socio-economic indicators

METHODS OF REPRESENTING VULNERABILITY

- ***Vulnerability indices:*** Based on indicators of vulnerability; mostly no direct relation with the different hazard intensities. These are mostly used for expressing social, economic and environmental vulnerability. V
- ***Vulnerability table***: The relation between hazard intensity and degree of damage can also be given in a table.
- ***Vulnerability curves:*** These are constructed on the basis of the relation between hazard intensities and damage data.
    - Relative curves: They show the percentage of property value as the damaged share of the total value to hazard intensity.
    - Absolute curves: Show the absolute amount of damage depending on the hazard intensity; i.e., the value of the asset is already integrated in the damage function;
    - Fragility curves: Provide the probability for a particular group of elements at risk to be in or exceeding a certain damage state under a given hazard intensity.

DISASTER RISK ASSESSMENT

Disaster risk was defined as the likelihood/probability of serious damage, deaths and injuries occurring as a result of a potentially damaging hazard interacting with vulnerable elements such as people and properties. Thus, disaster risk arises out of an interaction between a hazardous condition and vulnerable elements.

Fig 3: Disaster Risk

Disaster Risk Assessment

Risk assessments form an important aspect of risk reduction strategies. Risk assessment was defined and regarded as a methodology to determine the likelihood and magnitude of damage or other consequences by analysing potential hazards and evaluating existing conditions of vulnerability that jointly could likely harm exposed people, properties, services, livelihoods and theenvironment they depend on.

Components of Risk Assessment

There are two (2) main components:

- Risk analysis: The use of available information to estimate the risk caused by hazards to individuals or populations, property or the environment. Risk analyses generally contain the

following steps: Hazard identification, hazard assessment, elements at risk/exposure, vulnerability assessment and risk estimation.

- Risk evaluation: This is the stage at which values and judgement enter the decision process by including the importance of the risk and associated social, environmental, and economic consequences, in order to identify a range of alternatives for managing the risk.

Risk assessment involves the assessment of hazards and vulnerabilities. Thus, risk assessments are inextricably linked to and strongly influenced by the nature and likelihood of a hazard as well as the extent of loss that may occur due to the hazard.

CONTEMPORARY APPROACHES TO RISK ASSESSMENTS

- ***Multi-hazard***: The same area may be threatened by different types of hazards. Each of these hazard types has different areas that might be impacted by hazard scenarios. Each of the hazard scenarios also might have different magnitudes. For instance, water depth and velocity in the case of flooding, acceleration and ground displacement in the case of earthquakes. These hazard magnitudes would also have different impacts on the various elements at risk, and therefore require different vulnerability curves.
- ***Multi-sectoral***: Hazards will impact different types of elements at risk.
- ***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, district and local policies, plans and activities to see how they have contributed to increased or reduced risk, 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.
- ***Qualitative methods***: This involves qualitative descriptions or characterisation of risk in terms of high, moderate and low. These are used when the hazard information does not allow us to express the probability of occurrence, or it is not possible to estimate the magnitude. This approach has widespread application in the profiling of vulnerability usingparticipatory methodologies. Risk matrices can be constructed to show qualitative risk. A risk matrix shows on its y-axis probability of an event occurring, while on the x-axis potential loss. The probability is described categorically as low, medium and high, while the potential loss is also described similarly as in Figure 4.

Fig 4: An example of a risk matrix used for assessing risk qualitatively

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

Fig 5: Risk assessment matrix

Earthquake	Lightening	Debris Flow	Civil unrest	
Flood	Heat Wave	Hazardous materials release	Terrorism	
Fire	Drought	Transportation accident	Market fires	
Storms	Pandemic (e.g., HIV/AIDS, flu)			
Fire		Water shortage		
Food poisoning	Landslide	Power shortage		

Fig 6: Potential hazards

- ***Semi-quantitative methods***: These techniques express risk in terms of risk indices. These are numerical values, often ranging between 0 and 1. They do not have a direct meaning of expected losses; they are merely relative indications of risk. In thiscase, risk is expressed in a relative sense. The main difference between qualitative and semi-quantitative approaches is the assignment of weights under certain criteria which provide numbers as outcome instead of qualitative classes. The semi quantitative 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 (pre-assumed) does not justify the time and effort
- Where the possibility of obtaining numerical data is limited Semi-quantitative approaches consider a number of factors that have an influence on the risk.

A range of scores and settings for each factor may be used to assess the extent to which that factor is favourable or unfavourable to the occurrence of instability (hazard) and the occurrence of loss or damage (consequence). The matrix of hazards and consequences is used to obtain a ranked risk value. This is made by combining a set of hazard categories with a set of consequence categories. The final risk values can also be categorised and ranked with qualitative implications. The risk estimation can be done separately for loss of life and economic loss.

The semi-quantitative approach could be adapted to cover larger areas (spatial or GIS based). This approach may be applicable at any scale or level of analysis, but more reasonably used in medium scales. Nowadays, such a semi-quantitative approach can efficiently use spatial multi-criteria techniques implemented in GIS that facilitate standardisation, weighting and data integration in a single set of tools.

Semi-quantitative risk can also be conceptualised as:

Risk = Hazard * Vulnerability / Capacity

Although the equation is only conceptual, it allows incorporating the multi-dimensional aspects of vulnerability, and capacity. In this approach, indicators are used to characterise vulnerability and capacity, for instance, by relating it to population characteristics. These indicators are often integrated with hazard indicators using Spatial Multi-Criteria Evaluation

Quantitative methods

This aims at estimating the spatial and temporal probability of risk and its magnitude. In this method, the combined effects, in terms of losses for all possible scenarios that might occur, are calculated. There are several approaches; they express the risk in quantitative terms either as probabilities, or expected losses. In this approach, risk is perceived as follows:

Risk = Hazard * Vulnerability / Capacity

The equation given above is not only a conceptual one, but can also be actually calculated with spatial data in a GIS to quantify risk from hazards. The way in which the amount of elements-at- risk are characterised (e.g., as number of buildings, number of people, economic value or the area of qualitative classes of importance) also defines the way in which the risk is presented. The hazard component in the equation actually refers to the probability of occurrence of a hazardousphenomeno

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.

n with a given intensity within a specified period of time (e.g., annual probability).

Table 3: Different ways of expressing risk

Population Risk

Population risk can be expressed as individual risk or societal risk. Individual risk is the risk of fatality or injury to any identifiable (named) individual who lives 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. Individual risk can be calculated as the total risk divided by the population at risk. For example, if a region with a population of one million people experiences on average 5 deaths from flooding per year, the individual risk of being killed by a flood in that region is 5/1,000,000, usuallyexpressed in orders of magnitude as 5×10-6. Societal risk is the risk of multiple fatalities or injuries in the society as a whole, and where society would have to carry the burden of a hazard causing a number of deaths, injury, financial, environmental, and other losses. Below shows an example for population risk.

- **What are the risks from driving an automobile?**
- **There are 15,000,000 accidents per year, 1 in 300 of which result in death, there are 250,000,000 people**

$$Societal\ Risk = 15{,}000{,}000 \frac{accidents}{year} \times \frac{1}{300} \frac{accidents}{year} = 50{,}000 \frac{deaths}{year}$$

$$Individual\ Risk = \frac{50{,}000\ deaths/year}{250{,}000{,}000\ people} = 2 \times 10^{-4} \frac{deaths}{person \cdot year}$$

$$Lifetime\ Risk = 2 \times 10^{-4} \frac{deaths}{person \cdot year} \times 70\ years = 0.014 (1\ in\ 70)$$

MODULE 3 NOTES

Disaster risk management -Core elements and phases of Disaster Risk Management Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

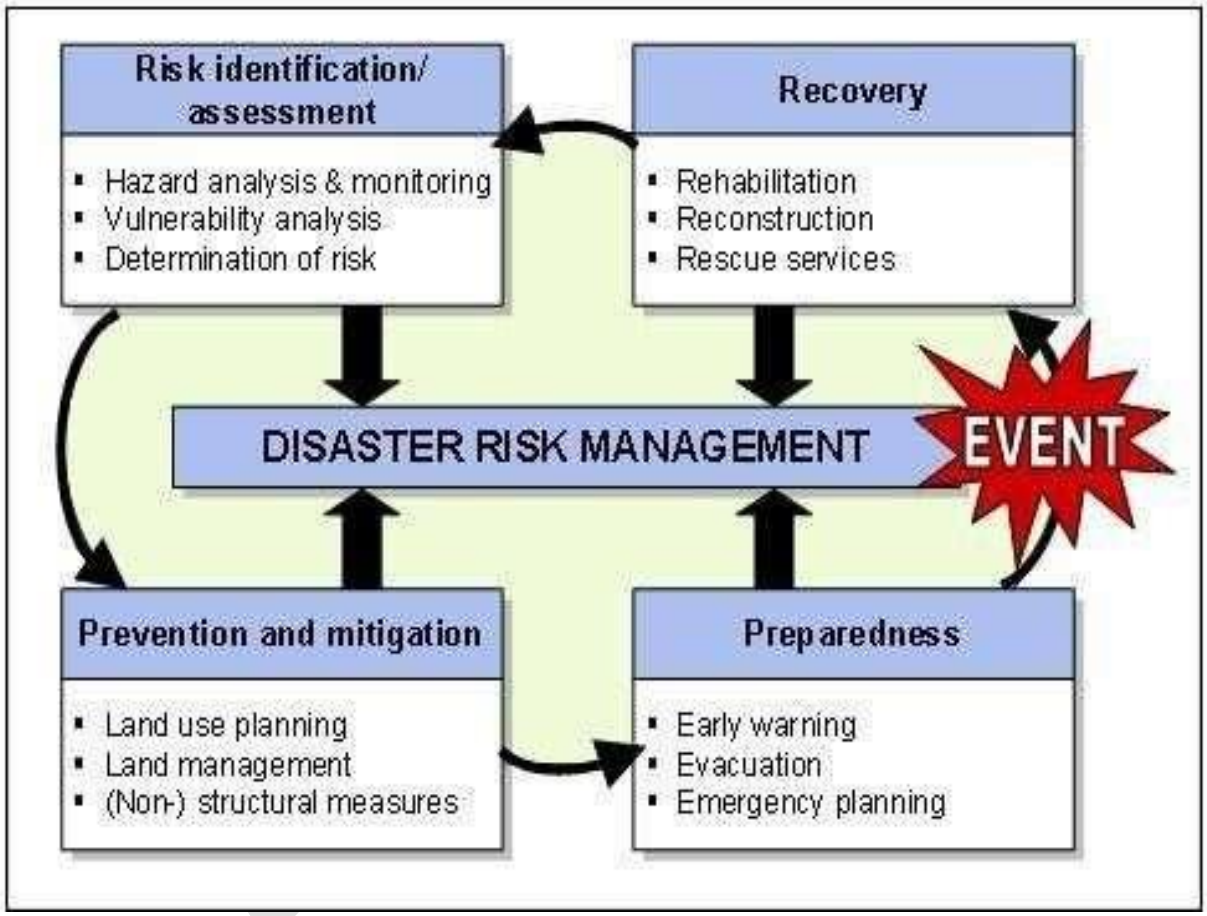
Disaster response- objectives, requirements; response planning; types of responses. Relief; international relief organizations.

Disaster risk management

- The systematic process of using administrativedirectives, organizations, and operational skillsand capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazardsand the possibilityof disaster.

Disaster Risk Management Framework

- The disaster risk management process (cycle)comprises the following main elements:



Risk identificationand assessment:

- This involves determining and analysing the potential, origin, characteristics and behaviour of the hazard
- ❑ E.g. frequency of occurrence/magnitude ofconsequences.

Application of risk reduction measures inmitigation:

- Planning and implementation of structuralinterventions (e.g. dams, sea defence) or nonstructural measures such as disaster legislation.

Disaster preparedness and emergency management:

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

Recovery/Reconstruction:

- Decisions and actions taken in the post-disasterphase
- Having a view to restoring the living conditionsof the affected population.

Disaster Risk Reduction(DRR)

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- The concept and practice of reducing disaster risks through systematic efforts to analyseand manage the causal factors of disasters, including

❖ Throughreduced exposure to hazards

❖ Lessened vulnerability of people and property

❖ Wise management of land and theenvironment

❖ Improved preparedness for adverse event

Given the importance of DRR in the international policyarena, five (5) priority areas areunderscored in the Hyogo Framework for Action (2005-2015):

Governance

1. Risk identification, assessment, monitoringand early warning
2. Knowledge management and education
3. Reducing underlying risk factors
4. Preparedness for effective response andrecovery

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) cornerstonesof Disaster Risk reduction:

- ❑ Four parallel and complementary lines of actions can be considered to reduce exposureto disasters and achieve a more sustainable approachto development:
- 1. Community / stakeholder participation
- 2. Public policy actions
- 3. Safer constructionand urban development
- 4. Development of a culture of prevention

Disaster Prevention

Definition:

- Disaster Prevention is defined as those activities taken to prevent a natural phenomenon or potential hazard from havingharmful effects on either people or economicassets.
- Broadly, disaster prevention refers to measures taken to eliminate the root causesthat make people vulnerable to disaster.

The Basis of Disaster Prevention

For disaster prevention to be successful, a prioriplanning is required.

- ❑ Planning of prevention hinges on two (2) issues:

Hazard identification (identifying the actualthreats facing a community)

1. Vulnerability assessment(evaluating the risk andcapacity 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.

Types of Disaster Prevention:

Disaster prevention may be considered as either primary or secondary.

- Primary prevention is to reduce, or avoid the risk of theevent 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 recognise promptly the

event and to reduce its effects,

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

Disaster Mitigation

Definition:

- Disaster mitigation refers to the lessening orlimitation of the adverse impacts of

hazards and related disasters.

Primary Objectives:

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 consequencereduction

- 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 negativeconsequencesas possible.

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

So in reducing both hazard likelihoodand risk consequence,

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

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 avoidpossible 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 provisionof inform ation, which can reduce risk and related impacT

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Ecosystem-based options
e.g. mangrove rehabilitation
EbA hybrid options
e.g. mangrove rehabilitation & bamboo fences
Infrastructure-based options
e.g. construction of dykes, dams, shore protection
Political and social options
e.g. development planning, early warning systems, land use planning
Overall Adaptation Strategy

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Disaster Preparedness

Definition:

Disaster preparedness encompasses the knowledge and capacities developed by governments, professional response and recovery organisations, communities and individualsto effectively anticipate, respondto, 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 mobilisation
Public education, training & rehearsals
Community-based disaster preparedness
Types of Disaster Preparedness:

Target-Oriented Preparedness:

- Preparedness plans may be target specific, for instance, we mayrequire 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 planrevisions, 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.

DISASTER RESPONSE AND RELIEF

- Disaster responses are the set of activities taken during a disaster or immediate followinga disaster, directed towards saving life and protecting property.

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
- Identificationof likely response requirements

Requirement for Effective Response

- Information
- Resources

Disaster response planning

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

Types of disaster responses:

1. Search and rescue
2. First aid and emergency medical care
3. Evacuation
4. Evacuation centremanagement
5. Development of Standard Operation Procedure(SOPs)
6. Immediaterepair of community facilities and services
7. Relief delivery
8. Coordination and Communication
9. Psycho-social counselling and stress debriefing
10. Medical services

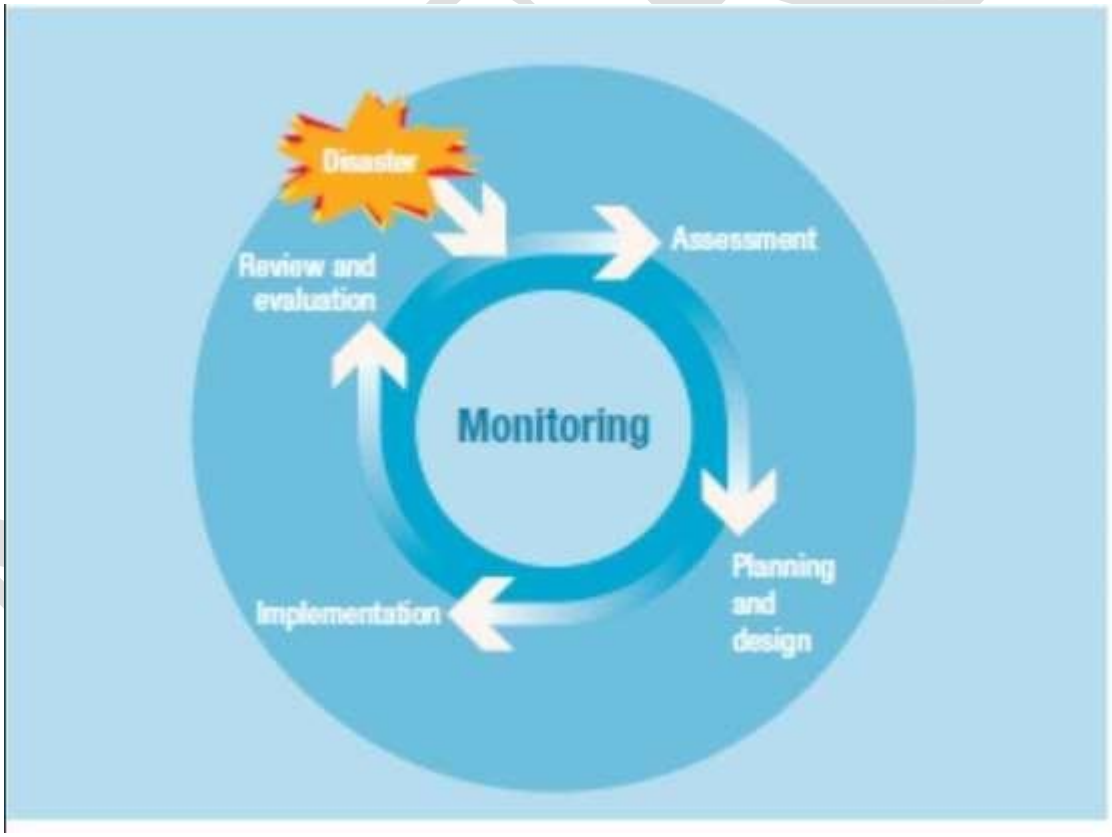
Relief

- It is defined as the provision of assistanceorintervention 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,
- shortterm,
- 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 Committeeof 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 4 NOTES

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

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

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 affects 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 analyze 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 model uses 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 be beneficial 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".

- 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 marginalized 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 organizations, private sector firms, and other development agencies. The Ghana Police Service, National Fire Service, National Disaster Management Organization (NADMO), Ghana Education Service (GES), Non-Governmental Organizations (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 Organization (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 stakeholdergroups. Key questions 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 answerinclude:

- 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 project strategy?
- 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 categorize different groups of stakeholders and to determine the relative priority that the project should give to each stakeholder group‟s interest.

Key questions to engage the attention of participants are:

- Who is 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 and conflicts;
- Opportunity to generate social learning and innovations based on field experience;
- 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 organizations and development partners.

Costs and Risks

The principal cost is the absence of stakeholder participation in programmes and projects. 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 limitedtime, 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 marginalized groups and ensuring

that the true priorities and needs of poor and vulnerable groups arerepresented;

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

Methods and Tools for Participatory StakeholderEngagement

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 minimize the time spent on project overview and maximize the time spent delving

deeper into the key lessons learned or implications for others.

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 neighbor to discuss the topic in twos, then in a subsequent round in groups of four or six, then in groups of eightor twelve.
- Growing the groups larger provides the opportunity for friendly challenging of ideas and cross-fertilizing the best of answers across groups.

Debates

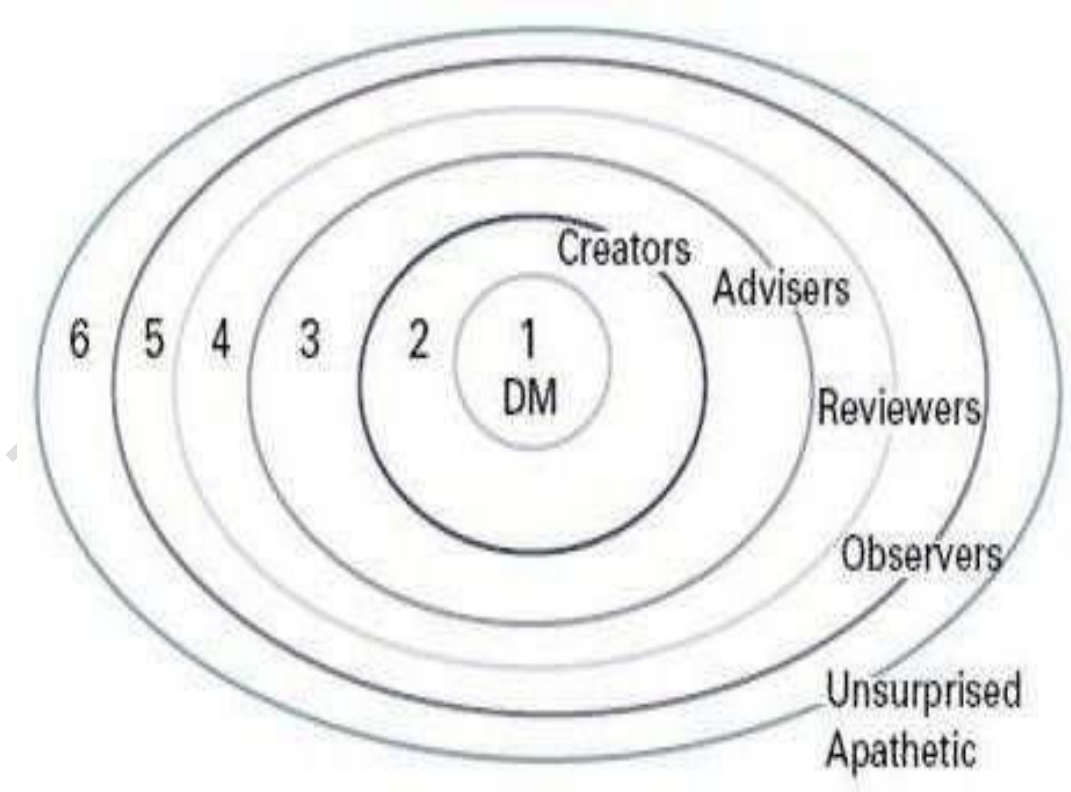
- Speakers present opposing sides of an issue.
- This format can liven up a discussion topic that lends itself to debating pros and cons, multiple views, or conflicting opinions around an issue.
- As a variation, groups of participants can be assigned opposing sides of an issue and asked to formulate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

Round Table

- Participants form groups around a specific topic area in order to share experiences and discuss 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 Participation

- 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 center of the orbit of influence on the decision-makingprocess.

- 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 promotes 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 issue they are not sure of.
- The communicator should also be well informed about the situation of things within 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 to the 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 judgmental 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 or checks-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 a time.
- 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 Counselors

Effective crisis counselors should possess characteristics such as:

- ***Non-judgmental***: willing to listen all through to the client without casting judgment 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 counseling that are quite different from normal counseling.
- ***Self-Awareness***: knows him/her self and empathize 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 providingthis 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 the options 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 the appropriate nuance has been added.

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.

Disaster Management

Earthquake

Structural Mitigation
Preparing Engineered structures
Retrofitting of existing buildings

Non structural Mitigation

i. Enforcing Building codes
ii. Public awareness
iii. Reduce possible damage by secondary effects like fire, floods.

Disaster Management

Landslide

Structural Mitigation

i. Drainage corrections
ii. Engineered structures

Non structural Mitigation

i. Hazard mapping
ii. land use regulations
iii. awareness.

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.

- Flood resistant infrastructure to continue critical services during floods.

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, inmonitoring, 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 FORREDUCING RISK

> Strengthening Capacities for Disaster Risk Reduction has been developed against the backdrop of the United Nations Development Program"s (UNDP's) longstanding commitment to supporting developing and high-risk countries through its programmes and services for capacity development and 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 tointegrate 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 region including 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 bankstrengthening;
- 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 to align them with national and international best practices;
- 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 NOTES

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

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 alsocause 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, Pondicherry, 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 Railwaysand 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, biologicalconditions 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, responseand 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 Actand 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 CentralGovernment 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.

APPENDIX 1	
CONTENT BEYOND THE SYLLABUS	
SL.NO	TOPIC
1.	Conceptual Understanding of Demolition Techniques, Demolition by Machines
2.	Embodied energy of materials