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

DEPARTMENT OF MECHATRONICS ENGINEERING

COURSE MATERIALS

MCN301 DISASTER MANAGEMENT

VISION OF THE INSTITUTION

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

MISSION OF THE INSTITUTION

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

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

ABOUT DEPARTMENT

- Established in: 2013
- Course offered: B.Tech Mechatronics Engineering

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

DEPARTMENT VISION

To develop professionally ethical and socially responsible Mechatronics engineers to serve the humanity through quality professional education.

DEPARTMENT MISSION

1) The department is committed to impart the right blend of knowledge and quality education to create professionally ethical and socially responsible graduates.
2) The department is committed to impart the awareness to meet the current challenges in technology.
3) Establish state-of-the-art laboratories to promote practical knowledge of mechatronics to meet the needs of the society

PROGRAMME EDUCATIONAL OBJECTIVES

I. Graduates shall have the ability to work in multidisciplinary environment with good professional and commitment.
II. Graduates shall have the ability to solve the complex engineering problems by applying electrical, mechanical, electronics and computer knowledge and engage in lifelong learning in their profession.
III. Graduates shall have the ability to lead and contribute in a team with entrepreneur skills, professional, social and ethical responsibilities.
IV. Graduates shall have ability to acquire scientific and engineering fundamentals necessary for higher studies and research.

PROGRAM OUTCOME (PO'S)

Engineering Graduates will be able to:

PO 1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 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.

PO 3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 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.

PO 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.

PO 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.

PO 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.

PO 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 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.

PO 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.

PO 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 OUTCOME(PSO'S)

PSO 1: Design and develop Mechatronics systems to solve the complex engineering problem by integrating electronics, mechanical and control systems.

PSO 2: Apply the engineering knowledge to conduct investigations of complex engineering problem related to instrumentation, control, automation, robotics and provide solutions.

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

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

Prerequisite: Nil

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

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

Mapping of course outcomes with program outcomes

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

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

Assessment Pattern

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

Mark Distribution

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

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

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

11. 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 of disaster management
[4]

OR

12. 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

13. a. What is participatory hazard mapping? How is it conducted? What are its advantages?

[8]

b. Explain the applications of hazard maps [6]

OR

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

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

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

OR

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

b. Explain the different disaster response actions [8]

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

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

OR

18. 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]

19. Explain the salient features of the National Policy on Disaster Management in India

[14]

OR

20. 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 1

SYSTEMS OF EARTH

LITHOSPEHRE

- 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 to 50 km.
- The crust and the mantle which is hard and brittle is lithosphere.
- Lithosphere is the outer layer of the earth that includes the crust and solid part of mantle
- Lithosphere interacts with atmosphere, hydrosphere and biosphere and forms **Pedosphere**.
- • Pedosphere has both biotic and abiotic components.

- • There are two types of lithosphere:
- – The oceanic lithosphere which is about 5 km to 8 km thick composed of basalt
- – 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.
- These plates are composed of oceanic and continental lithosphere.
- • They move independently over the mantle relative one another, below the outer rigid lithosphere. This area known as **asthenosphere** is about 100 km to 200 km thick.
- • They move with a restricted independence from the seven large plates.
- • The plates periodically reorganise 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. They are:
  1. Moving apart, thereby creating divergent boundaries,
  2. Gliding horizontally along each other, thereby creating wrench and transform boundaries, and
  3. Moving towards one another, and creating convergent boundaries.
- These movements may also combine:
  1. oblique convergence of plates could produce a 'transpressive deformation'
  2. An oblique divergence could result in the production of 'transtension'
  3. A convergence could be the effect of the descent of one plate beneath the other

Composition:

The lithosphere contains rocks, minerals and soil. It has more than 100 chemical elements, but most of them are rare.

Table 2.1 Elements of Earth's Crust

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

- Only a few elements are present in pure forms in the earth's crust.
- Called native elements, they include copper, gold, lead, mercury, nickel, platinum, and silver.
- These elements contained in ores are found in different combinations as minerals.

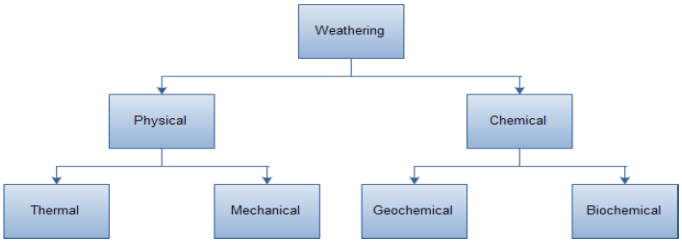
- Certain minerals are composed of single element. For instance, diamond and graphite are composed of only carbon

Rocks:
• Lithosphere has various types of rocks.
• Rocks are naturally occurring hard and consolidated inorganic materials, composed of one or a large number of minerals
1. Igneous: 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. Igneous rocks sometimes overlap with sedimentary and metamorphic rocks

2. Sedimentary: 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 and altered as well as newly synthesised secondary minerals

3. Metamorphic: Also known as Thermal rocks they are formed from pre existing rocks (igneous or sedimentary) due to change in the temperature and pressure These rocks are formed when magma intrudes through pre existing igneous or sedimentary rocks. Further, igneous and metamorphic rocks get weathered and form sediments. These sediments get deposited and `lithified' into sedimentary rocks.

Weathering:
Weathering is the process of disintegration and decomposition of rocks and minerals. Disintegration can takes place due to fragmentation, splitting, detachment etc. decomposition could occur as a result of chemical changes that could lead to formation of simpler products. Weathering could occur as a result of natural forces like heat, water, wind, micro organisms, action of glaciers etc. the resulting changes would be physical chemical or even both. Based on the occurrence weathering can be classified as follows:



Physical weathering
• Changes occurring only to the physical form of the rocks are known as physical weathering.

Thermal weathering:
- This weathering is caused by the expansion (when heated due to solar radiation at day time) and contraction (when cooled at night) of rocks as a result of fluctuation in temperature. Expansion of rock is more in summer than in winter.
- Pressure is created within the rocks when they expand or contract, due to which the rock on the surface is fragmented.
- Another weathering process, known as exfoliation, occurs in layered rocks. In such rocks the outer part expands and contracts at higher rates. Due to this, a thin layer of rock gets detached and form smaller parts.

Mechanical weathering:
- Many types of rocks absorb water and swell when wetted, and shrink when dried. This expansion and contraction of rocks due to alternate wetting and drying break the rocks into pieces.

- Water also gets accumulated in fractures and joints of rocks. When the temperature goes below the freezing point, this water becomes ice. Ice increases in volume and exerts tremendous lateral pressure on the surrounding rocks. Due to this pressure, the rocks get broken. This is known as **'frost wedging'**.

- **'frost heaving'**: Rock fragments contained in flowing water disintegrate while colliding with each and while rolling on the bed of rocks. The 'cutting action' of water and the suspended materials accelerate this disintegration

- Another form of weathering happens in glaciers. Glaciers are large bodies of ice that slowly move along the mountain slopes. When the glaciers flow down the slope, the rocks contained in it smash and shatter against one another. As the overlying rock gets removed, the underlying rocks expand and split due to the release of pressure.
- Certain other weathering agents include wind, gravity, plants, etc. Suspended particles in the wind have abrasive power, and over a period of time it could weather rock surfaces.
- When large masses of rocks get detached and fall down due to gravity, they get broken into pieces at the foothills.
- The roots of plants enter the rock fractures exerting lateral pressure and get broken in course of time.

<u>Chemical weathering</u>

- Alterations to the chemical or mineralogical composition of rocks are known as chemical weathering.
- During chemical weathering, minerals are decomposed into soluble and insoluble products. Due to this weathering different minerals may occur

Geochemical weathering

- This weathering occurs as a result of reaction with water, acids, bases, salts, etc.
- Eg) dissolution, hydration, hydrolysis, oxidation, reduction, carbonation, and other acid reactions.
- Minerals are not ordinarily soluble in water. However, due to hundreds of years of wetting in the presence of certain natural acids in water, the process of dissolution is accelerated
- Hydration is the binding of water to the molecules of minerals like iron and aluminium oxides
- Oxidation and reduction are other process wherein certain minerals are weathered.
- Hydrolysis is a process in which minerals get decomposed effectively. During hydrolysis, water molecule gets splits into hydrogen and hydroxyl ions. The hydrogen then replaces a cation from the mineral structure, whereby the particular mineral becomes easily susceptible to decomposition by further hydrolysis or other reactions.

Biochemical weathering

- This weathering occurs due to the action of organisms.
- Carbonation: In this process, carbonic acid is produced by the dissolution of CO_2 in water. For this the CO_2 available in the atmosphere, or from microbial or root respiration process is made use of
- The carbonic acid so produced has the property of dissolving many minerals.
- Further, certain plants and their associated micro-biota also cause weathering by modifying surrounding pH through the production of CO_2 and organic acids.
- • Different minerals weather at different speeds. Complex minerals weather easily.
- • The climatic conditions also influence weathering process. Chemical weathering is usually low in areas having low water and temperature, as against warmer and moister areas.
- • In humid tropical areas the rate of weathering is high with weathered products lost quickly by leaching. This is a continuous process and occurs even after formation of the parent material.

<u>Soil:</u>

- 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.
- 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.
- The lower limit is thought to be the lower limit of the common rooting depth of respective native perennial plants.
- Soil develops from rocks and minerals, which can be considered as parent materials.
- Soil is a natural resource that is renewable in nature.
- It serves as a natural medium, wherein microbial activity happens.
- Soil provides nutrients for the growth of plants.
- Properties, like texture, structure, permeability, water porosity, soil pH, nutrient (organic and inorganic) contents, microbial property, etc. determines the fertility and the resultant productivity of the soil.
- In addition to this, the topography, climate, biotic factors, etc. too contribute to the fertility. Soil fertility is the quality of a soil that enables it to provide nutrients in adequate amounts and balance, for the growth of plants.

Table 2.2 Different Types of Soil

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

Functions of Soil

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 matter.

ATMOSPHERE

- Based on the temperature, the atmosphere is divided into four parts: (1). Troposphere (2). Stratosphere (3). Mesosphere (4). Thermosphere

1. *Troposphere:*

- The bottom dense part, containing 70 per cent of the mass, close to the ground is troposphere. It reaches up to 11 km from the ground.
- Clouds, storms, fog and haze are found 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:*

- This layer extends to a height of about 50 km from earth's surface.
- Ozonosphere is an important layer found within stratosphere. Ozone (03) is found in this layer.
- The temperature increases with height in stratosphere. Due to this, vertical winds seldom occur and only horizontal winds parallel to earth's surface are seen.
- This property leads to absence of turbulence in this layer. This absence of turbulence and clouds ensures good visibility and smooth travel for jet planes

• It is often said that the flying of jet planes in this layer is partly responsible for the destruction of sizable quantities of ozone.

• Above the stratosphere, there is a small layer called Stratopause where temperature neither decreases nor increases with height.

3. *Mesosphere:*

- The portion of the atmosphere above stratosphere, between 50 km and 80 km is known as mesosphere.
- 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.
- Ions are abundant in thermosphere. It is in thermosphere that most of the approaching meteoroids burn up before reaching earth.
- Ionisation takes place in this layer also. Ionisation produces two ionised layers—E and F layers. These layers also have an influence over ratio communication as it reflects radio waves.
- In the upper thermosphere, due to higher concentration of ions, it is called Magnetosphere. Thermosphere has no definable upper boundary and it gradually blends with the outer space.

OZONE LAYER DEPLETION

- Due to human activities ozone layer is becoming thin. The thinning of this layer is called ozone depletion.
- Ozone-oxygen Cycle
- 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. At this altitude, it is 10 ppm. Beyond this, it ranges between two to eight ppm.
- The level of ozone is maintained at this level by Ozone- Oxygen Cycle.
- When ultra-violet radiation that emanates from the sun strikes the oxygen molecule (02), it splits the molecule into two individual oxygen atoms (0 + 0).
- The oxygen atoms, thus produced, combines with 02 molecule and produce ozone molecule (03). This reaction is aided by either Nitrogen (N2) or Oxygen, which absorbs the excess energy that is liberated.
- Ozone thus formed will be split by ultra-violet rays into a molecule of oxygen (02) and an atom of oxygen (0). It is through this repeated circular ozone and oxygen formation that the concentration of ozone is maintained in the stratosphere.
- 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).

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 to this action, Ozone concentration is decreasing at a drastic rate of four per cent per decade.
- Realising the seriousness of the problems created by CFCs and BFCs, countries initiated steps to either completely ban or phase out their use. Sweden was the first country to ban aerosol sprays that contained CFCs, as early as in 1978.
- On discovering the Ozone hole in 1985, countries came together and signed an international treaty at Montreal, in 1987. This treaty, known as Montreal Protocol, decided to completely phase out CFCs by the year 1996.
- The Montreal Protocol was followed up by Copenhagen Protocol. Representatives of large number of countries met in 1992 at Copenhagen in Denmark, and agreed to phase out ozone depleting chemicals.
- Because of these efforts scientists could announce on August 2, 2003 that the depletion of ozone layer has slowed down considerably.

Depletion by Nitric Oxide

- One molecule of nitric oxide (NO) combines with ozone (03); it gets oxidised to nitrogen dioxide (NO2) and Oxygen (02).
- This NO2 combines with another 03 molecule to become NO3 (Nitrate) and 02.
- The NO2 and NO3 then combine to form N205 (Dinitrogen pentoxide).
- Thus, due to this series of actions and reactions ozone is completely utilised, and thereby depleted.
- Large quantities of nitrogen are emitted by aircrafts that fly near stratosphere.
- Realising the seriousness of the issue, the international 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.

GREEN HOUSE EFFECTS

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.

- The incoming solar radiation (insolation) supplies the required energy and drives these processes.
- Only two-billionth of the solar energy reaches Earth, of which only a small portion is responsible for the physical and biological processes. Sun also emits solar winds consisting of charged particles like plasma, magnetic fields, etc.
- Insolation contains X-rays, gamma rays, ultraviolet (UV) rays, visible light, infrared rays, microwaves, radio waves, and the like.
- Of all the energy received by earth; UV, visible and infrared portions constitute over 95 percent.
- The harmful UV radiation is prevented from reaching earth by the ozone layer. Parts of the long waves within the solar radiation are absorbed in the troposphere.
- 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.
- Of the diffuse radiation that finally reaches earth's surface, based on the surface characteristics, substantial quantity is reflected back. The solar radiation that is reflected back is called albedo.
- As stated earlier, the albedo is based on the surface characteristics. For instance, the albedos of a water body, land area, forest area, desert area, etc. vary significantly.

Outgoing Radiation

- If the entire energy that is received by earth is retained in its 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 conduction will in turn initiate convection in the air above the earth's surface. The heat energy so emitted from the earth's surface is in the form of long wave radiation, and is called outgoing radiation.
- A portion of the outgoing radiation is absorbed by certain gases in the atmosphere. Gases capable of absorbing outgoing radiation are CO2, CO, water vapour, etc. They are called Green House Gases (GHG).
- The amount of radiation absorbed is in direct proportion to the concentration of gases.
- Due to the effect of GHGs 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 process is known as Green house effect.
- The intensity of Green house effect varies from place to place depending upon the concentration of GHGs.

GLOBAL WARMING

- Earth receives solar energy in abundance, heating its surface.
- Some quantities of heat is radiated back into the space.
- Certain gases, known as Green House Gases (GHG), that include carbon dioxide, methane, nitrous oxide, ozone, etc., and water vapour prevent the heat from escaping the earth's atmosphere.

- This leads to an increase in the atmospheric temperature, known as greenhouse effect. The greenhouse effect has its own positive effect. Without greenhouse effect the temperature of earth would have been much cooler and covered with ice.
- Recently, due to certain human activities the quantity of GHGs has increased manifold.
- The burning of large quantities of fossil fuels, deforestation, mining activities, agricultural activities, overall
- concentration industrial activities, etc. has increased the of GHGs around the globe.
- This is aggravated by the reduction in green coverage. Certain natural processes, like volcanic eruptions also contributes to GHG emissions. Chlorofluorocarbons (CFCs) like methane released from human and animal waste, garbage dumps, rice fields, etc. have caused large scale depletion of the ozone layer.

Per cent of Contribution of CHGs to Global Warming

S. No.	*GHG*	*% contribution*
1	Carbon dioxide	61
2	Methane	15
3	Chlorofluorocarbons	11
4	Nitrous oxide	4
5	Other gases	9

- The abnormal increase in the concentration of GHGs has led to the global temperature has become warmer. The average temperature of the globe has become warmer over the last century.
- This warming is however not uniform all over the globe. While the temperature is high in some places, it gets cooler in certain other places.
- Over the last century the overall temperature of earth's atmosphere has become warmer by about 0.6 degrees Celsius (1.3 degrees Fahrenheit).
- Evidences show that the warming is happening much faster than they have in the past.
- Further, there is new and stronger evidence suggesting that most of the observed warming over the last 50 years is attributable to anthropogenic reasons.
- If GHG emissions continue at this rate, by 2030 the temperature will rise by 1.5°C to 4.5°C.
- The Intergovernmental Panel on Climate Change (IPCC) states that the human induced change in atmospheric chemistry will increase temperatures by 1.4°C to 5.8°C by the year 2100 (IPCC, 2001).
- There has been large number of apparent signs of global warming in many parts of the globe. A few of them include melting of ice caps in the poles, shrinking of glaciers in mountain ranges, like Alps, Andes, Himalayas, Mount Kilimanjaro, etc.
- Some other signs include arrival of spring earlier than normal, and autumn arriving later in many parts of the globe.
- Continued global warming would result in melting of massive quantities of ice from the Polar Regions and glaciers, leading to rise in the sea level.
- It is estimated that if the glaciers continue to rise at the current rates, the sea level is expected to rise over 1.5 m in the next few decades.
- Rising sea levels are expected to inundate low lying areas leading to mass exodus of people and creation of climate refugees, intrusion of saline waters into arable lands thereby affecting food security, etc.

WEATHER

- When radiation from insolation strikes earth, its top layer gets heated. The heat energy so created is transferred to the overlying areas 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. 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 moves.
- In air and water, molecules keep on moving but in solids the molecules involve in a vibration movement in their place. The speed at which this vibration takes place is described as temperature. A body having higher temperature transmit it to another one having lower temperature.
- Temperature is measured using thermometer, and is reported in either Celsius, Kelvin or Fahrenheit scales.

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

2. Horizontal temperature variation: Temperature varies at different times of the day and also at different months and seasons of the year.

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 amount of insolation or incoming solar radiation is based on rotation and revolution of earth. 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 determines the temperature.

c) *Distance from the equator*: The sun rays strike in perpendicularly on the equator. Near to the poles it strikes at an angle. Due to this, areas farther away from equator will experience lesser temperature.

d) *The tilt of the axis*: The earth's axis is tilted at angle of 66.5 degrees to the plane of the ecliptic. This tilt is maintained throughout its orbit. This tilting of the axis leads to seasonal variations. The northern hemisphere tilts maximum towards the sun on June 22. Due to this, the months closer to June are summer months in this hemisphere. On December 22, the reverse occurs, and southern hemisphere will receive maximum amount of solar energy.

e) *The surface:* 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.

Cyclones

- The atmospheric pressure in a given area has an important role to play with respect to the formation of a cyclone. Whena 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 anticlockwisedirection in the northern hemisphere. it is called cyclone and anticyclone in southern hemisphere.
- In the southern hemisphere, the clockwise motion of gradient wind is called cyclone and anticyclone in

northern hemisphere.

- During a cyclone, the surface air moves towards the centre having low pressure and hence converges. The converged airhas the property of ascending in the centre within the lowpressure area.
- The reverse happens in a high pressure area. Air tends to sinkin the centre of a high pressure area during anticyclones.

Atmospheric Circulation

- 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.
- 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

Indian Monsoon

Monsoon is a regional wind that blows towards land at a certain season and blow from the landmasses 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 results in precipitation.
- Kerala gets the south-west monsoon 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

- The Inter-Tropical Convergent Zone (ITCZ) moves to the south of the equator, when the position of the sun shifts to the southern hemisphere. This leads to the reversal of winds, and the winds start blowing from the north-eastern direction towards the ITCZ. These winds are known as the north-east monsoon winds or the north-east trade winds.
- Since North-East winds originate mainly from the land 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 km2. 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.
- Water has a number of unique properties like high heat capacity, dissolving capacity, etc. These properties are made possible due to its molecular structure. A water molecule consists of two atoms of Hydrogen that are bound to an oxygen atom.

OCEANS

- Water in oceans is saline in nature. This salinity occurs due tothe 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 arealways added to the oceans through various processes.
- However, seawater salinity is stable due to various mechanismsthat remove salt from the oceans. Salt is spreaded to the atmosphere when wind blows sprays of sea water.
- The salt particles in the atmosphere enable water molecules tostick to it, and this falls on the land with rain and snow.

Oceanic Circulations

- Oceanic Circulations 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.
- The speed of ocean currents is much slower than air currents (the maximum speed that a current can reach is about 10 km/h).
- Most of the wind-driven surface currents occur parallel to the major wind systems. For instance, the northeast and southeast trade winds drive water westward along the equator. This is known as the equatorial current. In the Atlantic Ocean, the equatorial current flows into South America.

- In the Pacific Ocean this current flows into the East Indies. On reaching these places both these currents divide into two parts, with one flowing south and the other north.
- These currents move away from the equator through the continental edges. These currents are then influenced by the westerlies, and due to this they flow eastward across the oceans.
- Due to this movement gigantic whirlpools occur in the Atlantic and Pacific Oceans on both sides of the equator. These whirlpools are influenced by aspects, like the presence of islands, continental projections, undersea mountains and valleys.
- The pace and direction of the circulations are determined by various factors.
- They include the structure and strength of the wind systems, the regional distribution of precipitation patterns, the heat exchange with the atmosphere and the shape of the sea floor.
- These factors are instrumental in the stratification, circulation and the formation of global water masses.
- Stratification and circulation in the upper areas are crucial for the penetration of heat into the ocean.
- Formation of water mass in the higher latitudes works to control the oceanic uptake of CO2 through the sea surface.
- This process directly influences the radiative forcing in the atmosphere.
- Globally, ocean currents can be divided into large horizontal gyres, circulating in the ocean basins, and an overturning vertical circulation in the meridional realm.
- A combination of these circulations act like a huge conveyor belt that constantly distributes heat, nutrients, sediments and traces of chemicals around the world ocean.

Ocean as Moderator of Climate

- 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, and with it the heat or cold is transferred.
- This heat transfer plays a major role in impacting earth's climate. When extremes of incidents, like rainfall or droughts occur, the normal path of the ocean current can be disturbed and climate change could occur.
- The phenomenon of El Niño is a classic example of the impact of changes in the path of ocean currents.
- The oceans play a multifold role in the Earth's climate system. It plays both short- and long-term roles on the climate system.
- The short-term role is evident in the close correspondence that oceans have between the surface temperature and the air temperature close to the ground. The so called thermal inertia' of the great water masses also works to slow down climatic changes.
- The long-term role played by the oceans is evident from the heat distributions around the globe. Oceans determine climates through absorbing solar energy and transferring it around the world through the surface currents.

Oceans as Heat Reservoir

- Oceans as Heat Reservoir Oceans play a role of a heat reservoir, moderating extreme temperatures. This occurs through a complex process.
- 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. This energy transfer could exceed the solar energy that arrives at earth.
- Since the interiors of continents are lacking such a heat reservoir, they have lower temperature in winters and higher temperatures in summers than coastal areas.
- The heat transfer processes in the oceans occurs on a broad range of time scales. The interactive processes in the upper layer of the ocean takes place in shorter periods—may be a few days, weeks or months.
- The major heat redistribution processes between the massive warm equatorial water masses and the cold water of the deep ocean in the Polar Regions occurs over decades or even centuries.

Oceans as Reservoir for carbon

- 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.
- For instance, certain amount of carbon is deposited routinely on the sea bed through dead organisms and their calcified shells.
- The large surface area of oceans also has a major role to play with respect to carbon cycle.
- Though the water near the surface of the oceans has a quasi-equilibrium with the atmosphere, the ocean is normally inert to the increase in atmospheric CO2.
- The oceans withdraw CO2 permanently only when the carbon chemically or biologically bound in the surface water, sinks to lower levels in the ocean and gets buried in the sediments.

BIOSPHERE

- Biosphere is an important realm of Earth. The term biosphere' was first coined by the geologist Eduard Suess in 1875. More insights about biosphere were provided in the early 20th century by the ecologists Henry Cowles and Frederic Clements. Kirkham (2007) provided a comprehensive description of biosphere he referred it as: the totality of life on earth and 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 of the 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.
- Biosphere is a giant ecosystem that consists of two major ecosystems (a) Terrestrial ecosystem b) Aquatic ecosystem.

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.

- Natural Ecosystem: this consists of mountains, grasslands, forests, semi arid regions, deserts, tundra and islands. When there was no human intervention the ecosystem was sustainable. The ecosystem where capable of taking needs of their organisms. Due to industrial development in past few centuries led to the formation of artificial ecosystems.

- Artificial ecosystem: examples are crop fields and garden ecosystem. In this the land is used intensively and has been modified into irrigatable and pastoral lands. Large areas have been converted into urban and industrial centers. This conversion has increased the food production and raw materials. However, large scale conversion of natural ecosystem and misuse of land have led to degradation of natural environment

Aquatic Ecosystems:

- 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.

Natural Aquatic Systems:

- Natural aquatic ecosystem The natural aquatic ecosystem includes the marine and the fresh water ecosystems.
- Marine ecosystem is very vast and saline. It consists of the Ocean ecosystem, Coastal or estuarine ecosystem and the Coral reef ecosystem.
- Aquatic ecosystem can also be classified based on the salinity. According to salinity it is classified as fresh water, brackish water and marine ecosystem.
- Fresh water ecosystem consists of ponds, tanks and lakes (stagnant ecosystem); and streams and rivers (running water ecosystem).
- Brackish water ecosystems mostly consist of expanses of shallow water with peculiar vegetation. This ecosystem is ideal for certain water birds, fish and crustaceans. The water in such ecosystems is saline, but not as saline as that of the marine ecosystem. Brackish water ecosystems in river deltas have vast tracts of mangrove forests, and are considered to be some of the world's most productive ecosystem in terms of biomass production.
- The wetland ecosystem is a special ecosystem wherein water level fluctuates considerably based on the seasons. This ecosystem is highly fragile and is of importance to human beings in various ways.
- The species that thrive in the aquatic ecosystem are adapted to live in the different types of habitats. The natural aquatic ecosystems break down the chemical and organic wastes created by human beings. However, the aquatic ecosystem is incapable of handling wastes beyond a certain limit.

Artificial Aquatic systems: it consists of aquarium ecosystem and sewage ecosystem.

DEFINITION AND MEANING OF KEY TERMS IN DISASTER RISK REDUCTION AND MANAGEMENT

Disaster:

- A serious disruption of the functioning of a community or a society due to hazardous events interacting with conditions of vulnerability and exposure, leading to widespread human, material, economic and environmental losses and impacts.
- The International Federation of the Red Cross and Red Crescent Societies (IFRC) define disaster as *a calamitous event resulting in loss of life, great human suffering and distress, and large-scale material damage.*

Hazard:

- A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation is called hazard.

- A hazard turns into a disaster when there are elements of risk and vulnerability A is said to occur when the hazard impacts on that it exceeds its capacity to cope with it. Hazards vary duration, area of extent, speed of onset.

- Hazards can be single or a combination of many, in origin and effects. It can vary with respect to location, type, intensity, probability frequency

Exposure:

Exposure is the nearness of people, properties or communities to a hazard zone in space and time to suffer potential impacts. Houses and people close to an earthquake zone or at the epicentre are more exposed than those far away. However, a person living at the epicentre, but was away when an earthquake happened, would avoid personal injuries or death as opposed to a visitor who was at the premises.

Vulnerability:

Vulnerability is the degree to which a system, such as a community, is susceptible and exposed to the adverse effects of a given hazard. It is a condition that predisposes individuals, groups, communities or systems to hazard event. Vulnerability depends on the physical, socio-economic and environmental characteristics and circumstances that make the target system or community susceptible.

Categories:

Physical Vulnerability: It considers those aspects that may be damaged or destroyed by a hazard. This vulnerability is based on the physical conditions of a community and elements of risk. Physical conditions include different buildings, structures and infrastructures and their capability to withstand. The proximity and nature of hazard is also considered.

Socio- Economic Vulnerability: The socio economic conditions of a population also have a say on the intensity of impact to which a population is exposed to. For instance, poor people are most vulnerable in the event of cyclone or flood as the houses may not be strong and may be constructed with locally available materials. Further they find difficult to rebuild their houses.

Risk:

- The combination of the probability of a hazardous event and its consequences which result from interaction(s) between natural or man-made hazard(s), vulnerability, exposure and capacity is called risk.

Risk Assessment:

- An approach to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

- Risk assessments (and associated risk mapping) include: 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, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process.

- ISO 31000 defines risk assessment as a process made up of three processes: risk identification, risk analysis, and risk evaluation.

1. Risk identification: process that is used to find, recognize, and describe the risks that could affect the achievement of objectives.
2. Risk analysis: process that is used to understand the nature, sources, and causes of the risks that have been identified and to estimate the level of risk. It is also used to study impacts and consequences and to examine the controls that currently exist.
3. Risk evaluation: process that is used to compare risk analysis results with risk criteria in order to determine whether or not a specified level of risk is acceptable or tolerable.

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.

Capacity:

- The combination of all the strengths, attributes and resources available within a community, society or organization to manage and reduce the risks and strengthen resilience.
- Capacity may include infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management.
- Capacity assessment is a term for the process by which the capacity of a group is reviewed against desired goals, and the capacity gaps are identified for further action.

Coping Capacity:

- The ability of people, organizations and systems, using available skills and resources, to manage adverse conditions, risk or disasters is called coping capacity. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during crises or adverse conditions. It can be two types:

  Physical Coping capacity: Some members of a community affected by hazards could have the required skills to find employment elsewhere and helps their family to sustain.

  Socio – economic coping capacity: In the event of any disaster maximum losses occurs in physical and material realm. However rich members in a community could quickly and completely recover due to their strength of wealth. This may not be possible for poor people

Resilience:

- The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.
- Resilience means the ability to "resile from" or "spring back from" a shock. The resilience of a community in respect to any hazard or event is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need.

Disaster Risk reduction:

- Disaster risk reduction is a systematic and continuous analysis and redressing of the causal factors of disasters.
- It is the first step and key component of disaster (risk) management.
- It should be deliberate and proactive; not episodic (occasional or conveniently) and reactionary.
- Disaster risk reduction efforts and activities are normally specified in a formal document called disaster risk reduction plan prepared by an appropriate entity or authority.
- 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.

Disaster risk management:

- Disaster risk management is the application of disaster risk reduction policies, processes and actions to prevent new risk reduce existing disaster risk and manage residual risk contributing to the strengthening of resilience.

- Disaster risk management includes actions designed to avoid the creation of new risks, such as better land-use planning and disaster resistant water supply systems (prospective disaster risk management), actions designed to address pre-existing risks, such as reduction of health and social vulnerability, retrofitting of critical infrastructure (corrective disaster risk management) and actions taken to address residual risk and reducing impacts on communities and societies, such as preparedness, insurance and social safety nets (compensatory disaster risk management).

Early Warning Systems:

An interrelated set of hazard warning, risk assessment, communication and preparedness activities that enable individuals, communities, businesses and others to take timely action to reduce their risks is called early warning systems.

Effective "end-to-end" and "people-centered" early warning system comprises four interrelated key elements: 1) risk knowledge and risk assessment; 2) detection, monitoring, analysis and forecasting of the hazards and possible scenarios; 3) dissemination and communication of timely, accurate and actionable warnings and associated likelihood and impact information; and 4) preparedness and local capabilities to respond to the warnings received.

Disaster Preparedness:

Disaster preparedness 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 hazard events or conditions. Thus, preparedness is incomplete if potentially affected people are not aware of the threat of a hazard. Preparedness is embedded in disaster risk management.

Disaster Prevention:

- Activities and measures to avoid existing and new disaster risks is called prevention.

- Prevention (i.e. disaster prevention) expresses the concept and intention to completely avoid potential adverse impacts of hazards, vulnerability conditions and exposure through action normally taken in advance of a hazardous event. Examples include dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high risk zones, and seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake.

Disaster Mitigation:

- The lessening or limitation of the adverse impacts of a hazardous event is called mitigation.

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

Disaster Response:

- Actions taken during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

- The provision of emergency services and public assistance during or immediate after a disaster in order to save lives, reduce impacts, ensure public safety and meet the basic subsistence needs of the people affected

- Disaster response is predominantly focused on immediate and short-term needs and is sometimes called disaster relief. Effective, efficient and timely response relies on risk-informed preparedness measures, including the development of the response capacities of individuals, communities, organizations, countries and the international community.

- The institutional elements of response often include provision of emergency services and public assistance by public and private sectors and community sectors, as well as community and volunteer participation. The division between this response stage and the subsequent recovery stage is not clear-cut. Some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage.

Damage Assessment:

Damage assessment is the procedure for determining the magnitude of damage caused by a disaster or emergency event. Damages are normally classified as:

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

Crisis Counseling:

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 (usually based on a damage assessment) 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.

MODULE 2

Hazard:

- A hazard is a situation that has the potential to cause damage
- 'hasard' means 'chance'
- Hazard becomes a disaster when risk associated with it are not managed well
- Example
  - People living in coastal area live in hazardous situation as cyclone may strike them any time
  - Construction workers working in heights are in a hazardous situation of falling. It may lead to injuries and even death
- Three states of hazard : (i) Dormant (ii) Armed (iii) Active

Dormant:

- A dormant hazard is one which has the capacity for potential threat but presently does not affect people or property. People living on the banks of a river are on dormant hazard of floods during heavy rain. They are not presently subject to damage but face a threat of possible flooding

Armed:

- A state of armed hazard occurs when people are likely to be subjected to a threat because the hazard is developing A cyclone moving towards a habitat is a typical example

Active:

- A hazard is said to be active when it strikes a habitat When this happens it is no longer a hazard but a disaster

CLASSIFICATION OF HAZARDS

Based on the origin hazard is classified into:

Biological Hazard: Process or phenomenon of organic origin or conveyed by biological vectors, including pathogenic micro-organisms, toxins and bioactive substances. Examples of biological hazards include epidemic and pandemic diseases, plant or animal contagion, insect or other animal plagues and infestations.

Geological Hazards: Geological process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Geological hazards include internal earth processes, such as earthquakes, volcanic activity and emissions, and related geophysical processes such as mass movements, landslides, rockslides, surface collapses, and debris or mud flows. Hydro-meteorological factors are important contributors to some of these processes. Tsunamis are difficult to categorize; although they are triggered by undersea earthquakes and other geological events, they essentially become oceanic process that is manifested as a coastal water-related hazard.

Hydro-metrological Hazards: Process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Hydro-meteorological hazards include tropical cyclones (also known as typhoons and hurricanes), thunderstorms, hailstorms, tornados, blizzards, heavy snowfall, avalanches, and coastal storm surges, floods including flash floods, drought, heat waves and cold spells. Hydro meteorological conditions also can be a factor in other hazards such as landslides, wild land fires, locust plagues, epidemics, and in the transport and dispersal of toxic substances and volcanic eruption material.

Anthropogenic Hazards: Hazards induced entirely or predominantly by humans, including technological and socio- natural hazards. Man-made hazards (also known as human-induced hazards or anthropogenic hazards) are a collective term that covers the range of hazards that result from human activities. They are distinguished from natural hazards. The range of man-made hazards includes technological and socio-natural hazards, and those that may arise from the relationships within and between communities

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Natural Hazards: Natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Natural hazards are a sub-set of all hazards. The term is used to describe actual hazards as well as the latent hazard conditions that may give rise to future events. Natural hazards can be characterized by their magnitude or intensity, speed of onset, duration, and area of extent. For example, earthquakes have short durations and usually affect a relatively small region, whereas droughts are slow to develop and fade away and often affect large regions. In some cases hazards may be coupled, as in the flood caused by a hurricane or the tsunami that is created by an earthquake.

Radiation Hazards: Radiation hazards are due to electromagnetic radiation from many sources such as nuclear accidents, nuclear waste, mobile phones or transmission towers. They are very harmful and can have immediate or long term effects depending upon the type, exposure and amount of radiation.

HAZARD MAP

- A **hazard map** is a map that highlights areas that are affected by orare vulnerable to a particular hazard.
- They are typically created for natural hazards, such as earthquakes, volcanoes, landslides, flooding and tsunamis.
- Hazard maps help prevent serious damage and deaths.

- The purpose of hazard mapping is to gather together different hazard related information in one map.
- Hazard mapping involves a graphical representation of the location, magnitude and temporal characteristics of hazards on 2 or 3 dimensional surfaces.
- Two objectives of hazard map
    - To make the people of the region aware of the hazards likely in the region
    - To help disaster managers and other stake holders to plan and be prepared for the disaster as and when it occurs

Methods to hazard information collection

- Undertaking field travel and "overflights" of the study area
- Contacting local officials and community leaders
- Maintaining contact with appropriate national planning officers
- Determining the availability of existing data.
- Using experienced staff members or consultants to get an overview

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:

1. ***Base maps:*** Base maps represent topographic layers of data such aselevation, roads, water bodies, cultural features and utilities. It must be plan metric, i.e. a representation of information on a plane in true geographic relationshipand with measurable horizontal distances.

2. **Remotely sensed images:** Satellite images are sources of readily available information of locations on the earth's surface comparedto conventional ground survey methods of mapping thatare labour intensive and time consuming.
3. **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.

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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:

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

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 are applicable 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 of interest 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.

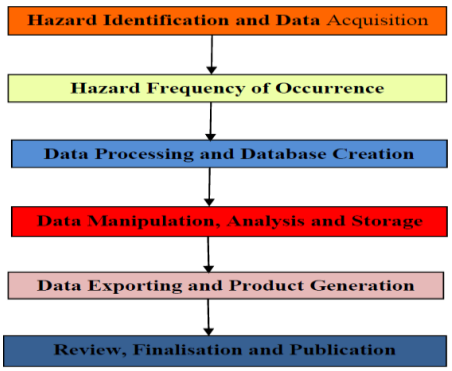
Approaches to Hazard Mapping

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) is appreciating that:

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

1. *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.



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2. *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; and
  - □ develop a presentation that synthesises the participatory mapping experience and presents the conclusion and possible questions for further investigation.

How to Conduct 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.

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 awareness among the population

- 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

Vulnerability Types

- It denotes the characteristics and circumstances of an individual, community or area that could be subjected to harm from a hazardous situation.

- There are four types of vulnerability (UNISDR) –Physical –Economic –social –Environmental

- In a disaster situation, the vulnerable population includes the poor, women and children and the disabled. In general, they are the most affected.

- •The vulnerable areas are those which are very close to the disaster site.

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- •In the case of a bomb explosion, assets and people living or present near the site of the blast are the most seriously affected than people far off from the area.

Factors of Vulnerability
- Poorly designed and maintained infrastructure
- Inadequate safety awareness and safety measures for assets
- Lack of awareness and adequate information about hazards and risk
- Inappropriate management of risks identified and lack of preparedness to face hazards
- Lack of proper management of resources and environment

Physical Vulnerability:

- Physical Vulnerability may be determined by aspects such as population density levels, remoteness of a settlement, the site, design and materials used for critical infrastructure and for housing. Physical vulnerability also includes impacts on the human population in terms of injuries or deaths.
- •Example: Wooden homes are less likely to collapse in an earthquake, but are more vulnerable to fire.

Social Vulnerability
- •Social Vulnerability refers to the inability of people, organisations and societies to withstand adverse impacts of hazards due to characteristics inherent in society.
- •It is linked to the level of wellbeing of individuals, communities and society.
- •It includes aspects related to levels of literacy and education, the existence of peace and security, access to basic human rights, systems of good governance, social equity, positive traditional values, customs and ideological beliefs and overall collective organisational systems.
- •Example: When flood occurs, elderly people and children are unable to protect themselves

Economic Vulnerability
- •The level of vulnerability is highly dependent upon the economic status of individuals, communities and nations.
- •The poor are usually more vulnerable to disasters because they lack the resources to build sturdy structures in their homes and put other engineering measures in place to protect themselves from being negatively impacted by disasters.
- •Example: Poorer families may live in low-lying slum areas because they cannot afford to live in safer (more expensive) areas. They are more vulnerable when a flood occurs and their belongings or even their homes get washed away.

Environmental Vulnerability
- •Natural resource depletion and resource degradation are key aspects of environmental vulnerability.
- •Example: People living in hilly areas become vulnerable because of environmental degradation. Their habitats have to necessarily be on hill slopes due to the terrain features. Deforestation and cutting of trees on hill slopes makes them vulnerable to hazards from landslides.

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.

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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 Crete 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.

Physical Vulnerability:

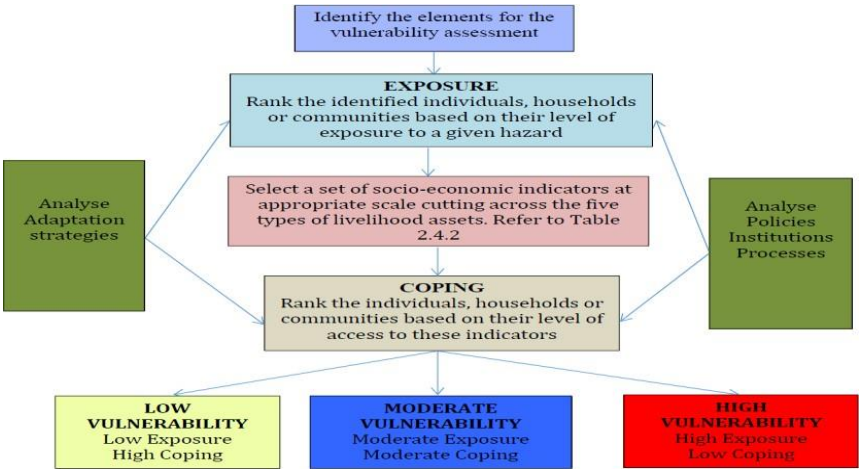
- Buildings: The vulnerabilities of buildings are based on the location of the site, the design, materials used for construction, construction techniques used, and its proximity with other buildings
- Infrastructure: In considering infrastructure, three broad groups are to be considered—they include transportation systems like roads, railways, bridges, airports, etc., utilities like water supply, sewage and power supply; and communication network.
- Other critical facilities: Critical facilities are vital to the functioning of the societies during times of disaster and are considered as lifelines. Examples include hospitals and other essential services; emergency services; communications systems; buildings and structures with cultural importance; and certain structures such as dams that are essential to the long-term sustainability of the economy.

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.

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.

- Certain groups of people like single parent families, pregnant or lactating women, mentally and physically handicapped people, children and the elderly require special attention and focus.
- Certain other groups like migrants, people residing at remote areas also require special attention. Risk perceptions for these groups have to be assessed, and the required awareness programs have to be initiated
- Direct losses potential: Direct losses could include damage or destruction of physical and social infrastructure and the likely cost incurred to repair or replace it. It could also include costs related to the damages to crops and other means of production.
- Indirect losses potential: Indirect losses include the impact due to loss of production, employment, income generating activities, and the likely inflation in the society. While direct cost is easy to calculate, assessment of indirect costs is difficult.



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

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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.
- □ 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 arises out of an interaction between a hazardous condition and vulnerable elements. However, disasters only occur when the risk materialises

- The Sendai framework for disaster risk reduction and its immediate predecessor, the Hyogo framework for action, both call for identification and assessment of disaster risk. Thus, risk assessments form an important aspect of risk reduction strategies.

- There are two 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.

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.

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- This approach has widespread application in the profiling of vulnerability using participatory 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.

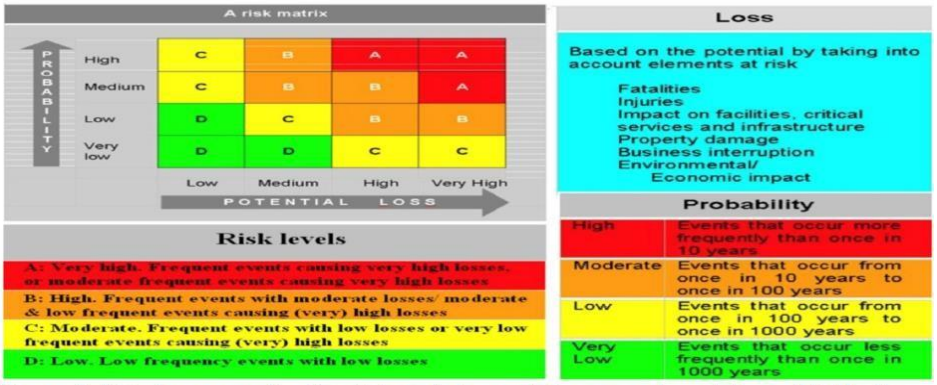

Figure 2.5.2: An example of a risk matrix used for assessing risk qualitatively

- *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 * Amount of elements-at- risk

Table 2.5.3: Different ways of expressing risk

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

- *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.
  - 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
  - The semi-quantitative approach could be adapted to cover larger areas
  - Semi-quantitative risk can also be conceptualised as: Risk = Hazard * Vulnerability/Capacity.

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MODULE 3

DISASTER RISK MANAGEMENT

- The systematic process of using administrative directives, organisations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster is called Disaster Risk Management.

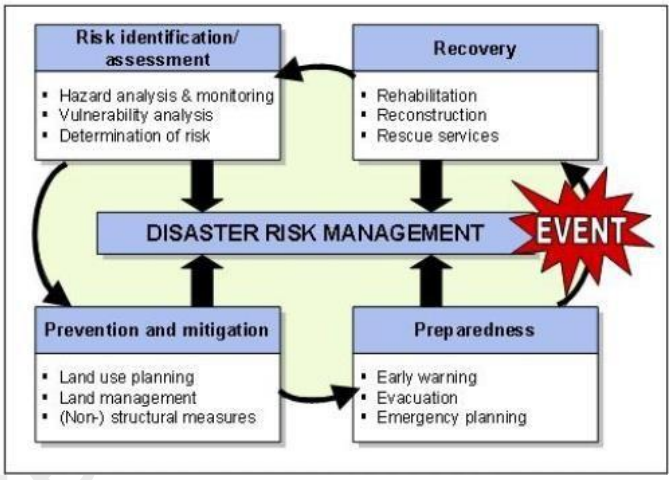
- Disaster risk management ultimately aims to decrease risk by reducing exposure to hazard, lessen vulnerabilities and increase capacity, and hence build resilience to disaster. When disaster risks are assessed, the next step is to consider a wide range of options available to prevent the disaster from occurring, protect people, their assets, and the environment, in the event that it occurs. The knowledge gained from the assessment allows individuals and communities to anticipate the types of disaster that are likely to affect them, and to think of ways to reduce the impact, or prevent it altogether.

- Disaster management functions are generally consisting of four stages of action.

- •The four stages or phases widely accepted are **mitigation, preparedness, response and recovery**.

- •Mitigation and preparedness are phases prior to the occurrence of a disaster. Response and recovery are post disaster phases.

Disaster Risk Framework



- Risk identification and assessment: This involves determining and analysing the potential, origin, characteristics and behaviour of the hazard – e.g. frequency of occurrence/magnitude of consequences.
- Application of risk reduction measures in mitigation: Planning and implementation of structural interventions (e.g. dams, sea defence) or non-structural measures such as disaster legislation.
- Disaster preparedness and emergency management: Activities and measures taken in advance to ensure effective response to the impact of a hazard, including measures related to timely and effective warnings as well as evacuation and emergency planning.
- Recovery/Reconstruction: Decisions and actions taken in the post-disaster phase with a view to restoring the living conditions of the affected population.

- The four (4) cornerstones of Disaster Risk Reduction Four parallel and complementary lines of actions can be considered to reduce exposure to disasters and achieve a more sustainable approach to development:

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

Disaster Management Cycle

- Disaster management is a continuous and integrated process. It involves planning, organising, coordinating and implementing, and evaluating actions which are required for:
    - **Preventing threat** to the community due to any emergency or disaster
    - Mitigation or **risk reduction** from any likely disaster or its consequences
    - **Capacity building**, including research and knowledge management, to reduce vulnerability
    - **Preparedness** of individuals and communities to cope with any disaster
    - **Immediate response** to any threatening situation or disaster
    - **Assessing the severity** and consequent effects of any disaster
    - Undertaking **evacuation, rescue and relief**
    - Ensuring **rehabilitation** of affected community and **reconstruction** for them

Measures for Disaster Risk Reduction

PREVENTION

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

The Basis of Disaster Prevention

- For disaster prevention to be successful, a priori planning is required. Planning of prevention hinges on two (2) issues:
    - □ hazard identification (identifying the actual threats facing a community) and
    - □ vulnerability assessment (evaluating the risk and capacity of a community to handle the consequences of the disaster).
- Once these issues are put in order of priority, emergency managers can determine the appropriate prevention strategies.

- Primary prevention is to reduce, avert or avoid the risk of the event occurring, by getting rid of the hazard or vulnerability, e.g. to avoid overcrowding, deforestation, choked drainage and to provide services.
- □ Secondary prevention means to 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.

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Hazard Mapping

- A hazard map shows the hazard likely in a region
- To prepare a hazard map data is required about the hazards that have happened in the region in the past. This data can be obtained from two sources –Recorded history –Information gathered from community
- **Recorded history:** For the last many decades, records of hazards that have occurred in different regions of the world are available. These are being compiled in many countries for the purpose of disaster mitigation. Such records gives an indication of types of hazards that may occur in that region.
- **Information gathered from the community:** Where records are not available or insufficient, it is necessary to talk to the people living in the region. They may remember the hazards they faced before or have heard about from their elders.
- **Two objectives of hazard map:** (i)To make the people of the region aware of the hazards likely in the region. (ii). To help disaster managers and other stake holders to plan and be prepared for the disaster as and when it occurs

Vulnerability Analysis

- Vulnerability analysis is the process of identifying vulnerable conditions exposed to natural hazards They provide valuable information

Physical Vulnerabilities Analysis

- •Buildings: The vulnerabilities of buildings are based on the location of the site, the design, materials used for construction, construction techniques used, and its proximity with other buildings
- •Infrastructure: In considering infrastructure, three broad groups are to be considered—they include transportation systems like roads, railways, bridges, airports, etc., utilities like water supply, sewage and power supply; and communication network.
- Other critical facilities: Critical facilities are vital to the functioning of the societies during times of disaster and are considered as lifelines. Examples include hospitals and other essential services; emergency services; communications systems; buildings and structures with cultural importance; and certain structures such as dams that are essential to the long-term sustainability of the economy.

Social Vulnerability Analysis:

- •Certain groups of people like single parent families, pregnant or lactating women, mentally and physically handicapped people, children and the elderly require special attention and focus.
- •Certain other groups like migrants, people residing at remote areas also require special attention. Risk perceptions for these groups have to be assessed, and the required awareness programs have to be initiated.

Economic Vulnerability Analysis:

- •Direct losses potential: Direct losses could include damage or destruction of physical and social infrastructure and the likely cost incurred to repair or replace it. It could also include costs related to the damages to crops and other means of production.
- •Indirect losses potential: Indirect losses include the impact due to loss of production, employment, income generating activities, and the likely inflation in the society. While direct cost is easy to calculate, assessment of indirect costs is difficult.

MITIGATION

- Mitigation refers to all the **measures taken to reduce the risk** from disasters.
- This can be done through many actions that are aimed at **increasing the capacity** and resilience of the individuals and community.
- A number of steps like **hazard mapping, vulnerability analysis, building codes** for structural mitigation, alternative economic models to prevent economic vulnerability, etc. are required.
- **Personal mitigation** is a key to national preparedness. Individuals and families are trained to avoid unnecessary risks.
- The objectives of mitigation are to:
  - **Reduce the risk** due to natural and man-made disasters
  - Take steps like **hazard mapping and vulnerability analysis** for risk management
  - Prepare and enforce **structural mitigation** measures like building regulations and their implementation
  - Reduce risk by exercising **control over development**
  - Help vulnerable populations putting in place measures **for crop planning, urban planning and land use** regulations.

- Primary Objectives of Disaster Mitigation: The primary objectives of disaster mitigation are two (2) fold, namely hazard likelihood reduction and 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. However, the likelihood of floods occurrence can be reduced by mitigation measures such as sea defence walls.
  - ***Risk consequence reduction:*** This is a reduction in the impact of a hazard, via a reduction in exposure and/or vulnerability. It involves ensuring that the population, structures, or other systems are able to withstand such an event with as few negative consequences as possible.

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- In reducing both *hazard likelihood* and *risk consequence*, the primary aim is to decrease risk of death and injury to the population. The secondary aims are to decrease damage and economic losses inflicted on public sector infrastructure and to reduce private sector losses.

a. *Mitigation measures for buildings*

- Mitigation measures for buildings are essentially aimed at **preventing damage and fatalities due to earthquakes**. These are generally referred to as **structural and non-structural mitigation measures.**

i. Structural Mitigation:

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

- Structural mitigation essentially means ensuring that **houses, offices and other commercial buildings** can withstand the likely disaster.
- In many countries **building regulations** exist. But it is implemented only in big cities.
- Large number of victims in rural areas during and after earthquakes is due to **faulty building construction**.
- Even in the **Latur earthquake**, buildings made of stones, weakly cemented together was the reason for huge loss.
- Structural vulnerability is also **high among the poorer sections** of society. Their houses generally get damaged and blown away during a cyclonic storm.
- The concept of structural mitigation also includes those structures which have not collapsed but suffered minor damage during an early disaster.
- Structural retrofitting is done in buildings to resist against future disasters.
- While in big cities, buildings are designed and constructed according to building regulations like the **Building Code of India**, the concept of such resistant buildings should also penetrate in rural areas.

ii. Non-Structural Mitigation:

- This refers to policies, awareness, knowledge development, public commitment, and methods and operating practices, including participatory mechanisms and the provision of information, which can reduce risk and related impacts.

Non-structural mitigation can be considered as having two components.

i. A structure, like a multi-storey building, has load-bearing components such as slabs, beams, columns and foundation elements. Walls, partitions, parapets, sun shades etc., are **non-load bearing components**. Failure of a non-structural component will not result in the collapse of a building.

ii. Within the building, there are many components like **electrical systems** (such as ducts for wiring, light fitting), AC ducts, fire-protection systems etc., which mainly add load to the structure (are not load bearing). Then there are **amenities** like tables, chairs, beds, cupboards, wall mountings etc., which are added as comfort components for functionality.

Mitigation done for those elements other than structural load bearing elements is considered non-structural mitigation.

- All non-structural components must be **adequately fixed** to avoid their falling off, due to vibration, during an earthquake. External elements like parapet walls, stone or tile facings need to be appropriately braced so that they don't fall off due to vibration. False ceilings and suspended ducting etc., must be adequately secured with nuts or screws.
- If there are **wall-mounted elements** like ACs, they need to be adequately anchored to the wall to prevent their falling off and injuring people.

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- **A cupboard, for example, can fall off during an earthquake** and injure people. It is advisable to fix them to the walls. Most of the other interior elements like tables etc., tend to move due to vibration and must be secured. Many chairs are on rollers in plush offices and will run on the floor if not secured.

iii. Mitigation Infrastructure

The major aspects of infrastructure are **communication and transport**.

- •During a disaster, we will generally not know what kind of damage will be caused to the infrastructure and what will be available.
- •Generally, one uses the road network and transport vehicles for evacuating people, transporting relief material, **medical (ambulance)** services etc., which are crucial in a disaster situation.
- •Many times, after a disaster, such road network may be damaged by landslides or flooding making **relief work difficult**.
- Alternative road networks or means of transportation must be designed as a mitigation strategy for making transportation possible.

b. Control over Development Activities

The government should have policies and practices in place for:

- **Land use for various purposes**: using the hazard mapping and vulnerability analysis.
- **Agricultural crop patterns:** Crop patterns must be studied and farmers advised to grow the kinds of crops that can withstand the impact of a disaster
- **Alternate income schemes** must be made available for people in case they lose their livelihood, including insurance schemes and similar means.
- **Critical infrastructure** must be ensured to save the heavy economic loss due to disasters.
- **Water resource management schemes** must be implemented to save water and to avoid flooding.
- **Building houses in flood-plains** must be avoided and commercial buildings on **hill slopes** must be avoided.
- Constructing houses is highly risky and must be approved based on thorough **geological studies** only

i. Construction of Dams:

- Construction of dams and embankments is necessary to **irrigate land, for power generation and also to provide drinking water** to the population.
- •Dams and embankments also help to reduce the severity of floods. They are constructed at huge cost for the benefit of many.
- •However, there is also a negative aspect of such infrastructure. A dam **displaces thousands of people** from the habitat that they have been living in for many years. They lose their homes as many villages are likely to be drowned due to the water body created by the dam. These people also **lose their livelihood.**
- The massive water body also drowns many square kilometres of forest area, destroying the flora and fauna of the region.

ii. Land Use

The pressure of population and economic development has altered the land use pattern over the years. It is easy to monitor land use with modern technology like remote sensing.

•Some points of concern are:

- •**Construction near river banks** has become very common. It is reported that one reason for the heavy flooding in Tamil Nadu in 2015 is the encroachment near river banks.
- •**Deforestation** has been another major area of concern. Cutting of trees for various purposes like buildings on hill slopes has caused major landslides. This is also an ecological disaster because trees protect us from pollution.
- •Construction of many buildings for housing and other purposes **prevents natural flow of rainwater**. With insufficient storm water drains, this acts as a trigger for floods in most cities in India. When we construct buildings it is imperative that we take care of means to drain rain water safely from such areas.

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c. Mitigation of Man-Made Disasters

- **Hazardous industrial units** must be located away from city limits and dense human habitat. Sufficient infrastructure and facilities must be provided so that the industries do not suffer due to their remote location.
- All industries must have **safety audits** conducted for their premises and processes. This must be made mandatory and government agencies must also check such audit reports.
- Fire is a major hazard in all the cities. **Fire prevention measures** must be implemented in all industries and public places like cinema halls, auditoriums etc. Installation of fire and smoke alarms, water for extinguishing fires and other measures put in place must be checked frequently. Fire drills must be conducted regularly.

- **Design of transportation infrastructure** like roads and railways must take into account strict safety measures for their functioning. Considering the enormous numbers of road accidents and fatalities, it must be ensured that stringent road use control is enforced for the safety of vehicle drivers and pedestrians.
- **Education and awareness** about man-made hazards and the way people can contribute to the safety of human beings and infrastructure must be mandatory. This is the simplest way to prevent man-made disasters.

PREPARDNESS

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

- Preparedness is the **second phase** of the disaster management cycle.
- This basically indicates the **measures required for facing disasters** that are likely to occur in the region.
- If mitigation measures as outlined earlier are taken, the community is better prepared to cope with disasters.
- The objectives of preparedness are to:

1. **Ensure public awareness** and preparedness for disasters
1. Prepare and be ready to implement a **disaster management plan**
2. Ensure standard **procedures for evacuation** and immediate relief
3. Prepare **sheltering plans** and ensure physical availability of shelters
4. Have plans for **warehousing** of relief materials and logistics of operation
5. Ensure availability of **healthcare services** by identifying teams, and availability of medicines and other essential materials

- Disaster preparedness can be studied under three specific categories:
  1) *Target-Oriented Preparedness*: Preparedness plans may be target specific, for instance, we may require different types of planning for the vulnerable groups of women, children, elderly and disabled.
  2) *Task-Oriented Preparedness*: Specific groups jointly develop activities based on one of the community's plans to evaluate the community's capability to activate the preparedness plan in a real emergency. Eventually, these tasks enable the development of plan revisions, employee training and material resources to support readiness.
  3) *Disaster-Oriented Preparedness*: This addresses the likelihood of occurrence of a specific disaster. Emphasis is placed on structural and non-structural mechanisms

- The effectiveness of the various types of preparedness depends on the availability of information on hazards, emergency risks and the countermeasures to be taken, and on the degree to which government agencies, non-governmental organisations and the general public are able to make use of this information.

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

a. *Disaster Management Plan*

- The first step in disaster preparedness is the making of a disaster management plan that honestly represents **what the local government and communities are capable of doing** to cope with a disaster.
- In the USA, such a plan is called an **EOP or Emergency Operational** Plan.
- The objectives of this plan are:
  1) Identify **agencies** for the DM operations and their functions
  2) Identify **individual(s)** to command the operations
  3) Identify individuals from different agencies, and their **functions**
  4) Identify the method of **coordination** between different agencies, government and private
  5) Identify the mechanism for **resources management**, needs and availability of resources
  6) Detail out the **likely emergencies** for the area, both man-made and natural
  7) Ensure **flexibility in the plan** to be able to modify it according to experiences gained

- The DMP should generally contain information such as:
  1) **Objectives:** How it helps citizens to cope with disasters
  2) **Disaster scenarios:** Contains information about actual and likely disasters; how the public will be informed and any unusual situations that may arise
  3) **Organisation and control:** The existing disaster management structure, the person or official in command, the roles of other officials and their functions
  4) **Coordination and inter-relationships:** Roles of government agencies, private agencies and other social groups and how they will interact to optimise the efforts.
  5) **Resources and logistics:** The resources available and to be procured from outside and procurement times, warehousing and distribution
  6) **Health and medical care:** From first aid to treating injuries, dealing with dead bodies etc. are to be dealt with. Preventive medical services and healthcare services must be detailed out, identifying the available infrastructure, and warehousing of medical supplies and their distribution.
  7) **Public information:** Mentions the methods of early warning to the public and continuous flow of information as the event unfolds.
  8) **Communication:** Communication channels between the central control and other government and private agencies must be known to everyone. This must find a place in the plan as this is a crucial element in disaster management.
  9) **Updating of plan:** The updating of plan is also required based upon the experiences gained by operating the plan in a disaster situation. Certain assumptions made in the planning may not be correct and these can all be corrected by keeping the plan flexible and easily changeable.

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b. *Early Warning systems*

- Wherever practicable, **people must be made aware** of a possible disaster in advance.
- This will give them **time to prepare** themselves for leaving their homes for safer areas.
- Many **natural phenomena are predictable**. It is possible to issue early warnings to the people likely to be affected by the event.
- Objectives:
  1) To **inform** the public about likely risks
  2) To **forecast** in advance and communicate to all concerned about impending disasters
  3) To **ensure speedy actions** in communication and response
  4) **Capacity and resilience** building in the community for the expected risks

- Early warning, however, is not restricted to warning about impending disasters alone. The early warning system should ideally consist of:
  a. **Hazard and vulnerability analysis** for a region; this will give a comprehensive idea about the risks the population is likely to be subjected to
  b. **Continuous monitoring** for early detection of impending disasters and issuing the necessary alerts to the public
  c. **Developing a communication system** and flow of communication such that public and, disaster responders are immediately informed of the developing situation
  d. Making **efforts for capacity building** for the identified risks in the community

c. *Evacuation Plans*

- In many instances like a cyclone (which is quite predictable now-a-days), a **major task before the disaster** strikes will be to evacuate people from the areas that the cyclone will affect.
- •There will be a storm **surge in sea level** and people living in low-lying areas will have to be taken to higher reaches.
- •Accompanying heavy rains can **flood** many areas which need to be identified.
- •An **evacuation plan** must be prepared and people must know and should be informed of such plans in advance.
- •Many people would be unwilling to leave their homes and **belongings** and shift to temporary shelters.
- •The **security of their homes** and belongings is an issue that they should be assured of.

d. *Sheltering Plans*

- A **basic need** of displaced persons is a place to live in and be safe.
- •A disaster management plan would have identified dedicated shelters or buildings like **schools** that can be used to accommodate people displaced from their homes.
- •Such temporary shelters must be **sufficient to lodge** the many thousands who may need them.
- •The shelters and sheltering plans will vary according to the disaster.
- •**In earthquakes, tents** in open areas may be more appropriate unless one can find safe buildings.
- •**In floods, buildings at higher levels** are to be found for sheltering people.
- •In the case of earthquakes for example, due to **aftershocks** after the main tremor, people may be afraid of living inside buildings. Even if a building stands, it may still be not safe for living. Temporary shelters in open spaces may have to be built in large numbers in such situations.

e. *Inventory of resources*

- An inventory must be made of **all the resources available** for disaster management.
- •The inventory includes material **resources, equipment, trained personnel, etc.**
- •Such inventories **help to plan actions** and deployment of resources and the roles of different people.
- •Providing resources for disaster management is essentially the **responsibility of the government**.

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- •Many private individuals, corporate bodies and others make **contributions** in terms of money and materials.
- •There must a central agency that must **evaluate the requirements** and tell the donors what the affected people need.
- Resources are of many types:
  1) **Money, space, equipment** for many purposes
  2) Trained and dedicated **human resource**, defence forces
  3) **Local agencies** like police force, firemen and community volunteers
  4) **Private agencies** in terms of expertise, human resource and material
  5) **Medical services** including human resource, equipment, hospitals, medical supplies
  6) Central **control room**, human resource
  7) Facilities for use of **modern technological tools** like GPS, GIS and remote sensing

f. *Warehousing*

- To cope with a disaster, we will need large quantities of **material resources** like food items, water, medical supplies, etc.
- •It **may not be possible to procure** them in large quantities at short notice.
- •Some quantity of such materials needed in an emergency must always be available.
- •In a disaster situation, with so much of media attention and help from across the world, the **availability of such materials is not generally a problem**, since so much of international help comes in.
- •The **channelling of such materials** to those in need is an issue. Many concepts of supply chain management are applicable here.
- Relief materials for different uses come from **many sources**. They have to be received, stored and dispatched to different end user-points in remote locations.
- •This needs careful planning. **Proper storage** of food items, medicines etc., is important so that they do not get spoilt during storage and transportation. Containers for storage, vehicles for **transportation and packaging** of relief material all should be covered under the plan.
- •The **distribution network must be carefully planned** so that relief reaches the needy in time and there is no delay due to bottlenecks in any aspect of distribution.

g. *Logistics*

- The Oxford Advanced Learners' Dictionary defines logistics as "the practical organisation that is needed to **make a complicated plan successful**, when a lot of people and equipment is involved."
- •The term probably came originally from **military science**, relating to procurement, maintenance and transportation of material, people and facilities.
- •Logistics is very important in disaster management because the response to a disaster invariably involves **moving many people, relief materials, medical supplies** quickly and efficiently to remote places.
- •Without a logistics plan such a complex operation cannot be completed. A logistics plan also **has to be flexible** as the disaster situation may change the assumptions on which the plan is based
- A logistics plan should invariably cover the following aspects:
  1) All the **usable routes** to reach the region affected including road network, rail lines, water transport systems and ports.
  2) **Alternative routes** in case of road blocks due to landslides/ avalanches, flooding etc.
  3) **Deployable vehicles** in terms of aircrafts, helicopters, buses, goods carriers and ships and boats. Existence of GPS in the vehicles is a must for easy location.
  4) **Quantum of supplies** in terms of food items, water containers, medical supplies and equipment, camping equipment, clothes and other items as may be required.
  5) A **plan for distribution** of relief materials to remote locations.

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6) A plan for **transporting personnel and equipment** for relief and rescue work
7) **Route maps** of all transport systems in hard and soft copy formats.

h. *Communication*

- A very **critical element** in disaster preparedness is communication.
- •Many communication systems and **modes** are available today like landline phones, fax, text messaging services, wireless phones, satellite phones, internet-based communication systems and so on.
- •Many of these communication systems **may not be functional** once the disaster strikes.
- •Having **alternate modes** of communication is necessary.
- •Another aspect of communication in disaster management can be called **information management**.
- •The **protocols** of communication must be established clearly. Otherwise, there is likely to be **miscommunication, rumours** and people not acting as per plan.
- The following points are important with respect to communication in disaster management.

1) •Ensure that a **standard operating procedure** (SOP) is available and it contains a section on communication.
2) •Make an **inventory of the modes of communication** and equipment available for communication.
3) •An **information flow chart** must be available for key individuals who are supposed to receive and send communication.
4) •**Communication protocol** must be available and known to all important people.
5) •Ensure that key persons have a **back-up communication** facility in case of failure of one or two modes of communication.
6) Warning about an impending disaster and its consequences must be made known through **mass media** and the information must be repeated a number of times.
7) •Mass media, like the **newspapers and radio and television**, have great reach and must be used for giving correct information. Media briefings should be arranged frequently and who will brief the media also should be decided upon.
8) •Ensure 24x7 availability of **emergency and toll-free numbers** during the emergency period. Such centres should get correct information which needs to be updated frequently so that people can get such information speedily.

i. *Education and Training of Personnel*

- Many activities associated with disaster management **require special skills**. People need to be trained to undertake such activities.
- •**Government officials** who are going to be involved with disaster management activities need to be trained for dealing with disaster situations as per need.
- •Many of them may not be aware of **concepts like hazard maps, risks, vulnerability, disaster management cycle, etc.** They need to get familiar with such terms and phases of disaster management.
- •Another important element of training may be the use **IT tools** and various kinds of software.
- Participants must also be familiar with concepts in **remote-sensing, GPS and GIS** to better appreciate the use of such tools.
- •A dedicated force like the **disaster response team** has to be developed by selecting the right people and training them in the special job that they have to perform, the tools and equipment they would use and the various methods of search and rescue.
- •Many of them may also be trained in simple **first aid** of medical service. People at the community level who volunteer to be part of the response team should also be trained in some aspects of search and rescue and to help the response force in their functions. Also depending upon their responsibilities and involvement, people must be familiar with
    i. the disaster management plan for the region and
    ii. the standard operating procedures.

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j. Public Awareness Program

- Public awareness must be created through multiple modes and methods. Some of these could be:
  1) •Attractively designed and attention-catching **publicity materials** to be displayed in several localities to create awareness about hazards and risks.
  2) •Volunteer groups must be encouraged to **stage street corner shows and plays** to highlight and inform public about disasters and standard procedures to save themselves.
  3) •**Discussions in mass media** like radio and television can be effective in creating public awareness.
  4) •Conducting **mock drills** frequently for the disaster can also increase awareness.
  5) **Informal training programmes** can be conducted to increase awareness about disasters.
  6) Discussions on **safety procedures** during disasters, among the local community, should be encouraged.
  7) Information about disasters and related procedures must be included in **school curricula**.
- The objectives are:
  1) •**Community level disaster management groups** must be trained and prepared to deal with disasters.
  2) •**Knowledge is power**; an informed community is better prepared to deal with disasters.
  3) **Confidence level** of the community will increase.

RESPONSE

- Response is the stage immediately after a disaster
- •The objectives of the response phase are to:
  1) provide immediate relief to **reduce the suffering** of the affected people
  2) Conduct **search** operations and **rescue** those stranded
  3) Provide **food, water and accommodation** in temporary shelters to displaced people
  4) Provide **medical services** as may be needed to people injured
  5) Take measures to **prevent unhygienic conditions** that can cause diseases, and their spread.

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

Factors that Determine the Nature of Disaster Response

- Disaster response is determined by the nature of disaster event which is mostly characterised by:

1) ***The type of disaster:*** Disaster manifests in many forms, its onset may provide long warning, short warning, or no warning at all. The relative anticipation of the disaster event thus, would influence the effectiveness of activating preparedness plans, mobilisation, and application or response effort.

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

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3) ***The severity and magnitude of disaster*** The severity and size of the problem determines the response required. Particular effects could be seen in the ability of responses to cope with the problem; the urgency of response action and the priorities which are applied in terms of the scale of potential effects of no appropriate response as well as the requirements for external assistance.

4) ***The capability of sustained operations*** The capability of sustained operation is an essential ingredient of effective response. This is influenced by factors such as resource capability, management capability, community self-reliance, and availability of international assistance. It is important that these issues are clearly addressed in preparedness planning and response action plans.

5) ***Identification of likely response requirements*** Knowing the likely response required to address specific disaster is important and ought to be identified in the preparedness planning stage of the disaster management cycle.

Requirement for Effective Response

Information and resources are two (2) essential requirements for effective response without which plans and efforts at responding will not yield the anticipated results.

Information

- An early warning system provides vital information for effective response operation despite the unpredictability of some disaster events.
- An effective warning system must be robust to transmit warnings as early as practicable.
- Information gained from these systems could help in the planning and decision-making as well as inform the general public.
- Resources form an essential component of disaster response. The need for disaster management organisations to be resource ready cannot be over emphasised considering the untimely occurrence of disasters, which most often is on short notice.
- The ability to mobilise the needed resources on short notice is most often hampered by many factors. Its effect on systems gives little room for procrastination of actions.
- Disaster management requires a carefully drawn response plan which is often prepared in anticipation of emergency and activated in times of urgency.
- The response plan as a component of the disaster management plan includes ways of managing human and financial resources, response to supplies availability and communication procedures.
- This involves identifying, strengthening, and organising resources and capacities for timely and effective response to a potential disaster.

Disaster Response Planning

- In disaster response planning, roles and responsibilities are defined, policies and procedures are developed and generic tools for responses are identified and developed.
- The response plan is developed based on assumptions of risks and hazards, and does not address specific disaster scenarios - as is the case for contingency plans.
- Plans thus, must be monitored, evaluated and adapted to the specific situation in times of disaster.

Rationale of Disaster

- Responses are mainly directed at:
    1) limiting casualties;
    2) alleviating hardship and suffering;
    3) restoring essential life support and community systems;
    4) mitigating further damage and loss; and
    5) providing the foundation for subsequent recovery.

Disaster Responses:

a. *Search and Rescue*

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- Typically, in many disasters, this is the first step in response.
- •As an example, in an **earthquake, many people get buried under debris** of their homes or other buildings. Some people may be alive under a collapsed building. Some of these people may survive if they are rescued and given medical help.
- •Some people may be dead and it is necessary **to remove those dead bodies** as rotting bodies can become a health hazard.
- •**Specialised teams** are involved in search and rescue. While the local community can also help, we need trained response forces having the necessary equipment to do the job.
- Depending upon the geographical spread of the affected area, **it may take time to reach** the affected people.
- •The transportation network may be damaged. In such situations, **aerial search** and location of affected people will be required.
- •The **local community can be trained** for some of these activities.
- •The **survivors will be the first responders** in disasters. They can help many other people so that they survive.
- •If a **proper disaster management** plan and operating procedures are laid out, the search and rescue work can take place fast.

b. *Medical Care/ First Aid*

- An **immediate requirement** when rescue efforts are going on is medical help.
- •Some people may have minor injuries that need **first aid** immediately. Some others may have serious injuries requiring **hospitalisation**.
- •Many others may need **heavy medication and surgical procedures** to save their lives. All this requires well-planned and organised medical services.
- •On-field care and **ambulance services** must be available.
- •Many **remote areas** may not have facilities and equipment available locally. The patients will have to be shifted to nearby towns for healthcare.
- •Also, the dead bodies recovered should be taken care of, till they are **identified and disposed** by relatives. It will also be necessary to monitor the health of survivors, particularly the children and the elderly.
- The need for first aid and emergency medical care arise in most disasters and response in this direction is of essence.
- First aid is the provision of initial care for an illness or injury.
- It is usually performed by non-expert, but trained personnel to a sick or injured person until definitive medical treatment can be accessed.
- Emergency medical care is immediate paramedic attention to severe wounds and the rapid transportation of the ill or injured to a health facility

c. *Relief Aid:*

- This relates to any provision of assistance during an emergency that is meant to attend to a person's immediate requirements for survival or recovery.
- It may include food, clothing, housing, medical care, necessary social services and security when a person is faced with circumstances beyond her or his control.
- Relief aid must be targeted at the most vulnerable first: Vulnerable children or orphans, female or child headed households, pregnant or lactating women, sick or elderly populations.

d. *Humanitarian Relief*

The Humanitarian Charter provided 4 (four) principles that must be followed in responding to emergencies based on the right to live in dignity, the right to receive humanitarian assistance, and the right to protection and security The principles are:

1) avoid exposing people to further harm as a result of your actions;

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2) □ ensure people have access to impartial assistance;
3) □ protect people from physical and psychological harm due to violence and coercion; and
4) □ enable access to remedies and recovery from abuse

e. *Damage Assessment*

- During the response phase, many **government and private agencies** will be at many sites where damage has occurred.
- •Loss of life and **damage to private and public property** has to be assessed.
- •**Aftershocks** of earthquakes can cause damages.
- •There may be damage to buildings, roads, and water supply and sanitation facilities. Such damage will have to be assessed and work started on priority on some aspects like **water and sanitation** for the health of the public.
- •People can live in temporary shelters for some days, but they would like to go back to their homes as early as possible. **Reconstruction efforts** should start as early as possible.

f. *Coordination*

- Coordination is key to successful disaster response, and is essential in ensuring timely and appropriate scaling-up of resources.
- Good coordination is crucial for combining resources effectively and efficiently, in order to reach the disaster-affected more rapidly.
- It contributes to better cooperation, reduces the level of duplication and helps to ensure a well-organised operation.
- Coordination activities can take place at different levels and in different forms.
- During the response phase, with **multiple agencies** offering their help, coordination of efforts is a key factor.
- •Setting up of a **control room** and identifying the person in command, is a first step in coordination.
- •For coordination of the response efforts, the following points are important:
  1) **Unified command:** A person, most suitably a government official, should be identified as the **person commanding the whole operation**. He or she may allocate duties to others in case the geographical spread of the area is large.
  2) **Control room:** The control room should be safe from the impact of the disaster. The control room should be manned **24 hours of the day with a good communication set-up** to communicate with people at different locations. Key persons in command must be notified of all developments at frequent intervals as agreed upon.
  3) **Communication network:** Communication network during disaster is of critical importance**. Fail-safe communication set-up must be available all 24 hours**. Normally satellite phones and internet facilities are used to have enough speed in the communication system. Failure in communication facilities becomes a serious handicap in response efforts.
  4) **Information to media:** Media briefing should be done daily so that correct information goes to the world at large. **Rumours can cause immense miscommunication and confusion**, resulting in hardship and suffering to people.

g. *Psychological Support:*

- Disasters come with grieving moments as many may lose not only properties, but also dear ones with negative psychological outcomes.
- Impacts on psychosocial well-being can be both short term and long term.
- Psychological services play a crucial role in responding to crises that involve large populations, as they cater for the needs of the majority of the affected population.
- They help in the recovery process and reduce the development of mental health problems.
- Psychosocial support activities include identifying and referring individuals requiring specialised support through professional mental health services.

h. Public Health Support:

Public health services are required during disaster response. The relevance of medical services is most felt in disasters when there are:

- Deaths, injuries, Loss of clean water, Loss of shelter, Loss of sanitation, Loss of routine hygiene, Disruption of solid waste management, Public concern for safety, Increased pests and vectors Damage to health care system, Worsening of chronic illnesses, Toxic/hazardous exposure, Loss of food supply, Standing surface water

The public health services required in responding to disasters include:

- Mass casualty management, Mental health, Environmental health, Reproductive health, Managing and continuation of existing health services, Managing and continuation of medication on chronically affected diseases (HIV, TB, Leprosy etc), Management of the dead and missing Emergency feeding, Communicable disease surveillance and response, Sanitation

Standard Operating Procedures (SOPs)

- In making disaster plans operational, there is the need to develop SOPs which could guide the team in effective operation.
- SOPs are the set of standard procedures that "operationalize" the disaster response and/or contingency/ plans.
- In other words, SOPs specify the way in which individuals or units will carry out their functions under the plan (such as, mobilisation of response team, deployment of assessment team process assessments, etc.)
- The SOPs set out what should be done, how it should be done, who is responsible for implementing what, and specifies available resources. SOPs take cognisance of four stages of preparation and procedures: *during normal times, alert/warning and, during disaster, rehabilitation*

During Normal Times: The state institution mandated to respond to disaster ought to:

- Formulate and distribute disaster preparedness plans, and conduct drills in all areas;
- Produce maps of Wards/Village Tracts showing areas most vulnerable to storms, floods and other natural disasters;
- Make a list of vehicles and motor boats that can be used for emergency work;
- Compile a list of departments, non-governmental organisations (NGOs), and members of People's Strength that will take part in relief operations in the predisaster, disaster and post-disaster periods and designate representatives for contact;
- Obtain beforehand the required relief and aid supplies;
- Form the necessary disaster preparedness committees and organisations;
- Create shelters and safe locations for use during disasters depending on local conditions;
- Conduct educational talks on natural disasters and rehearse periodically for the local community depending on local conditions; and
- Coordinate with departments concerned to form Security services, Auxiliary Fire Brigades, communication agencies and Red Cross Societies; and
- Provide organising and training activities.

Alert/Warning Stage: In the situation of impending danger, efficient warning systems would activate the needed alert. The following actions would be necessary in such stage of disaster.

- Emphasise the dissemination of news obtained through early warning systems to the community;
- Assign duties to administrative bodies and NGOs to fly warning flags as part of the disaster preparedness programme in the vulnerable areas of the Ward/Village Tract;
- Alert and mobilise members of the Security services, Auxiliary Fire Brigade, communication agencies, the Red Cross, Youth, members of People's Strength and NGOs;
- Make the necessary arrangements to evacuate the public to safe locations (shelters) in a timely manner;

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- Increase security sentries as required;
- Ensure that all levels of supervisors have all teams ready for assigned duties; and
- Keep the office operational 24 hours a day in the emergency period

During Disaster Stage: In the event of a disaster, the issues to consider are:
- Alert the community in areas the natural disaster is likely to strike;
- Safeguard the road and water transport routes, keep relief and medical teams at the ready and arrange transport to affected areas at short notice;
- Evacuate the community from vulnerable areas to safe locations or designated shelters as quickly as possible;
- Operate relief camps and supervisory centres at designated shelters as quickly as possible;
- Ensure that administrative personnel and NGOs in areas vulnerable to storms give disaster warnings door to door as a matter of urgency;
- Keep available relief and aid supplies at the ready to launch relief operations quickly and effectively;
- Evacuate the public remaining in the area to designated safe locations;
- Make arrangements to evacuate movable property including cattle to designated locations; and
- Ensure the well-disciplined implementation of orders received from the coordinating agencies and sub-committees with the help of members of the Security services, Fire Brigade, Red Cross Youth members, and members of People's Strength, social organisations and NGOs.

Rehabilitation Stage: The rehabilitation stage is the post disaster phase where affected population restart their lives in a much difficult situation considering the impact of their losses. The SOPs for the rehabilitation stage are:
- Conduct field inspections in affected areas as soon as possible and provide the necessary assistance and support;
- Submit immediate preliminary reports with population figures, death and injury figures of cattle and animals, data on socio-economic losses, and carry out further systematic data collection;
- Make arrangements to provide health care and social protection to disaster victims;
- Clear collapsed buildings and trees as quickly as possible;
- Prioritise the restoration of transportation, electricity and water supply and telephone and telegraph services as soon as possible;
- Make arrangements as quickly as possible to reclaim contaminated wells and ponds for access to clean water and dig new wells for drinking water;
- Make arrangements to bury/cremate the remains of disaster casualties and animal carcasses;
- Manage and systematically utilise disaster funds and supplies, as well as cash and supplies donated by well-wishers, social organisations and NGOs; and
- Support the local population for the resumption and recovery of economic activities to previous conditions.

RECOVERY

- The immediate goal of the recovery phase is to bring the **affected area back to normalcy** as quickly as possible.
- •The objectives of recovery phase are:
  1) To **take care of the displaced persons** till they are able to return to their houses
  2) To **assess the damage to infrastructure** and estimate the cost of reconstruction
  3) To obtain funding and start the **reconstruction of infrastructure and houses** for the displaced persons
  4) To undertake **economic rehabilitation** of people who have lost their livelihood
  5) To ensure that **essential services** like water, sanitation and power supply are available to people
- The recovery process can be very long and **may take years** to accomplish.

- •The responsibility for reconstruction is with the **government or local administration** and they must prioritise and undertake reconstruction work for the good of the public at large.
- •During reconstruction, it is recommended to consider the **basic causes for the extensive damage** to life and property and build that in the new design for reconstruction.
- •By this time, most of the NGOs and other **volunteers will leave** as the initial response phase gets over.
- •**Enormous amounts of funding** will be required to reconstruct the damaged infrastructure, including private houses.

a. *Assessment of Damage:*

- This may include:
    1. Number of collapsed **houses**, damaged houses and **public buildings**
    2. Damage to **road and rail** network
    3. Damage to **water supply** system and sanitation systems
    4. **Power supply systems** and lines and equipment damaged
    5. Damage to **communication network**
    6. **Environmental damage**, loss of animals, trees, damage to water bodies
- The costs will include:
    1. **Rebuilding** of collapsed houses and public buildings
    2. **Compensation** to people for the damages
    3. **Retro-fitting** of partially damaged buildings
    4. Cost of removing debris, reconstruction **of roads, railway, power and communication network**; re-laying of water and sanitation systems
    5. Cost of supporting people with **food and shelter** till they are able to move into their own houses.
    6. Cost of **economic rehabilitation**
    7. Cost of **restoring the damage to the environment**
- •All the costs should be worked out on current prices, with escalation for time lapse due to shortage of funding and delays in implementation of reconstruction plans.

b. *Reconstruction*:

- The reconstruction of **public utilities and services** take priority as they have an impact on a large number of people.
- •**Water supply system, sanitation system and power supply lines** must be set right so that people have these services at the earliest.
- •Attention will then have to go to **communication and transportation networks** which are again vital for many services.
- •With **international help**, both in terms of money and expertise, these can be set right fast.
- •It also must be ensured that people get **healthcare free of charge** during this period.
- •Many will **need long term healthcare** depending upon the disaster and injury.
- •Reconstruction work **may go on for years**. People will have to be compensated suitably during this period by way of monitory assistance.

c. *Economic Rehabilitation:*

- A disaster may bring to halt many economic activities like **manufacturing, trade and agriculture** on which many people depend for their livelihood.
- •As the restarting of many economic activities may **take a long time**, people need to be provided alternative sources of income.

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- •Creating a **data base of people with their skill sets** may help to assign jobs suitable to them for their economic rehabilitation.
- •They can be **employed in the reconstruction activities** to give them a source of income.
- Many actions can be taken to reduce the suffering of people due to loss of livelihood.
    1. Provide **economic support** to people for minimum standard of living
    2. Give **easy loans and aid** to take up some economic activity
    3. Provide **employment in the reconstruction activities**
    4. Create a **data base of skill sets** of people
    5. Provide **employment in government** sectors
    6. Provide **support and facilities to industry** to restart operations and so on
    7. Adopting **alternative crop pattern** and practices to reduce losses

RELIEF

- Disasters in most cases take away many essential subsistence needs and livelihood, making coping difficult for victims/communities affected. The victims end up needing help.

- It is defined as the provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. Relief can be of an immediate, short term, or protracted duration

- Relief, as a disaster management process, provides timely essential needs such as basic household items, shelter, food, water and sanitation, or health items.

- Relief activities provide goods and services to disaster-affected populations in the form of supplies, vouchers or cash transfers, so as to enable those populations to cover their essential needs. Relief measures differ, depending upon the nature of disaster. At certain occasions, money may have no value, but certain articles like food, clothes, etc. may be more important

- Relief, globally, is guided by fundamental principles which disaster organisations and NGOs engaging in disaster relief response ought to apply. The principles require that:
    1. Response to disasters must have humanitarian imperative
    2. Aid is provided based on needs alone and must be done without discrimination of any kind (race, creed or nationality of the recipients)
    3. Aid will not be used to further a particular political or religious standpoint
    4. Aid agencies do not to act as instruments of government foreign policy
    5. That culture and custom are respected in response and relief activities
    6. Disaster response is built on local capacities
    7. Ways be are developed to involve programme beneficiaries in the management of relief aid
    8. Relief aid would reduce future vulnerabilities to disaster as well as meeting basic needs
    9. Accountable to both those we seek to assist and those from who we accept resources
    10. Information, publicity and advertising activities shall recognise disaster victims as dignified human beings and not hopeless objects

Project Management Cycle related to relief:

- The project cycle management (PCM) is a conceptual tool used for the planning and management of programmes and projects leading to the improvement of programme effectiveness and outcome.
- In disaster response, the PCM provides five (5) main continuous components that guide disaster response.
- They are: assessment, planning and designing, implementation, monitoring, review and evaluation

Assessment

- The first step after the onset of a disaster is to assess the origin, magnitude and effect of the disaster on the affected population so as to be able to identify humanitarian needs and plan possible interventions.
- The purpose of an assessment, therefore, is to ascertain the need for an intervention based on identified needs.
- This is done to identify the problem, its source and consequences.
- There are four (4) types of assessments that are usually conducted during disasters. These are immediate, rapid, detailed and continual assessments.
  - **Immediate assessments** are conducted within 72 hours after the disaster. It is generally conducted by in country actors and involves the collection of basic disaster information.
  - **Rapid assessments** are conducted immediately after the disaster and take up to a week. These involve gathering of information on the needs and existing capacities of the affected population. Possible areas of intervention and resource requirements are determined.
  - **Detailed assessments** are conducted after rapid assessments to obtain further information on the affected population's needs and capacities for programme planning. They can take up to a month to conduct, more or less depending on the area, the complexity of the issues and resources available.
  - **Continual assessments** are conducted once the detailed assessment has been completed and relief programmes are running. They update information on the situation and involve beneficiaries for recovery programming. In addition, when contextual changes occur, continual assessments allow to initiate rapid or detailed assessments

Planning:

- The planning and design process is critical to a relief operation as it helps to set out in clear stages what the operation will do.
- It also determines how progress and results will be monitored and defines the duration of relief activities.
- The planning process describes the steps and order to undertake when planning relief interventions.
- The design describes the selection of relief interventions that are best adapted to the needs of the context faced.
- The factors that must be considered when planning relief activities are:
  - The needs identified during the assessment, presented by technical sector (shelter, NFIs, food, water and sanitation, health)
  - The overall PoA for the operation
  - The capacity and mandate of the disaster management organisation
  - Programmes conducted/planned by other stakeholders (government, humanitarian organisations)
  - The security and access to disaster-affected populations

Implementation

- The implementation phase is when the activities are carried out to achieve the desired results.
- The implementation of relief activities is conducted once the assessment and the planning processes are completed.
- This may include the mobilisation and distribution activities.
- The key issues that would be considered are beneficiary targeting and identification and methods and tools for implementation.

Monitoring

- Monitoring, also known as process evaluation, is a continuous process of follow-up on all the activities throughout the disaster response and relief activities.
- Monitoring is done through the use of indicators which measure the extent to which an objective has been accomplished.
- These indicators measure changes in the lives of beneficiaries as a result of the relief they received.

- The resulting progress reports lead to decisions on whether or not an intervention needs to be changed or adapted as the situation evolves.

Review and Evaluation
- Reviews and evaluations are the assessments carried out at a given point in the intervention.
- These involve analysis of the situation that produces intermediate/final reports that lead to recommendations for and adaptations to the intervention or to lessons learnt for the organisation.

INTERNATIONAL RELIEF ORGANIZATIONS

a. *United Nations and Subsidiary Agencies*

- The United Nations is an **inter-governmental organisation** of world countries.
- •It was established in **1945** after World War II to ensure that such a calamity does not recur.
- •It was started with 51 countries as members, and today has **193 members**.
- •The headquarters of the United Nations is at **Manhattan, New York, USA**. It has other main offices at Geneva, Nairobi and Vienna.
- •The United Nations is financed by assessed and voluntary contributions from member countries.

United Nation's Office for the Coordination of Humanitarian Affairs (UN-OCHA)
- •OCHA was formed in **1991** by a UN resolution to strengthen the UN response to disasters.
- •This was formed by combining two earlier offices of the **Department of Humanitarian Affairs and the Office of the United Nations Disaster Relief Coordinator**.
- •After its formation, it was given power for the coordination of humanitarian response, policy development and humanitarian advocacy.
- •OCHA is responsible for **bringing together humanitarian actors** to ensure a coherent response to emergencies.
- •OCHA also ensures there is a **framework** within which each actor can contribute to the overall response effort.
- OCHA's mission is to:

1) Mobilise and **coordinate effective and principled humanitarian action** in partnership with national and international actors in order to alleviate human suffering in disasters and emergencies
2) Advocate the **rights of people** in need
3) Promote **preparedness and prevention**
4) Facilitate **sustainable solution**

- The following agencies are a part of the relief efforts:
    1. United Nations Development Programme (UNDP)
    2. United Nations Refugee Agency (UNHCR)
    3. United Nations Children's Fund (UNICEF)
    4. World Food Programme (WFP)

United Nations Development Programme UNDP
- •UNDP is a global network for development. It has its headquarters in **New York**.
- •The major focus of UNDP is on
    1. Promoting change and connecting countries to **knowledge, experience and resources** to help people to have a better life

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2. Provide **expert advice, training and grants** to developing countries with focus on least developed countries

- •The development focus of UNDP projects is on poverty reduction, HIV/AIDS, energy and environment, democratic governance, social development, and **crisis prevention and recovery**. UNDP also promotes protection of human rights and empowerment of women in all projects.
- •UNDP is funded by voluntary **contributions from member countries**.
- •UNDP operates in **177 countries**
- UNDP projects are focused on **reducing risk of armed conflicts and disasters**.
- •It promotes and supports **early recovery** after disasters.
- •UNDP supports local governments in **needs assessment, capacity building**, coordinated planning and policy formulation and standards setting.
- •UNDP projects in the area of disaster management include
  1. **strategies to reduce the risk of natural disasters**
  2. **capacity building**
  3. **hazard mapping and assessment**

World Bank

- •World Bank, under the United Nations, is an **international financial institution**.
- •The bank essentially acts as **lender providing loans** to developing countries for undertaking development projects requiring large resources.
- •Many projects in developing countries have been supported by the World Bank during the last three decades.
- •Projects worth **40 billion dollars in the area of disaster management** have been funded in counties like Argentina, Bangladesh, Colombia, Haiti, India, Mexico, Turkey and Vietnam.
- These projects cover areas like
  1. **Mitigation and prevention** projects including fire prevention measures like early warning systems, and education and training
  2. **Early warning systems** for cyclones
  3. **Flood prevention** measures
  4. **Earthquake-resistant construction**
  5. Establishment of a global facility for disaster risk reduction to help developing countries **enhance local capacity** for disaster prevention and emergency preparedness

WHO

- •World Health Organization WHO is the directing and **coordinating authority for health** within the United Nation's organizational structure.
- •It is responsible for
  1. –providing leadership on global health matters,
  2. –shaping the health research agenda,
  3. –setting norms and standards,
  4. –articulating evidence-based policy options,
  5. –providing technical support to counties and monitoring and assessing health trends
- •WHO has **many publications related to disasters** and the medical emergencies arising out of such disasters.

IFRC

- •The International Federation of Red Cross and Red Crescent Societies (IFRC) is the **world's largest humanitarian organisation**

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- •It provides **assistance without discrimination** as to nationality, race, religious beliefs, class or political opinions.
- •Founded in **1919**, the IFRC comprises **189-member** Red Cross and Red Crescent National Societies, a secretariat in Geneva and more than 60 delegations to support activities around the world.
- •The **Red Crescent** is used in place of the **Red Cross** in many Islamic countries.
- •**Vision:** "To inspire, encourage, facilitate and promote at all times all forms of humanitarian activities by National Societies. with a view to preventing and alleviating human suffering, and thereby contributing to the maintenance and promotion of human dignity and peace in the world."

Role:

1. carry out relief operations to assist victims of disasters
2. combine relief with development work to strengthen the capacities of its member National Societies.

Focus: The IFRC's work focuses on four core areas:

1. promoting humanitarian values,
2. disaster response,
3. disaster preparedness, and
4. health and community care.

•The seven underlying principles

1. **Humanity**—Humanitarian assistance is provided to one and all to alleviate their suffering.
2. **Impartiality** — The assistance is provided without discrimination as to nationality, race, religion, class or political allegiance
3. **Neutrality** — lFRC and its national societies do not take sides in any conflict nor do they engage in controversies of political, religious, racial or ideological nature.
4. **Independence** —The National Societies, while working within the laws and other regulatory framework in different countries, will exercise autonomy in their functioning and, provide assistance as per requirements.
5. **Voluntary Service** - The service is without any expectations of gain in any manner.
6. **Unity** — There can be only one Red Cross and one Red Crescent society in one country.
7. **Universality** — The movement is a worldwide effort.

- IFRC has an exceptional **decades-long** tradition in assisting people in disasters and crises.
- •IFRC is a grassroots network with more than **13 million active volunteers** who work within communities in the areas of disaster response and recovery, disaster preparedness and risk reduction, health and development.
- •As **community-based responders**, the volunteers and staff are often first on the scene of a disaster.
- •They are capable of going the last mile in reaching out to vulnerable communities to provide assistance and to remain with the affected people throughout the **post-disaster recovery process**.
- •In **2010**, their volunteers provided services estimated as worth more than **six billion US dollars** and reached more than **30 million people** in disasters alone.
- •In large-scale disasters, such as the **Haiti earthquake in 2010**, more than **120 National Societies** from all continents contributed funds, human resources or goods to the Red Cross/ Red Crescent response.

TIEMS

- •The International Emergency Management Society (TIEMS) is a non-profit, international **NGO** registered in **Belgium**.
- •It has **chapters** in many countries including **India**.
- •The NGO provides a global platform for **education, training, certification** and policy planning in management.
- •The society aims to develop and bring **modern disaster management tools and techniques** into practice by exchange of information, innovations and new techniques.

- •It provides a **forum for stakeholders** to meet, discuss and network about new technical and operational methodologies. It is proposed to establish local chapters worldwide to take care of cultural differences.
- •The society also promotes **training and research in the area of disaster management**.

IAEM

- •The International Association of Emergency Managers (IAEM) is an international organisation dedicated to promoting the goals of **saving lives and protecting property** by
    1. mitigation,
    2. preparation
    3. response, and
    4. recovering from disasters.
- •IAEM also sponsors the **Certified Emergency Manager and Associate Emergency Manager** (AEM) Programs to instil and maintain professionalism through the certification process.
- •The IAEM has more than **9000 members** worldwide.
- •It is a **non-profit organisation** of emergency management professionals. It represents professionals whose aim is to save lives, protect assets and limit damage to environment during disasters.
- •The **mission of IAEM** is to "serve its members by providing information, networking and professional opportunities, and to advance the emergency management profession."

IRP

- •The International Recovery Platform (IRP) was formed at the **World Conference on Disaster Reduction** (WCDR) in Kobe, Hyogo, Japan in **January 2005**.
- •The Recovery Platform is a part of the International Strategy for Disaster Reduction (ISDR) efforts.
- •IRP is a key component for implementing the **Hyogo Framework** for Action, 2005-2015.
- •This was ratified by **168 governments** for building capacity and resilience of member countries and communities to disasters.
- The IRP's role is

1. –to identify gaps and constraints experienced by member countries in recovery and
2. –to develop tools, resources and capacity for resilient recovery.

Goals of IRP

- •to ensure that **risk reduction** approaches are systematically incorporated into the design of emergency preparedness, response and recovery programmes
- •to promote **"Build Back Better"** approaches and support the development of enhanced recovery capacity at a regional, national and sub-national level with a **particular focus on high-risk low-capacity countries.**
- •by closely linking its work with the goals of the **HFA**, to promote a shared vision amongst IRP partner organisations.
- •to serve as an **international source of knowledge** for the development of recovery and risk reduction resource

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MODULE 4

STAKE HOLDER PARTICIPATION

Stakeholder 'participation', stakeholder 'engagement' and stakeholder 'involvement' are often used interchangeably in relation to the interactions between two or more stakeholders in policy making, development projects, organisational management and decision making in disaster risk reduction (DRR) education.

In brief, 'stakeholder participation' is the involvement of interest groups (i.e., representatives of locally affected communities, national or local government authorities, politicians, civil society-based organisations and businesses) in a planning or decision-making process

Participatory development is defined as a process in which people are proactively and significantly involved in all decision-making processes that affect their lives

Meaning and Forms of Stakeholder Participation

Stakeholders are people/communities who may be directly or indirectly, positively or negatively affected by the outcome of projects, programmes or new initiatives such as DRR education. The three basic forms of stakeholders are:

***Primary stakeholders*:** They are the beneficiaries of a development intervention or those directly affected (positively or negatively) by it. They include local populations individuals and community-based organisations) in the project/programme area as well as poor and marginalised groups who have traditionally been excluded from participating in development efforts. In disaster risk reduction, these stakeholders include: homeowners, renters, homeless persons and community-based small-scale businesses.

***Secondary stakeholders*:** These refer to those who influence a development intervention or are indirectly affected by it. They include the government, line ministry and project staff, implementing agencies, local governments, civil society based organisations, private sector firms, and other development agencies.

Key stakeholders: This group can significantly influence or are important to the success of the project through financial resources or power. In the context of DRR in the local, regional or national scale, key stakeholders could include National Disaster Management Organisation (NADMO), Ministry of Local Government and Rural Development (MLGRD), Metropolitan, Municipal and District Assemblies (MMDAs), etc. and they could be financiers of DRR efforts. A key element in stakeholder participation is the ability to identify stakeholders, their needs, interests, relative power and potential impact on the intended endeavour in a people-centred fashion

Effective Ways of Promoting Stakeholder Participation in DRR

- In stakeholder participation initiatives some groups - such as the very poor, women, nomadic groups or ethnic minorities – may lack the organisational, social or financial means to make their voices heard and participate effectively.
- These are often the exact stakeholders whose needs and interests are critical to the success and sustainability of development interventions.
- Special efforts are needed to address the disequilibrium of power, knowledge and influence among stakeholder groups and to allow weaker, less organised groups to interact effectively with stronger, more established stakeholders.

These include:

- ***Capacity building* –** Providing training, coaching, funds or other resources to marginalised groups to assist them in organising, mobilising support, identifying and articulating their interests;

- ***Mandated representation –*** Where there is a danger of exclusion, it may be useful to establish targets of representation, for example, agreeing that all village committees will include an established number of women or that all ethnic groups in a given community will be represented on a decision-making body;

- ***Separate events –*** In some cases, it may be valuable to meet with specific population groups separately, for example, to hold a separate women's meeting to discuss their particular concerns;

- ***Levelling techniques –*** Power differentials between stakeholders can be reduced through the use of participatory methods. A skilled facilitator can use a number of techniques to ensure that all participants have equal opportunity to make their voices heard. Negotiating systems may need to be developed for handling conflicting interests between different groups of local stakeholders;

- ***Use of intermediaries –*** In circumstances where the direct participation of marginalised individuals themselves is not feasible, intermediaries or surrogates may be identified to represent their views and defend their interests. For example, if it is not possible for women farmers from isolated areas to participate directly in a national forum on agricultural development, female extension workers might be selected to represent their interests

Benefits and Cost of Stakeholder Participation in DRR

Benefits TO DRR

The potential benefits of increased stakeholder participation include the following:

- Improved programme/project design by drawing on **local knowledge and expertise** to ensure that designs accurately reflect stakeholder priorities and needs;
- Improved means of verifying the **relevance and appropriateness** of proposed interventions;
- Strengthened stakeholder commitment to, and **ownership of**, policies and projects, leading to 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;**
- Emphasised means to identify and address **potential negative social and environmental impacts**;
- Opportunity to generate **social learning and innovations** based on field experience;
- Capacity-building of stakeholders and local institutions (including their capacity to analyse problems and initiate other development activities);
- Improved means of ensuring that project benefits are distributed equitably; and
- Strengthened working relations between stakeholders, government and civil society organisations and development partners.

Costs and Risks to DRR

Each progressive level of stakeholder participation brings with it different 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 or merely token participatory activities due to limited time, capacity, commitment or resources;
- Lack of political will on the part of governments to allow wide stakeholder participation because they fear loss of power or influence;
- Difficulty in reaching out to marginalised groups and ensuring that the true priorities and needs of poor and vulnerable groups are represented;
- Difficulty in identifying genuine representative non-governmental organisations (NGOs) and civil society organisations (CSOs);
- Co-optation of the stakeholder participation process by more powerful or articulate stakeholders, and the exclusion of the poor and disadvantaged;
- Creation of unrealistic expectations;

- Aggravating conflicts between stakeholder groups with different priorities/interests;
- Weak capacity of beneficiary and intermediary organisations; and
- Challenge of coordinating efforts with other on-going consultation/participation processes to avoid '*consultation fatigue'*.

Basic Steps in Participatory Stake hold Engagement

Participatory stakeholder engagement: Stakeholder engagement is the identification of a project's key stakeholders, an assessment of their interests, and the ways in which these interests affect project riskiness and viability.

- Stakeholder analysis is a methodology for identifying and analysing the key stakeholders in a project and planning for their participation. It is, therefore, the starting point of most participatory processes and provides the foundation for the design of subsequent stakeholder activities throughout the project cycle.
- A thorough stakeholder analysis should be carried out in the early planning stages of all endeavours such as DRR, and reviewed and refined from time to time as the details of programme or project design become more detailed and definite.

- 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 or subject of interests;
  Step 3: Assess stakeholder influences and importance; and
  Step 4: Outline a stakeholder participation strategy.

Step 1*: Key Stakeholders Identification:* The first step of stakeholder analysis is to identify relevant stakeholder groups. 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?
- Whose behaviour has to change for the intervention to succeed?

An initial list of stakeholders can be drawn up on the basis of a desk review of secondary data (publications and documents) and existing staff knowledge of the project, sector and country. This preliminary list must then be verified, modified and enhanced through the use of the questions discussed above.

Step 2: ***Analysis of Stakeholder Interests and Programme/Project Impacts***
Once relevant stakeholder groups have been identified, the next step is to analyse their interests (overt and hidden) and to assess the potential impact of the proposed project on their interests.
Key questions for participants to answer include:

- How does each group of stakeholders perceive the problem at hand and proposed solutions?
- What are their key concerns and interests with respect to the project?
- What are stakeholders' expectations of the project?
- What does each group of stakeholders stand to gain/lose as a result 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?

These questions are best answered by stakeholders themselves in the context of a stakeholder workshop. Such a workshop requires careful preparation and could require a full day (depending on the complexity of the subject or project and stakeholder interests).

Step 3: *Stakeholder Prioritisation*

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

Key questions to engage the attention of participants are:

- Who are the project's targeted primary beneficiaries?
- What is the importance of each stakeholder group to the success of the project?
- What is the degree of influence of each stakeholder group over the project?
- Are special measures needed to protect the interests of primary stakeholder groups that are weak or vulnerable?

The results of the first three steps of stakeholder analysis can be represented in table form to provide a clear and comprehensive picture of stakeholder interests, importance and influence.

Stakeholder Analysis Matrices

The following three tables represent a framework for recording and organising the information generated by a stakeholder analysis in the context of DRR.
To review, the three variables used to construct the matrices are listed below:

- **Interests:** the priority concerns of the stakeholder group (or what is 'at stake' for them);
- **Influence:** the degree to which the stakeholder group has power and control over the endeavour and can thus facilitate or hinder its implementation; and
- **Importance:** the degree to which the achievement of programme or project objectives depends on the active involvement of a given stakeholder group.

Table 1: Identification of stakeholder groups and their interest, importance and influence

Stakeholder groups	Interest(s) at stake in Relation to program	Effect of Project on interest(s)	Degree of Influence of stakeholder over project	Importance of stakeholder for success of project
		+ = (positive) U= unknown 0 = neutral - = (negative)	U= unknown 1=little/no importance 2=some importance 3=moderate importance 4=very important 5=critical importance	1=little /no influence 2=some influence 3=moderate influence 4=significant influence 5=very influential

Table 2: Mapping key stakeholders' relative influence

Influence of stakeholder	Unknown	Little/no influence	Some influence	Moderate influence	Very influential
Unknown					
Little/no influence					
Some influence					
Moderate influence					
Very influential					

Table 3: Formulation of stakeholder participation strategy

Stages in project process	Information sharing (one- way- flow)	Consultation (one- way- flow)	Collaboration (increasing control over decision making)	Empowerment (transfer of control over decisions and resources)
Identification of common disasters in the locality				
Prioritization of disaster types and preventive/reduction/response initiative				
Implementation supervision and monitoring of accepted initiative				
Evaluation of programme initiative or measure				

Step 4: *Stakeholder Action Planning*

The ultimate goal of stakeholder analysis is the definition and development of a stakeholder action plan that outlines the specific activities to be carried out by each stakeholder group (including agreed timelines, inputs and resources, progress indicators, etc.). Some stakeholder groups will have active and continuous roles to play while others may only need to be kept informed of progress or be involved at certain key moments of planning or implementation.

A stakeholder action plan is best drawn up in direct collaboration with those concerned and a participatory workshop (or series of workshops) is often the best way to proceed.

Methods and tools for participatory Stakeholder engagement

1. Participatory Meetings and Workshops:

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 (Question and Answers) format with questions from both the moderator and participants.

Pyramid Schemes
Participants are given a question or problem to think through on their own for a few minutes. They are then asked to join with a neighbour to discuss the topic in twos, then in a subsequent round in groups of four or six, then in groups of eight or twelve. Not only is this effective in requiring engagement and participation by everyone, it also creates a safe zone early on in the smallest groups for tentative and exploratory answers that could serve as the seed for creative but credible responses. Growing the groups larger provides the opportunity for friendly challenging of ideas and cross-fertilising the best of answers across groups.

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

Round Table
Participants form groups around a specific topic area in order to share experiences and discuss ideas. This format provides an informal setting for starting dialogue, sharing and discussion. Depending on the purpose, formal questions could be posed to the group to guide their discussion or the topic could remain open for the group to determine the direction of their conversation. 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.

2. Participatory Research/Data Collection
Participatory Rural Appraisal (PRA) is one participatory research approach that offers a 'basket of techniques' from which those most appropriate for the project context can be selected. The basic principles of PRA tools are:

- Participation: local people serve as partners in data collection and analysis;
- Flexibility: not a standardised methodology, depends on purpose, resources, skills, and time;
- Teamwork: outsiders and insiders, men and women, mix of disciplines, etc..
- Optimisation: optimal cost and time efficient, but ample opportunity for ignorance, analysis and planning, etc.; and
- Systematic: for validity and reliability, partly stratified sampling, crosschecking.

The central part of any PRA tools includes:

- **Semi-Structured Interviewing:** These interviews are, therefore, more like conversations guided informally by the interviewers.
- **Mapping:** Creating or drawing community maps, personal maps, institutional maps, etc.
- **Ranking:** Problem ranking, preference ranking, wealth ranking etc.
- **Trend and Time Analysis:** Historical diagramming, seasonal calendars, daily activity charts, etc.

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COMMUNICATION IN DISASTER MANAGEMENT

Basic Steps in Communication:

- Forming of communicative intent
- Message composition
- Message encoding
- Transmission of signals
- Reception of signals
- Message decoding
- Interpretation

Importance of communication in disaster risk reduction

1. Communication promote preparedness for disasters:

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

2. Communications provide early warnings signals of disasters

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

3. Communication facilitates proper response to disasters:

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

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

Steps to Effective Communication

- Use standard terminologies when communicating-risks, disaster, coping, resilience, vulnerable, etc.
- Request and provide clarifications when needed- allow/encourage the beneficiaries to respond to issues they are not sure of.
- The communicator should also be well informed about the situation of 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
- Use proper order when communication information.

Barriers to Effective communication

- In emergency situations, communication breakdowns between potential victims and first responders can have dire consequences including unnecessary pain, misdiagnoses, drug treatment errors, unnecessarily long hospital stays and even death.
- Language barriers often exist when first responders and receivers have difficulty talking to people who speak a different language.
- Many areas have people who speak many different languages. Also, first receiver may come from other countries to help.
- In addition, communication may be difficult when people are under intense stress, which is inevitable during an emergency

- Non-Focus on the issue at hand, not being attentive
- Avoid interruption, show interest in what is being said
- Avoid being judgemental but make provision for feedbacks
- Pay attention to non-verbal communication
- Be conscious of individual differences
- Keep stress in check but be assertive

Disaster Risk Communication

Disaster risk communication helps to provide the public with information about the effects of disaster, and how actions may affect the outcome of the disaster. In other words it helps to inform the public about a potential disaster situation to enable people make informed choices. 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.

Effective Disaster Communication

- Effective risk communication requires the alignment of complex factors, including trust between the communicator and the audience(s), audience involvement, and emotional responses to risk.
- Trust in institutions and organisations should be considered in developing disaster risk communication messages and the need to reach out effectively to special needs of the target groups is necessary to

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provide insight on crafting messages for and understanding the behaviour of children, the elderly and disabled, those with literacy difficulties, activists, and minority racial and ethnic groups.

- Some specific principles related to effective risk communication include:
  - An understanding of the characteristics of an audience is essential to developing effective risk communication efforts;
  - The how, when, and by whom a message is delivered impacts its effectiveness
  - Communicators must continually adapt to changing situations;
  - Using the preparedness approach like games, interactive discussion groups or teaching make a proposal of how you can effectively increase knowledge or preparedness behaviour of the target group on disaster management; and
  - Promotion of discussion group approach to general disaster preparedness is more effective than the simple provision of written information.

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.
   i. 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.
   ii. 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

Definition of Crisis

- We can refer to crisis as any situation in which the individual perceives a sudden loss in his/her ability to solve a particular problem, and to cope with the situation.

- Crisis is how an individual reacts to a stressful life experience that affects his/her stability and ability to cope or function.

- It is a period of transition in the life of an individual, family or group, which serves as a turning point in their lives, and which may be seen as a challenge or a threat, a "make or break" new possibility or risk, a gain or a loss, or both simultaneously.

Instances of Crises

Most crises are part of the normal range of life experiences that most people can expect, and most people will recover from crisis without professional intervention. However, there are crises outside the bounds of a person's everyday experience or coping resources which may require **experts'** help to achieve recovery.

- Instances of crisis may include natural disasters, sexual assault, criminal victimisation, mental illness, suicidal thoughts, homicide, a drastic change in relationships and so on.
- Most severe outcomes of a crisis are suicide, homicide, **running away**, physical harm, psychosis or a family breaking apart.

Four stages of a crisis reaction:

(a) initial rise of tension from the emotionally hazardous crisis precipitating event,
(b) increased disruption of daily living because the individual is restricted and cannot resolve the crisis quickly,
(c) tension rapidly increases as the individual fails to resolve the crisis through emergency problem-solving methods, and
(d) the person goes into depression or mental collapse or may partially resolve the crisis by using new coping methods.

Defining Features of a Crisis

- A triggering event or long term stress
- The individual experiences distress
- There is loss, danger, and/or humiliation
- There is a sense of uncontrollability
- The events feel unexpected
- There is disruption of routine
- The distress continues over time (from about 2 – 6 weeks)

Counselling

Counselling is a personal, face to face, relationship between two people in which the counsellor, by means of the relationship and his special competencies, provides a learning situation in which the counselee, a normal sort of person, is helped to know himself and his present and possible future situations so that he can make use of characteristics and potentialities in a way that is both satisfying to himself and beneficial to society, and further, can learn how to solve future problems and meet future needs

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Crisis Counselling

Crisis counselling occurs when a client who is destabilised engages the services of a counsellor. The person is unable to cope with events in his/her life and, consequently, may be wracked by destructive feelings of self-doubt, anxiety, or guilt and may be engaging in hurtful behaviours. This crisis needs immediate attention otherwise there is the risk of further personality or behavioural deterioration.

The goals of crisis counselling can be summarised as, to:

- help the person return to his usual level of functioning;
- decrease anxiety; help people who are in crisis recognise and correct behaviours and cognitive distortions.
- teach crisis-solving techniques; and,
- give more assistance after immediate help is received.
- safety: ensures the individual is safe, any risk has been reduced and resources, if available, have been provided.
- stability: ensures the individual is stable and has a short-term plan which includes mastery of self and the emergency or disaster situation.
- connection: helps connect the individual to formal and informal resources and support. If resources are supports are not readily available, crisis counselling helps the individual pursue potential natural supports/resources.

Characteristics of Effective Counseller

Effective crisis counsellors should possess characteristics such as:

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

General Steps in Crisis Counselling

First Contact

In the first contact, it is useful to get personal information of the client and not be subjected to a lengthy intake evaluation. The counsellor should try to set the person at ease, clarify the task and invite him/her to talk. A good crisis counsellor is a good listener and more active. The crisis counsellor clarifies, reassures, educates, and offers advice on anxiety, depression, agitation or sleeplessness since they are at levels that severely impair functioning or make the crisis intervention impossible.

Long- and Short-Term Goals

In the midst of a crisis, people lose perspective. They are flooded with thoughts and feelings. Such persons have difficulty setting priorities and as a result they tend to get very concerned about things they cannot deal with and tend to avoid or ignore the more immediate concerns of the moment that they can deal with. For this reason, it is often useful to help them to organise their thoughts into two sets of goals - a set of short-term goals and a set of long-term goals.

Short Term Goals include calming down, trying to come to terms with their intense fear, talking about what has just happened to them, getting shelter for the night, having something to eat, etc.

Long Term Goals include getting into a long-term and normal counselling, looking for a job, finding permanent housing, etc. The crisis counsellor needs to be very active and directive in helping the person sort out these two types of goals and then in attending, in a very practical way, to achieving the short term goals and making a plan to attend to the long-term goals.

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Making a plan

People in crisis have trouble concentrating, thinking straight, using good judgment, and setting priorities. It is often helpful for the counsellor to take notes while talking to the client to keep track of all the information and to have a list of topics to remind him/her (counsellor) to cover during the interview.
At the end of the session, it is often very useful to actually write up a plan for the person to follow and send him/her away with the plan in their hand. It is best to prepare the plan with the person's collaboration to number each of the points and to format it so that it is easy to read.

Termination
Crisis counselling is, by its nature, very brief. Many interventions take place entirely in one session. It is important to conduct the session as a single session treatment. The crisis intervention should end with a concrete plan for the person to follow. The plan should be written and given to the person. The counsellor should make any and all referrals that might be necessary.

CAPACITY BUILDING or CAPACITY DEVELOPMENT

- The capacity development includes training programs, curriculum development, large- scale awareness creation efforts, and carrying out regular mock drills and disaster response exercises.
- The capability to implement, enforce, and monitor various disaster mitigation measures has to be improved at all levels from the local to the higher levels of governance.
- It is also strengthening the DRR governance at all levels to better manage risk and to make the governance systems more responsive.
- 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 Measures:

- Any physical construction to reduce or avoid possible impacts of hazards or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems.
- Undertaking necessary structural measures is one of the major thematic areas for action for disaster risk reduction and enhancing resilience.
- These consist of various physical infrastructure and facilities required to help communities cope with disasters.
- The implementation of these measures is essential to enhance disaster preparedness, a component of Priority-4 of the Sendai Framework.
- It is also an important component of investing in disaster risk reduction for resilience, which is Priority-3 of Sendai Framework

Non-Structural Measures:

- Any measure not involving physical construction that uses knowledge, practise or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education.
- Sets of appropriate laws, mechanisms, and techno-legal regimes are crucial components in strengthening the disaster risk governance to manage disaster risk, which is Priority-2 of the Sendai Framework.
- These non-structural measures comprising of laws, norms, rules, guidelines, and techno-legal regime (e.g., building codes) framework and empowers the authorities to mainstream disaster risk reduction and disaster resilience into development activities.

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- The central and state governments will have to set up necessary institutional support for enforcement, monitoring, and compliance.

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 (equipment, technical assistance, training and knowledge transfer) have had a very mixed record of success.
- Sometimes the instruments are the problem (they may simply be the wrong answer, based on a poor diagnosis of needs and options).
- Sometimes the problem is the way in which the instruments are used (supply driven by development partners rather than driven by sufficient domestic demand.
- Finally, it is sometimes the broader circumstances that are not conducive for CD) 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, and that more focus on capacity development is required.
- Selection of key capacity issues to be included in the ongoing policy dialogue, in monitoring, or as indicators.
- Decision about if and how development partners can support capacity development (CD) processes of partners.

How to assess capacity?

There are many different ways to assess organizational or system capacity, and there are numerous tools and instruments that can be used to diagnose different aspects of organizational 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 predefined 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 future capacity 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 organizations.** 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.

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STRENGTHINING CAPACITY FOR RISK REDUCTION

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

a) 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 centre staff and Disaster Management Officers at various levels
b) Strengthening the Disaster Response Force
c) Setting up a Decision Support System (DSS) and Emergency Operation Centers to integrate and analyze information from multiple sources in an integrated geo-spatial system.

2.Technical support for risk reduction and response preparedness:
To finance activities such as:

a) 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
b) River Morphology Study for some key rivers impacted by the disaster and to analyze and identify critical protective infrastructure works needed for river bank strengthening
c) 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
d) 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
e) 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 recover

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MODULE 5

COMMON TYPES OF DISASTERS IN INDIA

Natural Disasters:

1. **Droughts**

- 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 salinization of soil and groundwater decline, increased pollution of freshwater ecosystems and regional extinction of animal species.

2. **Floods**

- 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 produce.
- Sometimes, water remains standing over large areas for long span of time hampering the Rabi crops
- 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.

3. **Tropical Cyclones:**

- The major natural disaster that affects the coastal regions of India is cyclone and as India has a coastline of about 7516 kms, it is exposed to nearly 10 percent of the world's tropical cyclones. About 71 percent of this area is in ten states (Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Puducherry, Andhra Pradesh, Orissa and West Bengal). The islands of Andaman, Nicobar and Lakshadweep are also prone to cyclones.
- 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. On an average, five or six tropical cyclones occur every year, of which two or three could be severe. Most cyclones occur in the Bay of Bengal followed by those in the Arabian Sea and the ratio is approximately 4:1.

4. **Heat Waves:**

- 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 north western 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

5. **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.

6. Thunderstorm, hailstorm, dust storm

- As winter season transforms into spring, the temperature rises initially in the southern parts of India, giving rise to thunderstorms and squally weather which are hazardous in nature. While the southernmost part of the country is free from dust storms and hailstorms, such hazardous weather affects the central, north eastern, north and north western parts of the country. The hailstorm frequencies are highest in the Assam valley, followed by hills of Uttarakhand, Jharkhand and Vidarbha Maharashtra. However, thunderstorms also occur in Kolkata, Delhi, Jaipur and Ahmedabad. Tornadoes are rare in India but some of them are quite devastating

7. Earthquakes

- The Indian sub- continent situated on the boundaries of two continental plates is very prone to earthquakes. Some of the most intense earthquakes of the world have occurred in India. Fortunately, none of these have occurred in any of the major cities. According to latest seismic zoning map brought out by the Bureau of Indian Standard (BIS), over 65 percent of the country is prone to earthquake of intensity Modified Mercalli Intensity Scale (MSK) VII or more.

- India has been divided into four seismic zones according to the maximum intensity of earthquake expected Of these, zone V is the most active which comprises of whole of Northeast India, the northern portion of Bihar, Uttarakhand, Himachal Pradesh, J&K, Gujarat and Andaman & Nicobar Islands.

- 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.

8. Landslides

- 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 western ghat.
- 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.
- 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.

9. Tsunami

- Tsunamis and earthquakes happen after centuries of energy build up within the earth. 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.
- 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 is 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 non-seismic event also such as a landslide or impact of a meteor.
- Characteristics: Tsunami in the deep ocean may have very long waves length of hundred of kilometer and travels at about 800 km per hour, but an amplitude of only about 1 km. It remains undetected by ships in the deep sea. However when it approaches the coast its wavelength diminishes but amplitude grows enormously, and it takes very little time to reach its full height. Computer model can provide tsunami arrival, usually within minutes of the arrival time. Tsunamis have great erosion potential, stripping beaches of sand, coastal vegetation and dissipating its energy through the destruction of houses and coastal structure.
- For Tsunami to hit the Indian coast according to INCOIS, it is necessary that the earthquake of magnitude more than 7.0 on Richter scale should normally occur. The possible zones for such an event to occur are Andaman - Sumatra or Makran (Pakistan). Not all the major eqrthquakes are Tsunamigenic

<u>Manmade Disasters:</u>

1. 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.

- 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.

2. Stampede:

- The term stampede is applied to a sudden rush of a crowd of people, usually resulting in many injuries and death from suffocation and trampling. 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.

- Causes: 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**

3. **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.

4. **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."

5. **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.

6. **Mine Accidents:**

- 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.

- 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,

7. **Nuclear Disasters:**

- Nuclear emergency /Disaster is caused due to an extraordinary release of radioactive material or radiation either in the operation of nuclear reactors or other nuclear events like explosion of a Radiological Dispersal Device (RDD) or Improvised Nuclear Device (IND) or explosion of a nuclear weapon. It is accompanied with sudden release of harmful radiations or radioactive materials or both together in to the environment.
- Nuclear emergency may be encountered in the following situations: Intentional use of nuclear weapons in the event of war: Nuclear attacks may make use of nuclear weapons, which are extremely destructive and powerful enough to destroy an entire city.
- Accidents in nuclear power project: The nuclear Power Plants take care of safety by Engineered safety features by design and redundancy in safety systems to prevent any mal-operations and to bring the system to a safe shut down in case of any abnormalities. However, in case of a major malfunction, there is a remote possibility of release of radioactivity/ radiation to the environment. The area affected would depend on the amount of the release, and wind direction, speed and weather conditions.

8. Epidemics in India:

- 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, diarrheoa 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, overcrowding, biological conditions in addition to ecological factors.

DISASTER MANAGEMENT IN INDIA

- A permanent and institutionalised setup for DM was **initialised in India in the early 1990s.**
- •A few instances that prompted institutionalisation included the declaration of **1990 as the 'International Decade for Natural Disaster Reduction'** (IDNDR) by the UN General Assembly, the Latur (1993) and Bhuj (2001) earthquakes, the Orissa super cyclone (2001), and so on.
- •Institutionalised activities in India for DM started with the setting up of **Disaster Management Cell under the Ministry of Agriculture**.
- •This followed the report of the **J.C. Pant Committee**, constituted to draw up a systematic, comprehensive and holistic approach towards disasters.
- •From a relief through financial aid, the policy evolved into a **holistic DM approach**.
- •**In 2002** the DM Division was shifted from Ministry of Agriculture to **Home Affairs (MHA),** and an institutionalised and hierarchical structure was established for DM.
- •Under this structure, the DM Division is headed by **Joint Secretary (DM) in MHA**. The Joint Secretary (DM) is assisted by three Directors, with a host of officials including Under Secretaries, Section Officers, Technical Officers, Senior Economic Investigators, Consultants and other supporting staff.
- •The Division is **overseen by the Secretary (Border Management), Home Secretary, Minister of State and the Home Minister**.
- •The focus of DM now shifted to early warning systems, forecasting and monitoring of various hazards

Present DM Structure

- •The present DM Structure in India has National Disaster Management Authority **(NDMA)** at the helm.
- •The **Prime Minister heads NDMA**.
- •The State Disaster Management Authorities **(SDMA)** functions under the NDMA. This is followed by district and local level authorities.
- •The activities of NDMA are also supplemented by the **National Crisis Management Committee**.
- •A **number of nodal ministries** are identified for different types of disasters, who function under the overall guidance of the MHA. Thus, there are now various levels of institutional setup within the DM framework.

LEGAL ARRANGEMENTS IN INDIA ON DISASTER MANAGEMENT

THE DISASTER MANAGEMENT ACT, 2005

- •The Disaster Management Act was passed on **23 December 2005**, by the Government of India. The Act was a remarkable step towards holistic disaster management.

- •It lays down the **institutional, legal, financial and coordination** mechanism at various levels—National, State, District and Local Levels.
- •Rather than a response and relief-centric approach, the Act provides for a **proactive and comprehensive mindset** towards disaster management.

The highlights of the Act include:

- •Creation of a **policy, legal and institutional framework** that is backed by statutory and financial support.
- •Integrating the **disaster management concerns of various sectors** into the developmental process and mitigation measures.
- •Involving in a continuous and integrated process of **planning, organising, coordinating and implementing disaster management policies** and plans in a holistic, community based participatory, inclusive and sustainable manner.

Authorities Under the Act

- •The Act provides for setting up of **NDMA, SDMAs, DDMAs** Executive Committees at national and state levels, National Institute of Disaster Management **(NIDM)** which engages in capacity building, and the National Disaster Response Force **(NDRF).** The various Ministries and Departments are also expected to draw up their own plans within the general guidelines of the National Plan.

•Other provisions of the Act include:

1. 1.Provisions for financial mechanisms like **creation of funds** for response,
2. 2.Setting up of **National Disaster Mitigation Fund** and similar funds at various levels, and
3. 3.Providing **specific roles to local bodies** in disaster management.

INSTITUTIONAL ARRANGEMENTS IN INDIA

National Disaster Management Authority (NDMA)

- The National Disaster Management Authority (NDMA) was initially constituted on May 30, 2005 under the Chairmanship of Prime Minister
- The NDMA has been mandated with laying down policies on disaster management and guidelines which would be followed by different Ministries, Departments of the Government of India and State Government in taking measures for disaster risk reduction.

- It has also to laid down guidelines to be followed by the State Authorities in drawing up the State Plans and to take such measures for the management of disasters, Details of these responsibilities are given as under: -

1. Lay down policies on disaster management;
2. Approve the National Plan;
3. Approve plans prepared by the Ministries or Departments of the Government of India in accordance with the National Plan;
4. Lay down guidelines to be followed by the State Authorities in drawing up the State Plan;
5. 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;
6. Coordinate the enforcement and implementation of the policy and plan for disaster management;
7. Recommend provision of funds for the purpose of mitigation;
8. Provide such support to other countries affected by major disasters as may be determined by the Central Government;
9. 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;
10. Lay down broad policies and guidelines for the functioning of the National Institute of Disaster Management.

- Besides the nine members nominated by the Prime Minister, Chairperson of the Authority, the Organisational structure consists of a Secretary and five Joint Secretaries including one Financial Advisor. There are 10 posts of Joint Advisors and Directors, 14 Assistant Advisors, Under Secretaries and Assistant Financial Advisor and Duty Officer along with supporting staff.

National Executive Committee

- NEC is constituted as per Section 8 of the Act.
- •It assists NDMA in the performance of its functions.
- •It is the responsibility of the NEC to prepare the National Plan for Disaster Management.
- •This should be based on the broad guidelines of the National Policy on Disaster Management.
- •The NEC also monitors the implementation of the various guidelines issued by the NDMA.
- As per **Section 10** of the Act, NEC has the responsibility to:
  - □Act as the **coordinating and monitoring** body for DM,
  - □Prepare a **National Plan**,
  - □Monitor the **implementation of National Policy**, etc.

- •The **Home Secretary is the ex-officio Chairperson of NEC**. Other members include Secretaries to the Government of India in the Ministries or Departments of Agriculture, Atomic Energy, Defence, Drinking Water Supply, Water Resources, Environment and Forest, Finance (Expenditure), Health, Power, Rural Development, Urban Development, Science and Technology, Space, Telecommunication.

State Disaster Management Authorities (SDMA)

- •**Section 23** of the Act provides for constitution of SDMAs and DDMAs in all states and Union Territories.
- •The SDMAs are **headed by the Chief Minister** of the respective states.
- •The SDMA lays down **policies and plans for DM pertaining to the State**, in accordance with the guidelines laid down by the NDMA.
- •It is the responsibility of SDMA to coordinate activities like:
  - ✓ □**Implementation of the State Plan**,
  - ✓ □Recommendations regarding **provisioning of required funds** for mitigation and preparedness measures, and
  - ✓ □**Reviewing the developmental plans** of various departments of the State so that there is a harmonious integration of activities leading to prevention, preparedness and mitigation of disasters.
  - ✓

State Executive Committee (SEC)

- •**Section 20** of the Act prescribes establishing of SECs.
- •The SEC is **constituted by the State Government** to assist in the functions of the SDMA.
- •The SEC coordinates and monitors the **implementation of the National Policy, the National and State Plans**.
- •The SEC is **headed by the Chief Secretary to the State Government**. The Chief Secretary is assisted by four other Secretaries of such departments as decided by the State Government.
- •As per provisions of **Section 22** of the Act, the responsibility of SEC includes coordinating and monitoring the implementation of the National Policy and Plan, and the State Plan.

District Disaster Management Authority (DDMA)

- •**Section 25** of the Act provides for constitution of DDMAs at the district level.
- •**All districts** are expected to have DDMAs.
- •The DDMA is **headed by the District Collector**, Deputy Commissioner or District Magistrate.
- •The **Co-chairperson would be an elected representative** of the local authority.

- •Other members of DDMA include the CEO of the District Authority, Superintendent of Police, Chief Medical Officer and two district level officers as designated by the State Government.
- •The responsibility of DDMA includes:
  - ✓ □Acting as the planning, coordinating and implementing body for **DM at the District level,**
  - ✓ □Taking all the required measures for DM in accordance with **the guidelines laid down by the NDMA and SDMA**, and
  - ✓ □Ensuring that all the **guidelines** and directives provided by the Departments at the **State and District Level are followed as intended**.

National Institute of Disaster Management (NIDM)

- •The National Centre for Disaster Management (NCDM) was **established in New Delhi**, within the Indian Institute for Public Administration (IIPA) campus in **1995**.
- •It was established in the backdrop of the International Decade for Natural Disaster Reduction (IDNDR).
- •The NCDM was on **October 16, 2003 upgraded** and designated as the National Institute of Disaster Management **(NIDM).**
- •The responsibilities of the Institute are contained in Section 42 (Chapter VII) of the Act.
- •A few of the responsibilities include:
  - developing **training modules**,
  - undertaking **research and documentation** in the area of DM,
  - organising **training programmes**,
  - undertaking and **organising various study courses, conferences, lectures and seminars** for promoting and institutionalising disaster management,
  - **publication** of journals, research papers, books, etc.
- •The **Union Home Minister is the President** of the Institute, with 42 general body members.
- •The Institute is **headed by a Director**, who is assisted by faculty and staff.
- •Presently the Institute has **four academic divisions:**
  1. Geo-Hazard Division
  2. Hydro-met Hazard Division
  3. Policy Planning and Cross Cutting Issues Division
  4. Response Division

National Disaster Response Force (NDRF)

- •**Section 44** of the Act contains the provisions pertaining to the National Disaster Response Force (NDRF).
- •The force has been constituted by **upgradation/conversion of eight standard battalions** (consisting of over 1000 members each) of Central Para Military Forces.
- •This included two battalions each from the Border Security Force (BSF), the Indo—Tibetan Border Police (ITBP), the Central Industrial Security Force (CISF) and Central Reserve Police Force (CRPF).
- •They were converted as a **specialist force to respond to disaster** or disaster like situations.
- •The eight battalions consist of **144 specialised teams** that are trained in dealing with various types of natural disasters.
- •While all these eight battalions are being trained in natural disasters, **four of them are additionally trained for handling Chemical, Biological, Radiological and Nuclear (CBRN) disasters**.
- •Out of the 144 teams **72 are trained to cater to disasters-related CBRN**.
- •Each NDRF battalion consists of over **1000 personnel organised in 18 teams comprising of 45 personnel**.
- •All the personnel are equipped and trained for rendering effective response to any threatening disaster situation or disaster, either natural or manmade.
- •These battalions are **stationed in eight different regions** of the country, based on vulnerability.

- •As per the Act, the general superintendence, direction and **control of NDRF are vested with the NDMA.**
- The NDRF units will also impart basic training to all the stakeholders identified by the State Governments in their respective locations.
- Further, a National Academy will be set up to provide training for trainers in disaster management and to meet related national and international commitments

NATIONAL POLICY ON DISASTER MANAGEMENT

- The National Policy on Disaster Management (NPDM) has been prepared in tune with and in pursuance of the Disaster Management Act, 2005. National Policy on Disaster Management (NPDM) will provide the framework/roadmap for handling disasters in a holistic manner.

- The Policy covers all aspects of disaster management covering institutional, legal and financial arrangements; disaster prevention, mitigation and preparedness, techno-legal regime; response, relief and rehabilitation; reconstruction and recovery; capacity development; knowledge management and research and development.

- It focuses on the areas where action is needed and the institutional mechanism through which such action can be channelized.

- The NPDM addresses the concerns of all the sections of the society including differently abled persons, women, children and other disadvantaged groups. In terms of grant of relief and formulating measures for rehabilitation of the affected persons due to disasters, the issue of equity/inclusiveness has been accorded due consideration.

- The NPDM aims to bring in transparency and accountability in all aspects of disaster management through involvement of community, community based organizations, Panchayati Raj Institutions (PRIs), local bodies and civil society.

Vision: 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.

Approach: A holistic and integrated approach will be evolved toward disaster management with emphasis on building strategic partnerships at various levels. The themes underpinning the policy are:

- Community based DM, including last mile integration of the policy, plans and execution.
- •Capacity development in all spheres.
- •Consolidation of past initiatives and best practices.
- •Cooperation with agencies at national and international levels.
- • Multi-sectoral synergy.

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 SENDAI FRAMEWORK

The Sendai Framework for Disaster Risk Reduction 2015-2030 outlines seven clear targets and four priorities for action to prevent new and reduce existing disaster risks: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience and; (iv) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.

It aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.

The Framework was adopted at the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan, on March 18, 2015.

Targets

- Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared to 2005-2015
- Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015
- Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030
- Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030
- Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020
- Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030
- Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030

Guiding Principles

1. Primary responsibility of States to prevent and reduce disaster risk, including through cooperation
2. Shared responsibility between central Government and national authorities, sectors and stakeholders as appropriate to national circumstances
3. Protection of persons and their assets while promoting and protecting all human rights including the right to development
4. Engagement from all of society
5. Full engagement of all State institutions of an executive and legislative nature at national and local levels
6. Empowerment of local authorities and communities through resources, incentives and decision making responsibilities as appropriate

7. Decision-making to be inclusive and risk-informed while using a multi-hazard approach
8. Coherence of disaster risk reduction and sustainable development policies, plans, practices and mechanisms, across different sectors
9. Accounting of local and specific characteristics of disaster risks when determining measures to reduce risk
10. Addressing underlying risk factors cost-effectively through investment versus relying primarly on post disaster response and recovery
11. «Build Back Better» for preventing the creation of, and reducing existing, disaster risk
12. The quality of global partnership and international cooperation to be effective, meaningful and strong
13. Support from developed countries and partners to developing countries to be tailored according to needs and priorities as identified by them

Priorities for Action

There is a need for focused action within and across sectors by States at local, national, regional and global levels in the following four priority areas.

- **Priority 1: Understanding disaster risk** : Disaster risk management needs to be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment
- **Priority 2: Strengthening disaster risk governance to manage disaster risk**: Disaster risk governance at the national, regional and global levels is vital to the management of disaster risk reduction in all sectors and ensuring the coherence of national and local frameworks of laws, regulations and public policies that, by defining roles and responsibilities, guide, encourage and incentivize the public and private sectors to take action and address disaster risk
- **Priority 3: Investing in disaster risk reduction for resilience**: Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment. These can be drivers of innovation, growth and job creation. Such measures are cost-effective and instrumental to save lives, prevent and reduce losses and ensure effective recovery and rehabilitation
- **Priority 4 Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction**: be strengthened for more effective response and ensure capacities are in place for effective recovery. Disasters have also demonstrated that the recovery, rehabilitation and reconstruction phase, which needs to be prepared ahead of the disaster, is an opportunity to «Build Back Better» through integrating disaster risk reduction measures. Women and persons with disabilities should publicly lead and promote gender-equitable and universally accessible approaches during the response and reconstruction phases