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FUNDAMENTALS OF DISASTER MANAGEMENT

DEM 104

SELF-LEARNING MATERIAL

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FUNDAMENTALS OF DISASTER MANAGEMENT (DEM104)

UNIT-1: UNDERSTANDING DISASTER

UNIT STRUCTURE

1.1 INTRODUCTION

There is no precise definition of DISASTER, addressing entire process of disaster phenomenon. Different groups of workers defined disaster in different ways.

In fact, disaster is the outcome of a complex process. Hence, managing a disaster is a difficult task. It is essential to understand the mechanism and parameters involved in the process of occurrence of disaster prior to formulation of Disaster Management plans.

In this chapter, we shall discuss about different approaches of understanding the concept of disaster and parameters involved in the process of occurrence of a disaster. This chapter will focus on the importance of ***Disaster Risk Assessment*** and ***Disaster Risk Reduction*** to mitigate loss and damage. The issues related to IDNDR programme and different aspects of disaster management will also be highlighted in this chapter.

1.2 OBJECTIVES

The purpose of this unit is to outline

- Different concepts of disaster.
- Parameters involved in the process of occurrence of disaster.
- Probable causes of occurrence of a disaster and their remedies.
- Concept of risk and importance of risk analysis in disaster management planning.
- Other issues related to disaster phenomena.
- Details about IDNDR programme

1.3 CONCEPT OF DISASTER

1.3.1 WHAT IS DISASTER?

People from different disciplines have been trying to define ***Disaster*** in different ways. Most of the definitions of ***Disaster*** addressed the issues related to damaging events, loss and damage to life and property, affects on social system, and community needs.

Flood hazard of Assam
Photo: Centre for disaster Management, Tezpur University

Few common definitions of disaster are presented below

- The Oxford Dictionary defined disaster as *"Sudden or great misfortune, calamity"*
- The Webster's Dictionary defined disaster as *"A sudden calamitous event producing great material damage, loss and distress"*
- ADB handbook on disaster management defined disaster as *"An event, natural or man-made, sudden or progressive, which impacts with such severity that the affected community has to respond by taking exceptional measures"*

[Source: *Handbook on Disaster Management, ADB Publication**]***

1.3.2 DIFFERENT APPROACHES

The ***conventional*** and ***dominant approaches*** to describe disaster phenomena are

- Natural Science Approach
- Applied Science Approach

The Natural Science Approach equates disasters with devastating natural phenomena and describes disaster as a misfortune or Act of God. According to this approach, disaster is an accident, unforeseen consequence of unpredictable and uncertain natural force, inevitable occurrence – over which we have no control.

In this approach, there is no scope for damage mitigation planning.

On the other hand***, the Applied Science Approach*** focuses on determination of magnitude of disaster based on magnitude of loss and damage, associated with devastating phenomena.

While the first approach considers the triggering forces i.e., natural phenomena like earthquake, cyclone etc. as disasters; the second approach deals with outcome of the disaster phenomena. Both the approaches have certain limitations in describing the complete process of disaster and its management.

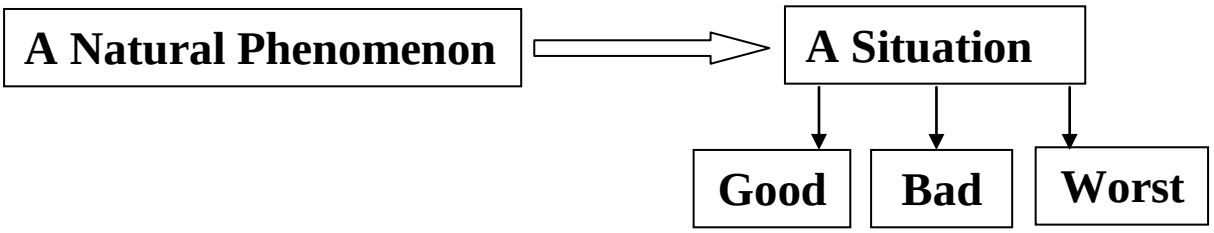
The applied science approach recommends short time emergency actions like, response and recovery to deal with crisis situations and has very little scope for risk management based on rectification of the causes of disasters. This approach gives stress on enhancing resistance of the exposures and physical structures for minimizing loss and damage.

Since 1960's, social scientists, anthropologists and development workers started thinking for an alternative ***Progressive Approach*** to describe disaster phenomena more precisely, considering the reasons behind damage and disruptions under the influence of natural forces. Going one-step ahead of dominant approaches, progressive approach tried to correlate the occurrence of disaster with some unresolved problems of development in our systems. The outcome of research works carried out by different groups since 1970's depicts a strong correlation between unsustainable development and occurrence of disasters.

The ***Holistic Approach*** considers both the external triggering force (natural or man-made) and internal negative factors of our systems responsible for occurrence of disasters.

Let us see some practical examples to understand the concept of holistic approach.

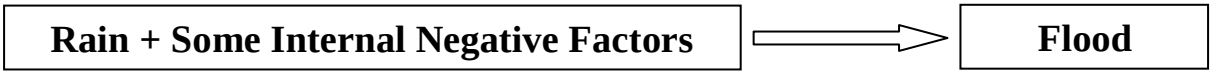
Any natural phenomenon can lead a good, bad or worst situation. Natural phenomena are not always responsible for occurrence of disasters.



Rain is a natural phenomenon. Rain can lead to flood damage or good harvest depending on some prevailing conditions/factors of our system.

Case 1

Case 2



Similarly, a moderate earthquake may or may not cause structural damage to a building. It depends on, how this building is constructed. A building may collapse under the impact of an earthquake on two conditions

- The magnitude of earthquake is extremely high or
- The building is constructed violating the IS codes for Earthquake Resistant Building.

Here, the second condition plays vital role in damage mitigation planning as the first one is beyond our control.

From the above examples, it is now clear that a natural phenomenon combined with some internal negative factors of a system cause damage and disruption to the system. The prevailing negative factors within our system play the role of catalyst between external triggering force and disaster.

1.4 CONCEPT OF HAZARD, VULNERABILITY AND CAPACITY

1.4.1 HAZARD

Hazard can be defined as *"A phenomenon or an event or an object, which has potential to cause damage and disruption to our life, property and environment".*

Or

"Anything which is harmful for our system or has the potential to cause damage and disruption to our normal pattern of life".

For example,

Excess rainfall may lead to flood hazard. Here rain is the main force of flood hazard. In absence of rain, there is no possibility of flood. Rainfall is a natural phenomenon.

Release of energy due to rupture in earth's crust may cause earthquake and subsequently damage to our structure. Here, released energy is the force of Earthquake Hazard. Earthquake is a natural phenomenon.

A bomb blast may cause severe damage to life and property depending on other local factors.

Here, bomb is an object and its blast is an event.

Leakage of poisonous gas can cause damage to our lives. Poisonous gas is harmful object and its leakage is harmful event.

Therefore, the primary component of disaster is the hazard, which may be a devastating natural phenomenon or harmful event or harmful object.

Sometime harmful exposures may play the role of hazards. For example, a weak and old building may collapse even in absence of any external triggering force like earthquake, resulting loss and damage to life and property. In this case, the building itself is a hazard.

Many people defined natural hazards in different ways. Few common definitions of natural hazards are *[Source: Natural Disasters by David Alexander]*

- ✓ "A naturally occurring or man-made geologic condition or phenomenon that presents a rise or is a potential danger to life or property" (American Geological Institute 1984).
- ✓ "An interaction of people and nature governed by the co-existent state of adjustment of the human use system and the state of nature in the natural events system" (White 1973).
- ✓ "Those elements in the physical environment [which are] harmful to man and caused by forces extraneous to him" (Burton and Kates 1964).

- ✓ "The probability of occurrence within a specified period of time and within a given area of a potentially damaging phenomenon" (UNDRO 1982).

Detail about assessment of natural hazards will be discussed in the subsequent chapters.

1.4.2 VULNERABILITY

If we repeat the examples of hazards, we shall able to understand that only hazards are not responsible for damage and disruption. Other factors are also involved in this process.

In absence of rain, there is no possibility of flood. There may not be heavy flood or flood damage in the event of heavy rain. For heavy flood or flood damage, there should be some unsafe conditions within our system, like poor carrying capacity of river, weak embankment, settlement in low-lying areas etc.

Similarly, an earthquake may not be the sole reason for damage of buildings and engineering structures. There should be some other reasons, which make the structures susceptible to earthquake hazard. The reasons may be related to violation of Indian Standard Codes for earthquake resistant structures like, testing of soil quality, proper earthquake resistant design, quality construction material, proper safety norms etc.

A bomb blast in open space without any exposures may not cause damage to life and property. There may be significant damage if it is a crowded place; if there is no monitoring system in place; if people are not alert etc.

The reasons behind possible disaster due to leakage of poisonous gas may be; violation of safety norms by the plant, plant is located in thickly populated area, people are not aware about safety norms, lack of awareness about precautionary measures etc.

Such unsafe conditions of our systems, which enhance the probability of loss and damage, are called ***Vulnerability.***

Vulnerability may be defined as *a set of prevailing or consequential unsafe conditions or negative factors, which reduces our ability to resist external hazards to minimize damage and disruption of the system or to cope with disaster situation.*

Proper assessment of vulnerability is essential to assess the risk and formulation of risk reduction plans of a system. In most of the times, we can not prevent natural hazards to avoid disasters. But, we can minimize the magnitude of loss and damage by either eliminating or reducing unsafe conditions of our systems.

Vulnerability assessment is a complex process. This is because one visible unsafe condition of our system may be the outcome of some hidden dynamic pressures. The unsafe conditions of a system may have some remote root causes.

To remove a single unsafe condition of our system, it is essential to find out the root causes of unsafe conditions and eliminate them by taking appropriate measures.

The detail about dimension and assessment of vulnerability factors will be discussed in subsequent chapters.

1.4.3 CAPACITY

Capacity means resources, means and strength required to improve our capability to reduce the risk of our system or cope with disaster situation.

Capacity building mechanism primarily involves reduction of vulnerability factors by developing adequate resources in terms of physical, material and living resources; inventing

suitable technology and methodology to deal with the problem areas; and enhancing the strength in terms of financial and other matters.

1.5 CONCEPT OF RISK

The word ***RISK*** implies the probability of damage, loss and other negative consequences in a system under the influence of a triggering force.

When a system is at high risk, we can expect maximum damage and disruption in the system if a hazard strikes the system.

1.5.1 PARAMETERS OF RISK

The first parameter is hazard

When a system is exposed to a specific hazard like flood or earthquake, it induces some sort of risk. If the system is prone to more hazards and magnitudes of hazards are high, the risk of the system goes higher.

Therefore, the Risk of a system is directly proportional to frequency and magnitude and other characteristics of the hazards, to which the system is exposed.

If there is no possible hazard or threat to a system, the risk of the system will certainly be zero. In practice, it is not possible make the risk of a system zero by eliminating its threats or hazards completely.

The second parameter is vulnerability of the system

More unsafe conditions of a system result more damage and disruption to the system under the influence of hazards. So, the risk of a system is also directly proportional to numbers of unsafe conditions or vulnerability factors of the system.

The combined impact of Hazard and Vulnerability to a system is called ***Specific Risk***. Both the parameters are primarily responsible for enhancing the disaster risk of our systems. In absence of one parameter i.e., "Hazard or Vulnerability", the Disaster Risk of a system becomes zero. In reality, it is not possible.

Third parameter

Third parameter of the Risk is the elements at risk.

If there is no resource or element in a system, there is no possibility of loss and damage, even in presence of external hazards.

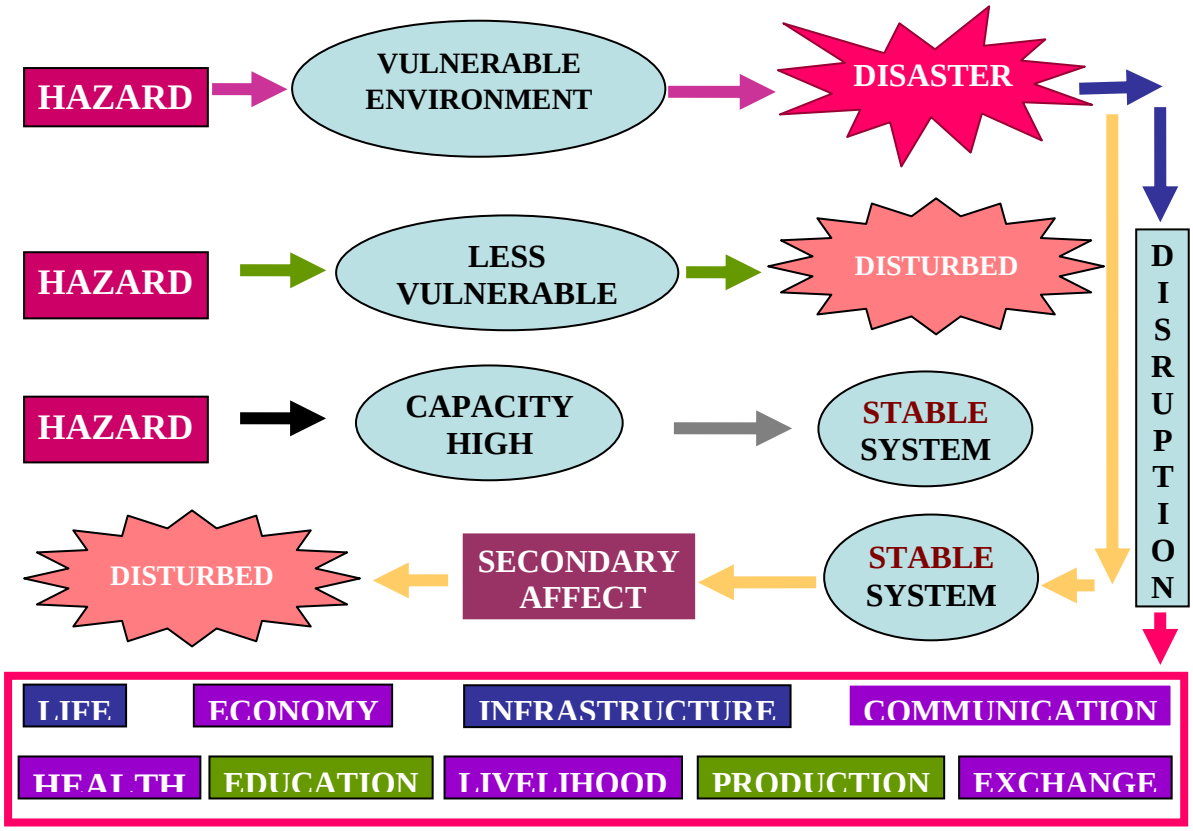
If a system has valuable physical and living elements but these are less susceptible to hazards; then also the risk of the system will be in lower side. In that case, probability of loss and damage to the system under the influence of external hazards will be low.

When the physical and living elements of a system are at high risk of damage under the impact of hazards, then disaster risk of the system will be very high.

Therefore, the disaster risk of any system depends on probable hazards to which the system is exposed; vulnerability of the system, and elements in the system which are at risk.

$$\text{DISASTER RISK} = \frac{\text{Elements at Risk} \times \text{Hazard} \times \text{Vulnerability}}{\text{Capacity}}$$

The diagrammatic representation of disaster risk of a system is presented below.



1.5.2 DISASTER RISK REDUCTION (DRR)

Disaster Risk Reduction is the first option of Disaster Management. Disaster Risk Reduction of a system means minimize the risk of the system either by preventing hazards or by reducing vulnerability factors.

Let us explain the disaster risk reduction (DRR) mechanism by considering above flow diagram

Suppose a place, like the state Assam, is located in high seismic zone. That means there is every possibility of occurrence of high magnitude earthquake in this locality at any time. Hence, one component of disaster risk for this place is **Earthquake Hazard**.

The loss and damage pattern in this region due to earthquake will depend on magnitude, epicenter ***(The location vertically above the focus of the earthquake)*** and depth of Earthquake. Determination of these factors in advance is not possible for earthquake hazard.

Hence, prevention of earthquake or early warning for occurrence of earthquake is also not possible. In this case, the DRR planning has nothing to do with occurrence of hazard. Only thing we should remember that, the entire area is exposed to earthquake hazard and planning for DRR should be made considering codes and norms for earthquake damage mitigation.

Now, let us consider three different locations of this region to determine risk factors of these locations.
Location 1: An Urban Area (Like Guwahati)
Location 2: One Semi Urban Area (Small town)
Location 3: One Village

For all these locations, common hazard is Earthquake.

For location 1, probable vulnerability/unsafe factors may be unplanned and haphazard developmental activities in the area, over population, overcrowded high-rise building, most buildings are not earthquake resistant, no fire safety provisions in the buildings, narrow roads, weak counter disaster resources (medical, fire service etc) ……

For location 2, vulnerability/unsafe factors, may be lack of proper planning, market area is overcrowded with population and unsustainable buildings, few private hospitals are not safe, market area is exposed to fire hazard but not equipped with fire safety machinery, in some specific areas of the town roads are narrow including market places, weak counter disaster resources etc.

For location 3, vulnerability/unsafe factors, may be few buildings are not safe, weak counter disaster resources etc.

Now we can assume that, the vulnerability factors of location 1 are much higher than other two locations. Location 2 has medium range of unsafe conditions and location 3 has minimum unsafe conditions.

Therefore, disaster risk of location 1 for earthquake hazard is very high. Risk of location 2 and 3 for earthquake hazard are medium and low respectively.

In location 1, there will be instant severe loss and damage of life, household assets, infrastructure, communication facilities, health care facilities etc. in case of a high magnitude earthquake. There may be secondary affects on physical and mental health, economy, livelihood, production, etc.

Compare to location 1, instant loss and damage in location 2 will be lower and negligible in location 3.

Now, we know the disaster risk factors of all three locations.

Location 1 needs a major action plan for its Disaster Risk Reduction.

Since, earthquake hazard is not predictable or preventable, only option to reduce disaster risk in this region is reduction of vulnerability/unsafe conditions by taking appropriate steps. The probable steps may be eviction and resettlement of unauthorized residents, demolition of weak and unauthorized buildings and infrastructure, retrofitting of weak buildings, widening of roads and lanes, improvement of counter disaster resources, imposition of suitable codes and norms etc.

We can take three types of actions for Disaster Risk Management (DRM) to mitigate loss and damage in our system.

Prospective DRM, by making all the elements of our system hazard proof. May be, all the buildings and infrastructure are earthquake hazard resistant.

Corrective DRM, by reducing unsafe conditions of the system like retrofitting of weak buildings *(taking additional measures to strengthen the weak structures)*.

Compensatory DRM, by providing incentives and other supports to weak families to take appropriate measures for DRR.

1.5.3 SELECTIVE MODELS

A number of models have been developed by different groups of workers to understand the complete process of disaster and its management. The popular models are

Contract-Expand Model **:** describes process of disaster phenomena
Disaster Crunch Model **:** focuses on causes of disasters
Disaster Release Model **:** focuses on remedial measures for mitigating disaster loss

Let us discuss the principles of these models briefly.

Contract-Expand Model *(Kotze & Holloway, 1996)*

This model is relevant to the progressive approach of disaster management and relates disasters with differential vulnerabilities of our systems. The model was used by the communities of South Africa to assess disaster risk, reduce disaster loss, and prepare them to cope with disasters. The basic principle of this model is based on the assumptions,

Assumption 1

"Disasters occur when a hazard exceeds a community's capacity to manage It". That means, when magnitude of hazard and vulnerability of the system go beyond the community's capacity to handle these. This assumption describes clearly the role of three components involved in the process of disaster and its management i.e., hazard, vulnerability and capacity.

Assumption 2

"All components of disaster risk reduction can be carried out concurrently, but with relative emphases". This assumption suggests, the risk reduction mechanism for any system has a number of components or steps, like assessment of parameters involved in the process of disaster, damage mitigation strategies etc. We can carry out all these activities simultaneously. But, these should be done systematically based on priority. For this, we must have knowledge on role of different parameters and their relationships.

Assumption 3

"Relative weighting of the activities depends on relationship between the Hazard and vulnerability of the community at risk and technical or operational mandate of the organizations involved". This assumption describes, the nature and weightage of different activities for disaster risk reduction depends on

- ✓ nature of external hazards and unsafe conditions of the vulnerable community.
- ✓ how the internal negative factors of the locality or community and external hazards are helping each other to cause maximum loss and damage to the system.
- ✓ nature of technical and organizational supports required for disaster risk reduction of the system.

Though this assumption is mainly based on social science approach, but it addresses all three stages of disaster management; pre, during and after a disaster.

Disaster Crunch Model *(Blaikie et al. 1994)*

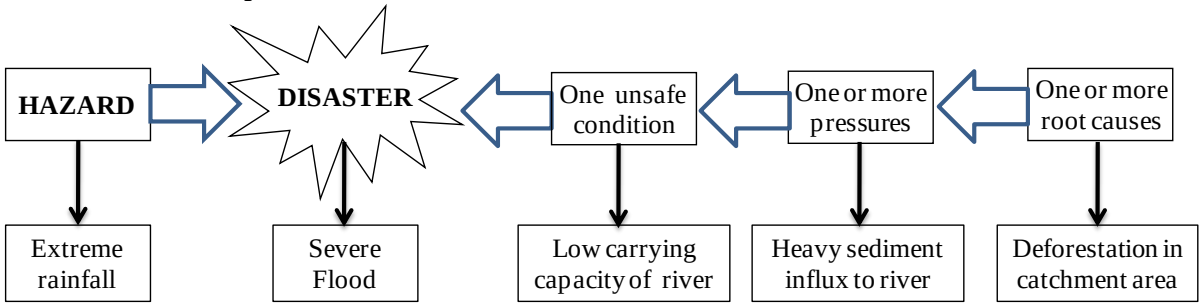
This model deals with the causes of disasters, based on the study of hazards and unsafe conditions, which make the communities ***vulnerable*** to hazards.
This model considers the differential vulnerability of our systems as the main reasons of disasters. These are rooted in our socio-political and socio-economic processes. According to the model, disaster may occur only when a hazard strikes a vulnerable community having many unsafe conditions. That means, the unsafe conditions or vulnerability of our own system dominate over external hazards in the process of disaster.

The model suggests in-depth analysis of differential vulnerability of a system for proper risk assessment and risk reduction planning. But, genuine vulnerability assessment is a complex process, as it is difficult to study the dynamic pressures and root causes of a single unsafe condition.

There are some visible or hidden root causes, which generate pressures on our system and subsequently create a local unsafe condition. Therefore, an unsafe condition of our system may not be solely responsible for occurrence of a disaster.

If we remove one local vulnerability factor of our system without removing its root causes, the pressure will remain same to the community and within short time the system will regain its original risk. In this case, temporarily we can get relief, but next time we may face more severe problems.

Let us see an example of this model to understand the causes of flood induced disaster.



Flow diagram of the progression of flood disaster

Using Disaster Crunch model, we can study the complete process of flood disaster systematically involving hazard, vulnerability, dynamic pressure and root causes of vulnerability. The prime conditions for river flood are

- ✓ The area is low-lying.
- ✓ There should be a river close to the area.

The hazard is certainly either continuous heavy rainfall or high intensity sudden rainfall in the area or in the catchment area of the river.

One possible unsafe condition for flood may be low carrying capacity of the river. The river may not have sufficient capacity to carry the runoff water in peak season. As a result, water migrates in the surrounding low-lying areas.

It is not possible to solve the problem of flood by considering this local vulnerability factor only. To find out a permanent solution, we need to address the reasons of decreasing trend of carrying capacity of the river.

There may be few reasons or dynamic pressures for this particular vulnerability factor like soil erosion in the catchment area, heavy sediment influx to the riverbed, poor economy etc. We cannot simply eliminate these pressures or unsafe condition without addressing their root causes.

What may be the root causes of soil erosion and sediment transport?

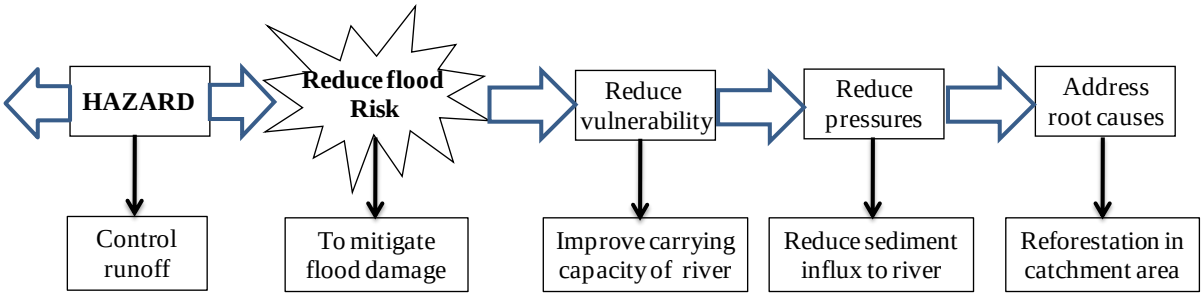
The possible root causes for soil erosion and sediment influx are deforestation in the upper catchment area, shifting cultivation in hill areas, other human activities in the carchment area, artificial landslide in the catchment area etc.

Like this, we can study the nature of hazard and progression of vulnerability factors by identifying local unsafe conditions, dynamic pressures and root causes of the unsafe conditions to understand the causes of disasters.

How we can minimize disaster risk of a system?

Disaster Release Model is useful to understand the principle of disaster risk mitigation.

Let us consider the same example, considered in the case of Disaster Crunch Model. We have already described the process if identifying the hazard characteristics, unsafe condition, dynamic pressure and root causes of flood disaster.



To reduce flood risk, we can either minimize probability of occurrence of hazard or reduce unsafe conditions by addressing root causes of the problems.

We cannot control rainfall. Therefore, we should try to reduce surface runoff of rainwater in upper catchment area to minimize the intensity of hazard and thereby reduction of flood risk in the lower catchment areas.

We can also minimize flood risk by reducing the vulnerability factors. Here, one specified vulnerability factor is low carrying capacity of river. We can remove this unsafe condition in two ways,

- We can improve the carrying capacity of river by dredging riverbed locally. This is a very short time measure and expensive also.

- We can reduce pressures like soil erosion and sediment transport by taking some corrective measures like, aforestation/reforestation in catchment areas, alternative agriculture policy to stop shifting cultivation, enforcement of land use regulation to stop unsustainable and harmful developmental activities in the upper catchment areas etc.

Like this, we can make hazard and location specific risk assessment and risk reduction plan by addressing probable threats, unsafe conditions, dynamic pressures and root causes of the problems.

The changing concepts of understanding disaster risk and risk reduction encouraging people to conduct in-depth research for new methodologies and techniques suitable for disaster risk mitigation.

1.6 APPROACHES TO STUDY THE NATURAL HAZARDS AND DISASTERS

So far, we have discussed in detail about different parameters of disaster risk and principles of risk reduction.

Now, the natural hazard induced disasters are no longer considered as natural disasters. Studies on ***Human-Environmental*** and ***Human-Ecological*** interferences are getting importance in disaster risk assessment and risk reduction planning.

Human interference to our natural environment is mainly responsible for increasing disaster risk of our platforms (Milete, 1980). According to Hewitt (1983), vulnerability is the critical determinant factor of risk and impact of natural hazard.

Most of the researchers are on the view that, disasters caused by natural hazards are social problem. The nature of disasters depends on geographical location and action of communities.

Now, study of natural hazards and disasters has become more complex and multidisciplinary. People from different disciplines are involved in this field of study. They have different views and approaches but a common agenda to find out genuine methodology for disaster Risk Reduction.

Let us see few common approaches of study of natural hazards and disasters. *(Source: Natural Disaster by David Alexander)*

Geographical approach *(after Harland Barrows 1923; Gilbert F. White, 1945)*

This approach of study specifically based on spatio-temporal distribution of hazards, vulnerability and impact of hazard, and adjustment processes to natural hazards.

Anthropological approach *(Torry 1979)*

This approach is focused on the study of finding out the role of disasters to socio-economic evolution of populations and destruction of civilizations. According to this approach, there is some limitation in the magnitude of disaster, beyond which the affected communities cannot manage or provide the victims the basic requirement for survival.

Sociological approach *(Russel R. Dynes, 1970; Enrico, L. Quarantelli, 1978)*

In this approach, the human attitude towards nature, socio-economic condition of the community, and affects of disasters to community and organizations are considered as determinants to study the vulnerability factors of the community and probability of damage and disruption to a system. This approach also considered the psychological affects of disasters, like, stress and trauma.

Development studies approach *(Chen et al. 1980; Davis 1978; Knott 1987)*

This approach deals with the post disaster problems relevant to relief and aid; relief camp management, refugee management; health care; food etc. This also shows the correlation between poverty and human vulnerability to natural hazards.

Disaster medicine and epidemiology *(Bolt et al. 1977; Beinin 1985; El-Sabh 1988)*

It is comparatively a new field of study to address the post disaster medical problems like, management of mass casualties, dealing with epidemic and communicable diseases, treatment of trauma patients etc.

Technical approach *(Bolt et al. 1977; El-Sabh & Murty 1988)*

This approach is focused on management of disasters from technical and engineering points of view, covering the geophysical and geomorphological aspects of hazards and disasters.

1.7 LEVELS OF DISASTER

The national guideline has categorized the level of disasters as Lo, L1, L2 and L3 and role and responsibility of different line departments to tackle disasters.

Level (0): It denotes the pre disaster period to be utilized for monitoring, documentation, prevention, mitigation and preparedness related activities. During this period, community to state level disaster management plans to be prepared. Training on different aspects of disaster management to be carried out during this period.

Level (1): It is the level of magnitude of the disasters that could be managed at the district level with the support and assistance from state and central government, as and when necessary.

Level (2): In this level, the district level agencies may not be able to manage the situation. It may require direct assistance and support from state level disaster management agencies, including mobilization of state counter disaster resources.

Level (3): It is the level of disasters, which is not manageable by district and state level disaster management agencies. In this case, direct assistance from the centre in terms manpower, equipment and fund will be required to control the situation.

1.8 INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION (IDNDR)

In view of the increasing trend of loss and damage to life and property due to disasters, particularly in the developing countries, the General Assembly of the United Nations designated the decade of 1090's (1990-1999) as the ***International Decade for Natural Disaster Reduction (IDNDR),*** at its 42nd Session on 11th December, 1987. The Secretariat of IDNDR was established at Geneva.

The US Academy of Sciences took initiative for this international programme in 1984.

The objective and goals of this programme are

- To develop concentrated international strategy and coordination to reduce loss and damage caused by the natural hazards, especially in developing countries.

- Enhancement of capacity of the developing countries for mitigation of disaster risk effectively and expeditiously. This includes assessment, prediction, prevention, mitigation of natural disasters; disaster resistant structure, early warning system etc.

- To formulate guidelines and strategies for proper application of existing scientific and technical knowledge in disaster management.

- Technology transfer and technical assistance; training and education; project demonstration etc.

In May 1994, the UN World Conference on Natural Disaster Reduction was held in Yokohama (Japan), to review the activities under this programme.

The INNDR Secretariat has also established close link with Fire Ecology Research Group and the Global Fire Monitoring Center in 1997, to improve effectiveness of early warning systems.

With the end of the IDNDR programme in 1999, the United Nations started another programme ***"International Strategy for Disaster Reduction*** **(ISDR)"** to carry out the activities on disaster management.

Though the outcome of IDNDR programme was not that much satisfactory, but it could be possible to establish vital link among political, scientific and technological communities for future programmes.

1.9 WHAT WE LEARNT FROM THIS UNIT?

There are many conventional approaches to describe the disaster phenomenon. The dominant approaches are the natural science approach and applied science approach. While natural science equates disaster with the natural phenomena, the applied science considers impact of hazards as disaster.

The holistic approach considers disaster as the outcome of combined affects of hazard (natural phenomenon) and vulnerability (unsafe conditions). This is the most useful approach for understanding the disaster risk of any system and risk mitigation planning.

The Disaster Crunch and Release Models are the useful tools for understanding the causes of disaster and process of disaster risk mitigation. To mitigate disaster risk of our systems, we have to either prevent the external hazards from striking our systems or reduce unsafe conditions of our systems. For this hazard assessment and identification of root causes of vulnerability factors are essential. There are three ways of disaster risk mitigation, prospective, corrective and compensatory.

The role and responsibilities of district, state and national levels disaster management agencies depend on level of disasters. In India, role of these agencies are categorized into four levels; Lo, L1, L2 and L3 depending on magnitude of disasters and capacity of these agencies to deal with disasters.

The United Nation's General Assembly designated the decade of 1990's as International Decade for Natural Disaster Reduction (IDNDR) to develop international strategies and cooperation for disaster risk mitigation and improving the capacities of different nations to deal with disasters.

1.10 PROBABLE QUESTIONS

1. What do you mean by Disaster?
2. Which model addresses the causes of disasters?
3. What are the parameters associated with Risk?
4. What do you mean by Vulnerability?
5. What is Level (3) of disaster?
6. What is ISDR?
7. Explain about disaster risk assessment and risk reduction planning.

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FUNDAMENTALS OF DISASTER MANAGEMENT (DEM104)

UNIT-2: HAZARDS

UNIT STRUCTURE

2.1 INTRODUCTION

Hazard is the primary and essential component of Disaster. A triggering force is required to cause damage and disruption to a system. Natural and Man-made hazards play the role of triggering force in case of a disaster.

Moreover, Disaster Risk Analysis is largely hazard and location specific. The nature of loss and damage also depends on nature of hazard. So, genuine hazard assessment is mandatory for Disaster Risk Reduction Planning.

In the previous unit, we have discussed briefly about definition and characteristics of hazard. The issues related to disaster risk and different approaches to study the natural hazards are also highlighted in the previous unit.

In this unit, we shall discuss in detail about different types of natural and man-made hazards, their characteristics, problem areas, assessment procedure etc.

2.2 OBJECTIVES

The objectives of this unit are

- To discuss about different types of hazards based on their origin, response time, duration, warning sign etc.
- To highlight the characteristics and problem areas of different hazards.
- To describe damage characteristics of few natural hazards.
- To highlight the assessment procedure of natural hazards.

2.3 ABOUT HAZARD

As discussed in unit 01, hazards are the harmful natural or man-made phenomena or events or objects that have the potential to cause damage and disruption to our systems.

Disaster risk of a system is directly proportional to frequency, magnitude and exposure time of the hazards, to which the system is exposed. Therefore, magnitude of loss and damage to our life and property depends on magnitude and exposure time of the hazards.

One aspect of disaster risk reduction is prevention of hazard from striking our system or reduction of exposure time of the hazards. It is not possible to prevent most of the natural hazards. But, prevention is possible in case of some man-made hazards.

Let us discuss about different kinds of natural and man-made hazards, which often cause loss and damage to our systems. Primarily there are two types of hazards.

Natural Hazard: These are guided by natural forces, like, atmospheric pressure and temperature; extreme rain; strain accumulation and release of energy in the earth's crust etc.

Man-made Hazards: These are linked to harmful human activities against natural laws and unsustainable development.

2.4 CLASSIFICATION OF HAZARDS

Based on origin and nature of forces, we can divide natural and man-made hazards into number of groups.

Geophysical

- Earthquake
- Tsunami
- Volcanic Eruption

Atmospheric and Hydrological

- Flood
- Drought
- Hurricane
- Lightning
- Hailstorm
- Avalanches

Land surface related

- Soil Erosion
- Desertification
- Landslide
- Subsidence
- Forest and range fires

Human interference

- Structural Damage
- Environmental hazards
- Civil unrest

Accident related hazards

Biological hazards

The impact of hazards to the exposures depends on their response time, length of forewarning, frequency and time of exposure. Let us divide the hazards according to these parameters.

Type of hazard	Response time	Length of forewarning	Frequency	Time of exposure
Geophysical				
Earthquake	Seconds – minute	Not predictable	Random	Long time
Tsunamis	Hours	Hours	Random	Short time but highly intensive
Volcanic Eruption	Minute – days	Minutes - weeks	Random	Long time
Atmospheric and Hydrological				
Flood	Hours – days	Hours – days	Seasonal	Hours - weeks
Drought	weeks – months	Months	Seasonal	Long time
Hurricane	minutes – hours	Hours	Seasonal	Short time but highly intensive
Lightning	seconds – hours	Seconds – hours	Seasonal	Hours and intensive
Hailstorm	Minutes – hours	Minutes – hours	Seasonal	Hours and intensive
Avalanches	Minutes – days	Minutes – days	-	Long time
Land Surface				
Soil Erosion	Hours – days	Hours – days	Continuous process	Long time
Desertification	Years	Years	Continuous process	Long time
Landslide	Minutes – days	Minutes – days	Random	Short / long time
Subsidence	Minutes – days	-	Random	Short time but permanent
Forest and range fires	Hours – days	-	Random	Long time
Human Impact				
Engineering faults	Minutes - hours	Long time	Random	Long time
Environmental problems	Long time	Long time	Continuous	Long time
Civil unrest	Minutes - days	Long time	Continuous	Long time
Accident related Hazards	Seconds	-	Random	Hours – days
Biological Hazards	Minutes - days	-	Random	Minutes - weeks

Why the hazard assessment based on above-mentioned parameters is important for Risk Assessment?

In fact, these parameters are the determinant factors of magnitude of probable loss and damage to a system under the impact of a particular hazard. Let us discuss the role of these parameters one by one.

Response time: Response time is the period, within which the vulnerable community has to respond to a hazard to save their life and property.

People can not decide or take action for saving their life and property within short response time. If the hazard is unpredictable and response time is very short, people gets absolutely no time to save their life and property. In this case, amount of loss and damage depends on magnitude of hazard. The best example is ***earthquake.***

But, if the hazard is predictable and the response time is short, people can take advance measure to avoid loss and damage to their life and property. Best example is ***lightning.***

Length of forewarning: The time scale for forecasting a hazard before it strikes a system.

For some natural hazards, we get considerably long time for their forecasting. In this case, magnitude of loss and damage could be minimized by taking immediate action, before the occurrence of disaster. Example is ***seasonal flood.***

For some hazards, forewarning time is either very short or zero. In this case, probability of loss and damage is very high. We need long term plans for sustainable development to minimize loss and damage. Example is ***earthquake.***

Frequency: The number of times a particular hazard strikes a particular place within a specific period of time.

The nature and frequency of hazards should be well defined in a hazard and location specify disaster risk reduction plan.

Time of Exposure: The period for which the affected community remains exposed to the impact of a specific hazard.

The magnitude of loss and disruption may be very high, if a system remains exposed under the impact of a specific hazard for long time. Example is ***drought.***

Even a short exposure time can lead significant damage and disruption, if the magnitude of hazard is very high. Example is ***flash flood.***

2.5 INDUSTRIAL HAZARDS

We need industries for production of our day-to-day required items. Industries play vital role in national development and employment generation. But, unsafe industries may become hazards and cause large scale loss and damage to life and environment. Generally, industrial disasters have long-standing affects to our society.

Best example is the ***Bhopal gas tragedy.*** The worst industrial catastrophe occurred in India on the night of December 2-3, 1984 in the Union Carbide India Limited pesticide plant at Bhopal. More than 3500 people died within a week due to leakage of poisonous Methyl Isocyanate (MIC) gas from the plant. So far, over 8000 people died due to secondary affects

of this disaster. More than 3900 people are struggling with their life for serious injuries and another 38400 people are partially affected.

Study shows, this disaster occurred due to

- Use of MIC instead of other less dangerous gas.
- Lack of proper safety measures in storing the poisonous chemicals.
- Lack of proper maintenance of the plant.
- Ineffective safety systems and their failure at the time of disaster.
- Some important safety systems, like refrigeration system of MIC tank, were switched off at the time of tragedy, for cost benefit.
- Location of the plat was in densely populated area.

2.5.1 UN HAZARD CODES

The common industrial hazardous substances as per UN hazard code are listed below
(Source: Industrial Disaster Management and Emergency Response (2007) by U. K. Chakrabarty)

Class 1	: Explosive
Class 2	: Gases
Class 3.1	: Flammable liquids, flash point below -18^0 C
Class 3.2	: Flammable liquids, flash point between -18^0 C and 23^0 C
Class 3.3	: Flammable liquids, flash point between -23^0 C and 61^0 C
Class 4.1	: Flammable solids
Class 5.1	: Oxidizing agents
Class 5.2	: Organic peroxides
Class 6.1	: Poisonous substances
Class 7	: Radioactive substances
Class 8	: Corrosive substances
Class 9	: Miscellaneous dangerous substances

2.5.2 CHEMICAL DISASTER

Plants in which dangerous chemicals are used may need special attention for safe running of the processing units. The chemical hazards are mainly associated with process and bulk storage system. The chances of accidents are linked with

- General process like absorption and filtration etc.
- Special process like acid pickling, spray painting, surface preparation with toxic solvents etc.
- Type of chemical used in terms of toxicity, flammability, reactivity etc.
- Storage process of chemicals.
- Protection measures to different process units and storage.
- Safety status of storage tank and pipelines.

- Status of isolation system.
- Status of fire fighting system.
- Protective measures with sophisticated process controls, like, emergency shut down. system, alarm system, emergency illumination and communication system
- Safety Integrity Level of important instruments.
- Location of the plant.

2.6 CHARACTERISTICS AND PROBLEM AREAS OF FEW NATURAL HAZARDS

Earlier we have discussed about different types of natural and man-made hazards based on their origin and nature.

The characteristics and problem areas of different hazards are not same. Naturally, impacts of different hazards on their exposures are also different. For any risk reduction plan, it is necessary to understand the characteristics of hazards, to which the system is exposed. The loss and damage patterns are highly dependent on nature of hazards.

Let us see the cases of few natural hazards

2.6.1 EARTHQUAKE

Fig.: Structural damage of Bhuj Earthquake, Gujrat - 2001.
Photo source : undp.org.in/photogallery

General characteristic of the earthquake

- Earthquake is the manifestation of a geophysical phenomenon, hence purely a natural event.
- The earthquake hazard is not predictable and hence it does not have any warning sign.
- Earthquake occurs suddenly, at any place of seismically sensitive zones.
- The frequency of earthquake is random, the occurrence of earthquakes in a particular location and within a specific time frame can not be ascertained in advance.
- Earthquake occurs only in certain locations of the glove.

- Earthquake creates permanent fault lines in the crust.
- Fault lines are also responsible for earthquake.

Now, to justify these characteristics let us explain the reasons.

To do so, first we need to understand the ***causes of earthquake.***

If we consider the structure of Earth, the Earth's crust is divided in to number of plates. These plates are not static and moving horizontally with certain velocity, relative to each other. The internal heat flow or convection current is mainly responsible for movements of these plates.

Energy has been constantly accumulating in the plates (rock system) due to subduction process and relative motions of the plates. When the accumulated energy in a certain plate (rock system) goes beyond the threshold limit, the rock system releases excess energy by means of rupture in the plate. The energy released in this process travels in different directions in the form of wave and cause ground vibration, which we call ***Earthquake.***

That's why, Earthquake is a **Geophysical Phenomenon.**

Why prediction of an Earthquake is not possible?

Because, we do not have much information about

- Geological characteristics of the rock system (plates), in which strain is accumulating.
- Elastic limit of the rock to bear the stress or threshold limit of strain.
- Total energy accumulated in different rocks (plates) so far.
- In which plates, accumulated energy already reached to its threshold value.
- Whether the process of energy release in the rock system already stared with small earthquakes and by creating small ruptures / cracks.
- How much energy already released by the process.
- Whether remaining energy is sufficient for major shock (big earthquake) etc.

For these reasons, we can not predict occurrence of earthquake in terms of time, magnitude and location. It strikes our system suddenly and stays for very small time, without leaving space for saving our life and property. These reasons are also applicable for the question, why the frequency of earthquakes in a specific location is random.

Why earthquake occurs only in certain regions of the world?

We have seen, earthquake occurs by the process of energy accumulation and release of energy in the rock system of earth's crust. Energy accumulated in the plates due to relative movements of the plates and their subduction process. So, there are maximum chances of ruptures in the locations close to plate boundaries, due to the process of energy release. Real data of earthquakes also confirmed the fact that, most of the earthquakes occur in the certain belts, close to plate boundaries.

Some well-known earthquake belts are

- Circum-Pacific belt.
- Alpine-Himalayan belt.
- Pamir-Baikal zone.
- Atlantic-Artic belt.

- Belt of Central Indian Ocean.
- Rift Zones.
- Wide-Triangular active area.

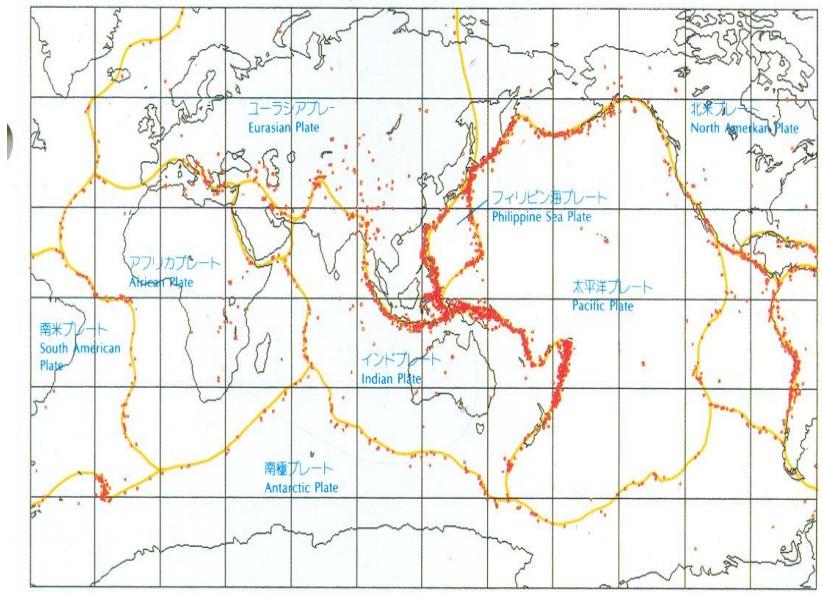


Fig.: Active belts of earthquake
Source: National Geophysical Research Institute, Tezpur branch

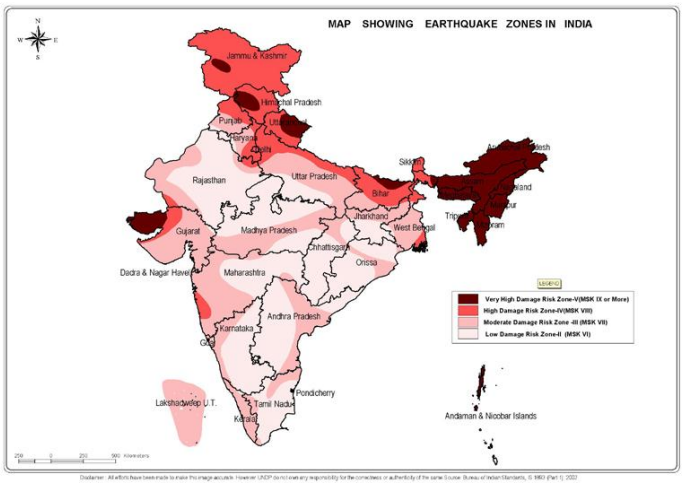


Fig.: Seismic zoning of India
Source: Vulnerability Atlas of India

Why earthquake creates fault lines and fault lines cause earthquake?

Fault line implies cracks or fracture in a particular rock mass in the earth's crust. Since earthquake energy releases by creating rupture in rock system of earth's crust, thus each earthquake creates a permanent fault line.

Faults are the weakest zones of the rock system. So, generally the earthquake energy releases along the fault lines. Active faults are the sources of earthquakes, in which two sides of the fracture move with respect to each other.

Problem areas of earthquake

A high magnitude earthquake may create several kinds of problems for the vulnerable communities, response forces, and other agencies. Some problems are instantaneous and some are related to secondary affects of earthquake-induced disaster.

Direct affects

- Large scale of destruction of buildings and infrastructures.
- Destruction of lifelines and essential services.
- Destruction of soil and landslide.
- Widespread fire in residential buildings and other establishments.
- Disturbance of man's mind.

For these problems, we need urgent counter measures, specially search, rescue and medical assistance.

Secondary affects

- Disturbance in public functions.
- Inundation due to earthquake induced flood.
- Leakage of poisonous gas.
- Panic.
- Problems in management of relief camps.
- Problems in handling large number of injured people.
- Lack of life goods.
- Social unrest.
- Restoration of public functioning and rebuilding.

Contingency planning for earthquake damage mitigation

- Identification of earthquake prone areas.
- Identification of problems.
- Identification and mobilization of resources.
- Command and control.
- Advance preparatory action.

2.6.2 FLOOD

Fig.: Flood disaster in Sonitpur District, Assam
Photo: Centre for Disaster Management, Tezpur University

General characteristic of flood hazard

- Flood is the product of atmospheric and hydrological phenomena.
- The forewarning time may be long, short or zero depending on types of flood.
- Speed of onset for normal flood is long / gradual.
- Speed of onset for flash flood is sudden.
- Most floods are seasonal, but frequency may be more than one.
- All locations in the glove are not vulnerable to flood.

Causes of flood

Let us discuss the issues related to causes of flood to justify the above mentioned characteristics of flood.

A flood is the condition of partial or complete inundation in an area, which otherwise remains dry. The common reasons of flood are

- High runoff of surface water from high land to low-lying areas.
- Overflow of river or tidal water.

Floods can be divided into following types, based on the source and reasons for flood.

- River flood
- Ocean flood
- Manmade flood
- Engineering flood
- Flood due to earth's movement

In any case, the main force behind a flood is ***"RAIN".*** Many atmospheric conditions; like temperature, evaporation of seawater, transpiration, precipitation etc.; are involved in the process of Rain.

Second important condition for flood is flow pattern of water. We need a drainage/river network to complete the water cycle, i.e., flow of water from watershed to ocean.

Here again two conditions applied for flood

- Rapid accumulation of local surface rain water in low lying areas due to blockade in drainage network or absence of adequate drainage system.

- The carrying capacity of drainage network itself is not sufficient to carry the catchment runoff, resulting overflow in low-lying areas.

All other conditions for flood are also related to runoff and flow pattern of water. If it is an oceanic flood, water flows against the gravity under the impact of some other natural forces. If it is an earthquake-induced flood, artificial landslide or a dam break may result high discharge of storage water to drainage network, followed by overflow of water to low lying areas.
So, both atmospheric and hydrological factors are involved in the process of flood hazard.

Rain is a seasonal phenomenon. During monsoon period, we can expect flood.

So, most floods are seasonal.

Except the conditions applied for a flash flood, i.e., very high intensity rainfall within short duration, generally floods occur in gradual manner. Because, water takes time to reach the downstream from watershed, depending on runoff and distance.

So, except flash flood, forewarning for most of the common floods is possible and that too well before the flood strikes our system.

Only on certain conditions, like high tide, tsunami etc., water may flow against the gravity and inundate high lands mainly in costal areas. Other common reasons for flood have close relation with many geographical and climatic conditions.

So, floods are location specific and only certain parts of the globe are flood prone.

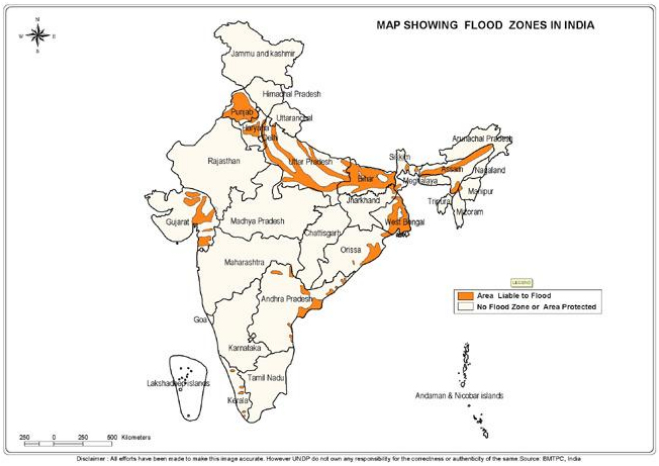


Fig.: Flood Zoning Map of India. **Source :** Vulnerability Atlas of India

Problem areas of flood

Flood is seasonal, gradual and normal process for most of the well-identified flood prone areas. Even than, every year flood causes enormous loss and damage to life and property in these areas, probably due to lack of proper planning and preparedness. The major problems arise due to inundation, which may disrupt the normal pattern of life for a reasonable period. Some problems, which may arise due to inundation, are

- Isolation of affected community from rest of the country may result scarcity of essential items for their survival.

- Communication disruption and difficulties of access and movement.

- Situation may not permit government and non-government response forces to go for immediate rescue of flood victims and their safe shelter. In that case, affected community may face serious problems, if they are not prepared.
- Even if the affected community gets timely support from outside agencies in their rescue and safe shelter, security problem may arise for their unattended assets.

- Another major problem is proper management of evacuation/relief centres. Generally, flood victims are allowed to take shelter in nearby schools and colleges. But, these do not have minimum basic facilities, like sanitation, drinking water, lighting, sufficient space and ventilation, proper security (mainly for women), etc. to accommodate large number of people. As a result, many secondary health and social problems may arise. In view of these reaosns, concerned organizations may face problems in

    - ✓ Distributing relief items like, food, water, cloth etc.
    - ✓ Arranging adequate sanitation facilities for all.
    - ✓ Handling an epidemic like situation and extending medical care to all.
    - ✓ Preventing social chaos and misdeeds.

- Damage of crop and food storage, in this case large scale relief may be required until next crop harvest.

- Administrative and financial problems for reconstruction and rehabilitation may lead longstanding sufferings of the flood victims.

Contingency planning for flood damage mitigation

The planning for flood damage mitigation needs,

- Zoning of flood prone areas based on historical, primary and secondary data.

- Implementation of Land Use Regulations in flood prone areas.

- Identification of problem areas and needs of the vulnerable communities, in advance.

- Advance arrangement of essential materials in the flood prone areas, based on assessment of problems and needs of the vulnerable communities. Basic facilities to be installed in safe locations and these should be accessible to affected communities during flood.

- Strong and efficient organizational network involving government line departments, non-government organizations working in the field of disaster management, trained

volunteers from vulnerable communities, and other concerned agencies from corporate and financial sectors.

- Training for different organizations and individuals, involved in the process of planning and execution of plans.

- Capacity building in terms of skilled manpower, equipments and tools, finance etc.

2.6.3 LANDSLIDE

General characteristic of landslide

- It is a land surface related phenomenon, but depends largely on geomprphological, geological, ecological, tectonic and climatic conditions of the localities.

- It occurs mainly in hilly terrains.

- In general, landslide prone areas are well defined and many visible warning signs help to give forewarning for this event. In rare cases it occurs without any warning.

- Once the process start, it occurs very fast without leaving time to save life and property.
- In most of the cases, landslide causes blockade to other physical elements and secondary disruptions.

- Landslide combines with heavy rain generally lead to flood hazard.

Fig.: Landslide in a hill nearby Guwahati city
Photo courtesy: telegraphindia.com

Causes of landslide

Landslide is the sudden failure of a slope due to slumping, falling or sliding of landmass.

The pre condition for a landslide is slope and the triggering forces for a landslide may be

- ✓ Precipitation and tectonic activities like earthquake.
- ✓ Change in vegetation cover around the slope.
- ✓ Construction activities like road, buildings etc. on sloping ground.
- ✓ Liquid disposal by means of sanitary and sewers.
- ✓ Excavation and mining.

These above mentioned conditions may lead a landslide in the form of

- Freefalling, bounding, or rolling of a big landmass detached from a steep slope.
- Rotation and toppling of a unit landmass or rock system over a slope.
- Sliding of a landmass in the slope.
- Mudflow

The probable factors involved in the process of landslide justify the above mentioned characteristics of landslide.

Warning signs for a landslide

Few visible signs in and around the slope may be appeared before a landslide in the surrounding areas. These are

- Appearance of new water spring or saturated ground near the slope.
- Appearance of cracks or bulges in the ground, street pavements or sidewalks.
- Disturbance in foundations, tilting of ancillary structure from main house; crack in the floors; broken water lines and other underground utilities.
- Tilting of retaining wall, poles or trees slowly but continuously.
- Sudden decrease of water level in the streams inspite of regular rainfall.
- Visible disorder in door and window frames.

Problem areas of landslide

A sizable landslide in a locality may create severe damage and disruption locally or in distant areas. A landslide may cause following problems

- Damage to buildings and other infrastructures, in and around the slope, resulting large-scale loss and damage to life and property of the locality. Communication disruption and other adverse conditions of the locality may create difficulties in rescue operation.
- There is every possibility of road blockade. This may lead communication disruption, isolation of different places and communities from rest of the country, scarcity of essential items etc.
- A heavy mudflow from hilly area during monsoon season may cause disruption in the foothill regions.
- A landslide may also block a river or stream resulting artificial lake. This may enhance the risk of flash flood in the downstream areas.

Contingency planning for damage mitigation

The planning for landslide damage mitigation must include

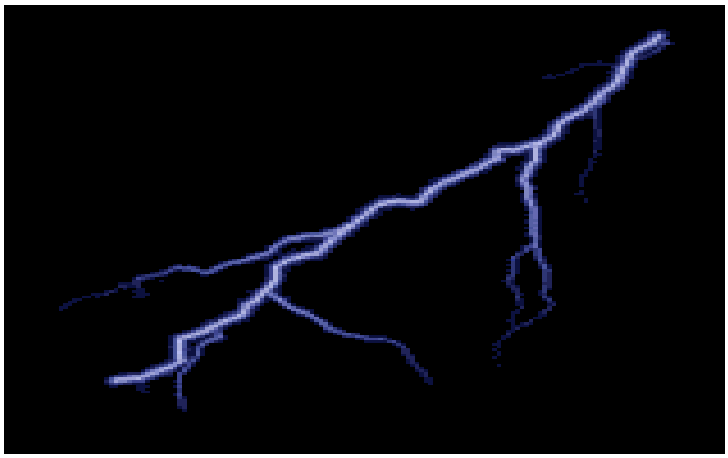
- Proper zoning of landslide prone areas.
- Imposition strict regulations to stop avoidable and unauthorized developmental activities in landslide prone hilly slopes.
- Awareness of people about the risk of landslide and its impact.
- Imposition of penalty and exclusion from government support, for unauthorized dwellers in landslide prone hilly areas.
- Relocation plan for the communities staying in the hilly landslide prone areas from generations.
- Discouraging people from destruction of forest and vegetation in hilly areas.
- Insurance for unavoidable infrastructures at landslide risk.
- Proper structural protection measures (mainly stabilization of slope) for unavoidable important infrastructures in hilly landslide prone areas, like roads, bridges, electricity and telecommunication facilities, etc.
- Capacity building of the concerned organizations for speedy recovery of the normal situation in case of communication disruption.

2.6.4 LIGHTNING

Lightning is the flow of electrical current between earth and storm clouds in the atmosphere. This happens due to polarity of positive and negative charges build up in the atmosphere during a storm.

The basic characteristics of lightning are

- It generates 35,000 to 40,000 amperes current in the atmosphere and travels towards earth. The lightning induced current can travel as far as 40 miles.
- Lightning can generate enormous amount of heat, as high as 50,000 degrees Celsius.
- It falls somewhere on the earth in every second.
- It can strike more than once in the same area.



The lightning can create following problems

- The lightning has the potential to damage all kinds of electrical and electronics installations within a fraction of second.
- It may cause damage to all living elements.
- Lightning may trigger fire and lead total property loss.

Planning for damage mitigation

- Installation of lightning protection systems in all building should be made mandatory. This will certainly mitigate the magnitude of damage of property under the impact of lightning every year.

- Education and awareness of people about other indoor and outdoor safety measures for lightning.

2.6.5 TROPICAL CYCLONE

Generally, warm tropical moisture bearing clouds developed in open ocean or sea causes cyclone. This allows the atmosphere to develop low-pressure zone and violent thunder storms.

The general characteristics of tropical cyclone are

- It is an atmospheric and climatic phenomenon. By observing meteorological data, it is possible to forecast the occurrence of cyclone in a particular location well ahead of time.
- The process of cyclone in an area develops gradually and does not strike a system suddenly.
- The destructive wind force and violent thunder storm result wide spread destruction and flooding in coastal areas.

Fig.: Orissa cyclone damage in the year 1999
Photo source : members.tripod.com

The major problem areas for cyclone are

- Difficulties in rescue operation during cyclone due to high wind and storm.
- Everything in the surface of the earth, physical or living elements, may be damaged under the impact of strong cyclone.
- Large-scale debris may cause difficulties for post cyclone rescue and recovery operations.
- All structures and establishments may collapse in case of a cyclone. Therefore, problems may arise in rescue and safe shelter of the victims. The response forces may also face problems in distributing relief material and extending medical support to the victims timely.
- Wide spread destruction of trees and crops may lead long standing secondary problems.

Contingency plan for damage mitigation should include

- Development of effective warning mechanism in all cyclone prone areas.
- Construction of high wind resistant structures in cyclone prone areas.
- Development of cyclone barriers.
- Proper rescue, relief and rehabilitation plans.
- Preparedness, public education and awareness for damage mitigation etc.

Like this, we can study the characteristics and problem areas of different hazards. It is essential to understand the nature and problem areas of the hazard, to which a particular location is exposed, prior to formulation of damage mitigation plan for this area.

2.6.6 DROUGHT

Drought is an important and dominant natural hazard that causes enormous disruption to life support systems and heavy economic loss. Drought affects largest population in Asia.

Drought is basically a condition of abnormal dry weather, which results serious hydrological imbalance and has negative consequences on different factors.

The general characteristics of drought are

- ✓ It is a hydro-meteorological hazard.
- ✓ Exposure time of drought is very long.
- ✓ Speed of onset is long or may stand for whole year depending on the pattern of rainfall.
- ✓ Forewarning is long.
- ✓ All locations on the globe are not drought prone.

Causes of drought

- ✓ Absence of rainfall for long period of time
- ✓ Changes in timing, frequency and intensity of rainfall.
- ✓ Environmental degradation.
- ✓ Wrong land use practice, settlement pattern, and farm management.
- ✓ Poor water management and water wastage.
- ✓ Water diversion by inter-basin transfer.
- ✓ Big dams in upper catchment area.
- ✓ Poor water storage facilities.
- ✓ Poor recharge of aquifers and overexploitation of ground water.
- ✓ Pollution.
- ✓ Siltation in water reservoirs.
- ✓ Human activities like deforestation, environmental modification, misuse of wetland etc.

Problem areas

- ✓ Shortage of surface and ground water.
- ✓ Enormous negative impact on agricultural production and damage to standing crops.
- ✓ Scarcity of food, that may cause malnutrition and famine like situation.
- ✓ Migration of population.
- ✓ National economic loss.
- ✓ Social chaos and civil unrest.

- ✓ Epidemic.
- ✓ Administrative problems in providing relief for long time.
- ✓ Rehabilitation.

Drought management

- ✓ Close monitoring on changing rainfall pattern and emerging threat of drought for early warning and preparedness.
- ✓ Planning for relocation of effected population or providing long time relief.
- ✓ Planning for alternative agriculture.
- ✓ Proper land use planning and farm management.
- ✓ Proper policy for water management and distribution.
- ✓ Improvement of water and crop storage facilities.
- ✓ Aforestation and wet land management etc.

2.7 DAMAGE CHARACTERISTICS OF DIFFERENT NATURAL HAZARDS

In advance, we can assess the probability, nature and magnitude of damage to a system under the influence of a specific hazard, by studying past hazard specific damage characteristics. `

Most of the natural hazards cause

- Damage to physical and living elements on the surface of the earth.
- Injury to people, epidemic, other medical problems.
- Damage to crop, forest etc.
- Disruption in normal pattern of life and essential services.
- Social and psychological problems; stress; trauma etc.
- Economic problems.
- Disruption in government functioning.
- Many secondary affects in the fields of medical, financial, social, administrative, infrastructure etc.

Question is that, whether this much information is sufficient for damage mitigation planning?

In fact, nature and magnitude of damage in an area primarily depend on hazards characteristics as well as nature of their exposures i.e., local environment of the system/area. Hence, we need to have hazard specific damage assessment for damage mitigation planning.

For example,

For an earthquake, ground vibration is mainly responsible for sudden damage to buildings and infrastructures, which may lead a series of secondary problems. The damage and disruption may spread over wide area, depending on magnitude of earthquake. The nature of damage is also related to developmental pattern of the locality.

In this case, the design parameters based on earthquake resistant building codes play vital role in damage mitigation planning.

For flood, inundation is the major factor to cause damage to crops, household assets, roads, bridges etc. It can lead a series of secondary problems like, epidemic, food scarcity, social and

financial problems etc. Generally, flood damage remains confined to certain parts of a locality.

So, flood zoning, land use regulation, flood preparedness, alternative adjustment process etc. may be the major components of flood damage mitigation planning.

Like these, a cyclone may cause wide spread damage and disruption to all physical and living elements of an area under the influence of high wind and storm. It may lead floods in low lying areas also.

A fire may destroy its physical exposures completely. But, it may not spread over wide area. The damage mitigation planning for fire largely depends on nature of exposures.

Moreover, one natural hazard may create another hazard and subsequently a series of secondary loss and damages to a system.

For example,

An earthquake may lead landslide, fire and flood hazards.
A flood may lead bank line erosion.
Landslide may cause flashflood and mudflow.
Cyclone may result flood.

2.8 HAZARD ASSESSMENT

We have already discussed in detail about different types of hazards and their characteristics.

Now it is clear that, hazard is the first parameter of risk of a system. For proper risk assessment and risk reduction planning, we need genuine hazard assessment.

The hazard assessment is essential to understand

- The types of hazards, to which an area is exposed.
- Nature and behaviour of hazards.
- Area likely to be affected by the hazard.
- Its impact on the system including damage pattern and magnitude of damage.
- Time of occurrence and duration etc.

The hazard assessment process involves

- Hazard mapping to determine hazard prone areas and types of hazards.
- Historical profile to understand hazard specific damage characteristics.
- Seasonal calendar to understand time of occurance of hazards, their impact on community and needs of the community.

To do so, we need to

- Collect primary and secondary data.
- Analyze the data to understand nature and impact of hazards.

The sophisticated tools available for hazard assessment

- Arial photograph and satellite imagery to get information about landscape.

- GIS and remote sensing based analysis to store and present spatial data and information in digital format.

2.9 WHAT WE LEARNT FROM THIS UNIT?

Hazard or threat is the triggering force of a disaster. In absence of a hazard or threat, there is no possibility of disaster in a system. Hazards are devastating natural phenomena or harmful events and objectives, which have the potentials to cause damage and disruption in our systems. Basically two types of hazards are there, natural and man-made. These hazards can be divided into number of groups based on their origin.

The damage characteristics of a hazard depend on its origin, force, response time, frequency, magnitude, warning sign and exposure time. Therefore, the problem areas of different hazards are not same. For damage mitigation planning, hazard assessment is essential to identify the areas prone to hazards, nature of hazards and probability of damage and disruption due to these hazards.

2.10 PROBABLE QUESTIONS

1. Define hazard.
2. Whether disaster risk has any relation with hazards?
3. Explain different kinds of hazards based on their origin and response time.
4. What factors may cause landslide hazard?
5. Give an account of few general characteristics of flood and earthquake hazards.
6. Why prediction of earthquake is not possible?
7. What may be the causes of landslide?
8. Describe briefly the general damage characteristics of hazards.
9. Why we need hazard assessment for risk reduction planning?

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UNIT-3: VULNERABILITY

UNIT STRUCTURE

3.1 INTRODUCTION

Vulnerability is the most important but complex parameter of disaster risk. In unit 01, we have discussed about disaster risk. Disaster risk assessment gives us idea about probability of occurrence of disaster in an area and expected loss and damage. Unit 02 describes the role of hazards in disaster risk and damage characteristics of different hazards.

Only a hazard cannot trigger a disaster like situation in an area. External hazards may cause damage and disruption in our systems, only when some elements in our system are at risk and susceptible to the hazards.

We have also discussed about specific risk of a system, which is the combined affect of hazard and vulnerability. Most of the times, we cannot prevent natural hazards to reduce the disaster risk. But, we can mitigate magnitude of loss and damage by minimizing vulnerability factors of the system.

Hence, vulnerability assessment is essential for disaster risk reduction planning. Vulnerability assessment facilitates us to identify unsafe conditions of our systems and analyze the progression of vulnerability factors.

This unit is specifically designed to cover different aspects of vulnerability including its dimension, assessment, relationship with risk and damage etc.

3.2 OBJECTIVES

The purpose of this unit is to highlight the issues relevant to

- Dimensions and progression of vulnerability of a system to understand the dynamic pressures and root causes of unsafe conditions of the system.
- Correlation between vulnerability and disaster risk of a system.
- Principle of vulnerability assessment
- Other aspects of vulnerability and disasters.

3.3 DIMENSION OF VULNERABILITY

As discussed earlier, vulnerability of a system implies unsafe conditions or elements at risk of the system, which are susceptible to one or more hazards. These factors generally reduce the ability of the community to resist the hazard, cope with disaster and recover from the impact of hazard.

Therefore, vulnerability has multidimensional aspects and it is little difficult to assess vulnerability of a system addressing all dimensions.

Let us discuss the issues relevant to dimensions of vulnerability factors in detail.

Physical vulnerability: Physical vulnerability of a system determines the physical elements that are at risk and exposed to different hazards. Physical elements of a system may be buildings, infrastructures, facilities, agriculture based industries, forest, river network, hazard protection mechanism etc. Weak physical elements are responsible for creating unsafe conditions and enhance the disaster risk in a system. This also increases the probability of damage and disruption in the system.

Social vulnerability: It indicates the weak social conditions of the community, which gives extra pressures to a system and enhance its disaster risk. The social vulnerability may be week community, poverty, weak leadership etc.

Economic vulnerability: Poor economic conditions of the people, community or organizations, which play negative role in the capacity building process of a community. Otherwise, severe loss and damage of physical components under the impact of natural and man-made hazards may enhance economic burden of a nation. In any case, economic vulnerability of a nation creates hindrance in effective management of disaster. Therefore, the physical vulnerability factors have significant role on enhancing economic vulnerability of a system.

Motivational vulnerability: It indicates lack of motivation of the people or community to do good work. Motivational vulnerability is mainly responsible for unsustainable development.

Similarly, there may be ***Technical, Environmental, Political, Cultural, Educational, and Institutional*** vulnerability factors in a system, which have the potential to enhance disaster risk of the system.

All these vulnerability factors or unsafe conditions arise in our system due to some hidden dynamic pressures. The dynamic pressures have some root causes and we cannot simply remove these pressures without addressing their root causes. The dynamic pressures of a community or system are variable with root causes.

Another feature of vulnerability factors is that, they respond differently with different hazards. The disaster risk of a system for same set of vulnerable conditions may be different for different hazards.

Therefore, study on progression of vulnerability factors and impact of probable hazards on unsafe conditions of a system is mandatory for proper risk assessment.

3.4 VULNERABILITY ASSESSMENT

Vulnerability assessment is the process, which facilitates us in identifying the unsafe conditions or elements at risk in a system, pressures and root causes of these unsafe conditions, and their susceptibility to different hazards. Vulnerability assessment is essential to estimate the level of risk of the system for different hazards.

It also gives us scope to analyze the progression of vulnerability i.e., correlation amongst unsafe conditions, dynamic pressures and root causes. Disaster Crunch Model is useful to understand the method of studying the progression of vulnerability in a system.

3.4.1 STEPS FOR VULNERABILITY ANALYSIS

- Identification of elements at risk and unsafe conditions of a system, which is prone to one or more hazards.
- Study on progression of vulnerability to find out the pressures and root causes of unsafe conditions.
- Response of prevailing vulnerability factors to different hazards to understand the damage characteristic.
- Estimation of hazard specific disaster risk (high, medium, low etc.) of the system.

3.4.2 EXAMPLES OF VULNERABILITY ASSESSMENT

The first step of vulnerability assessment is identification of the unsafe conditions or elements at risk of the system.

Physical vulnerability: Community, building, infrastructures, critical facilities etc. may be at risk or not functioning well due to different reasons. *For example,*

- A large number of community people living in hazards prone areas without protection and preparedness.
- A number of residential buildings are in hazard prone locations, like flood prone areas or on high seismic zone.
- Most of the buildings are weak due to violation of hazard resistant building codes in terms of location, soil quality, design perspective, construction material, shape, size, safety norms, interior design etc.
- Infrastructures like road, bridges, airport, railways, etc. are not safe.
- Utilities like water supply, electricity, telecommunication, sewerage etc. are at risk or not functioning.
- The hazard resistant measures like embankment, dykes, deflector, small dams, safety equipments, fire service equipments, guard wall etc. are at risk or not in working condition.
- Condition of critical facilities like, hospitals, emergency services like ambulance and fire services, transport and communication services, power plants, etc. are at risk
- Community people are exposed to risky sources of livelihood and production like nuclear plant, cement factory, etc.
- Scarcity of food and other basic requirements for survival.
- Lack of basic services like, education, health, safe drinking water, shelter, sanitation, roads, electricity, communication etc.
- Lack of skilled manpower and facilities for post disaster response.
- Overexploitation of natural resources.

- Population explosion and unsustainable development.

Social vulnerability: Different social factors, which are not favourable for sustainable development and disaster risk reduction of vulnerable community. *For examples,*

- Insecure livelihood options of majority population may lead economic, social, law & order problems.
- People exposed to different hazards are poor.
- Most families are socially, politically and economically weak.
- Conflict, division, rumors among community people.
- Lack of active participation in community affairs.
- Undue political interference, injustice to community.
- Gap between community and government organizations.
- Communities are confined to certain locality and do not have access to outside world.
- Socio-cultural degradation.
- Lack of work culture.
- Migration of population from rural to urban areas due to lack of communication and other basic facilities.

Economical vulnerability: As discussed earlier, poor economic conditions of the community and organizations may enhance disaster risk of a system or a disaster may cause severe economic loss resulting poor economic conditions of the community and organizations of the system. Poverty and disaster have strong correlation. *For example,*

- Poverty may compel people to live in hazard prone areas without preparedness.
- Poor countries may not able to implement disaster risk reduction plan.
- Poor organizations may not be well equipped to handle a disaster like situation.
- A disaster may be the cause for national economic recession due to
    - ✓ Severe damage to physical infrastructure and facilities.
    - ✓ Loss of employment, production, vital services, livelihood options.
    - ✓ Inflation and price rise of the essential commodities and services.

Motivational vulnerability: This is related with negative attitude of the community members and lack of motivation. *For examples,*

- Lack of initiative and negative attitude towards sustainable development.
- Lack of motivation and sincerity to do good work for the society and nation.
- Lack of fighting spirit.
- Helplessness and dependency on external support.
- Lack of efforts to understand and solve own problems.
- Corruption

Technical vulnerability: Weak and faulty engineering devices, unstable hazard resistant mechanism, violation of codes and norms during construction etc. may also enhance the risk of a system

Environmental vulnerability: Damage to our biodiversity and unstable ecosystem are the major reasons for environmental stress and natural hazards.

Political vulnerability: Lack of political initiatives to formulate policies for solving the national problems, inefficient leadership, ineffective decision making, political corruption and violence etc. are mainly responsible for unsustainable development and disaster risk.

Cultural vulnerability: Socio-cultural degradation, disrespect to traditional practices etc. are also contributing to disaster risk.

Educational vulnerability: Lack of proper education, training, research technology development, and technology transfer etc.

Institutional vulnerability: Lack of planning, public services, emergency response, preparedness etc. to mitigate disaster risk.

Let us see few examples of dynamic pressures, which may generate many unsafe conditions in our systems.

Low per capita income, unstable livelihood, lack of proper relocation plans for vulnerable communities, national economic recession, poor job opportunities, corruption, lack of health care mechanism and schemes, lack of forest conservation, population explosion, poor political representation from vulnerable communities etc.

Such dynamic pressures are mainly responsible for creation of many unsafe conditions in our systems.

Few examples of root causes of unsafe conditions of our systems

- Poor watersheds management.
- Lack of policies for water resource conservation.
- Deforestation and other human activities in the upper catchment areas.
- Population explosion and migration of population in urban areas.
- Poor implementation of land use regulations and town planning.
- Lack of policies for equal distribution of services and resources.
- Unsustainable development.
- Unequal political and social representations from vulnerable communities.
- Lack of job opportunity.

Vulnerability analysis for a hazard prone area needs continuous observation on pre to post disaster conditions of the area; collection of primary and secondary data including remote sensing based satellite imageries; and analysis of data in the laboratory.

3.4.3 PRACTICAL EXAMPLE OF VULNERABILITY ASSESSMENT

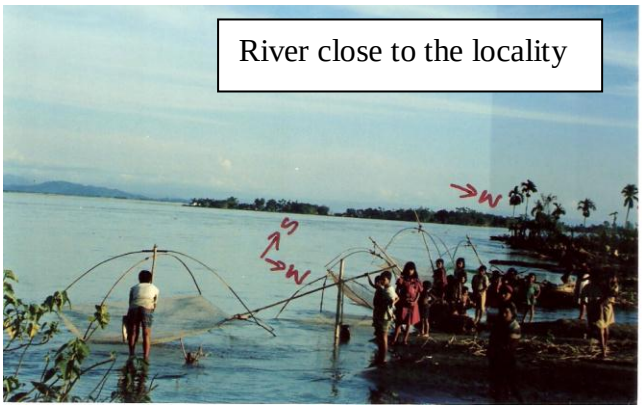
The above picture represents a flood disaster situation

What vulnerability factors may be responsible for this kind of situation?

We can assume,

- The area is low lying and flood hazard prone.
- People constructed their houses in low-lying areas.
- People are residing in these houses.
- Housing pattern is not suitable for flood prone area.
- People are either not aware about their risk or not prepared to cope with the situation.
- Affected people are dependant on outside agencies for rescue and shelter.

What may be the reasons for such a situation?

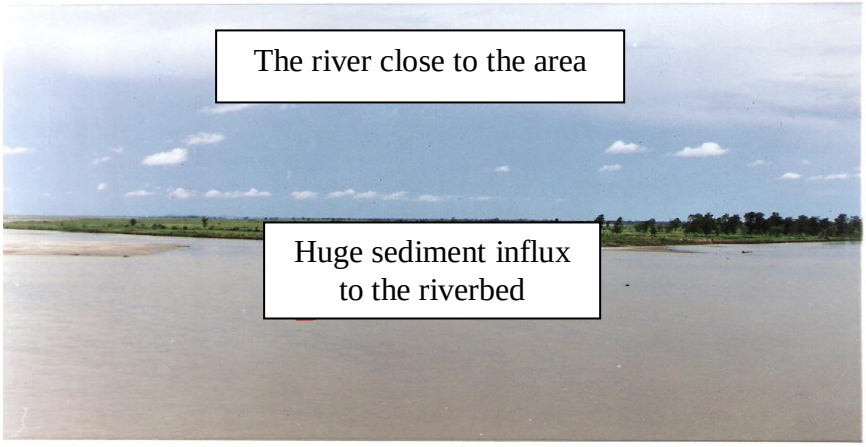


We can assume,

- There is a river very close to the area.
- Carrying capacity of the river is not sufficient to carry the runoff water. As a result, water migrates to the low-lying areas during peak season.
- To protect this area from flood, one embankment is constructed. But, it is constructed by pure sand and violating other safety norms.
- There is possibility of breaching of embankment during monsoon, i.e., the embankment itself is at risk.
- The river is shifting laterally due to bank line erosion. The river bank already touched the embankment.
- No preventive measure is visible to stop riverbank erosion and protect the embankment form breaching.
- People of this area were also reluctant to monitor the condition of embankment and take temporary protection measures.
- People felt secure due to this embankment and did not prepare themselves for a disaster situation.

As a result, the embankment may breach at a particular location closed to the area during monsoon season resulting such a disastrous situation for the localities.

What are the active dynamic pressures acting behind these unsafe conditions?



The dynamic pressures responsible for these unsafe conditions of the community may be

- Huge soil erosion in the upper catchment area and heavy sediment influx in the riverbed may be the reason for decrease in carrying capacity of the river.
- Poor economic condition of the affected community may compel people to live in flood hazard prone areas.
- Affected community is not aware about alternative adjustment processes.
- Absence of risk reduction plan or misappropriation of government money in risk reduction activities.

What are the root causes of all these problems?

The root causes of the unsafe conditions and dynamic pressures may be assumes as,

- Large scale deforestation in the upper catchment area.
- Human activities like, shifting cultivation, developmental activities etc. in the upper catchment area.
- Non implementation of forest and land use regulations in the upper catchment and flood prone areas.
- Lack of hazard specific risk assessment and risk reduction planning.
- Lack of initiative in monitoring vulnerable conditions and timely remedial actions.
- Government does not have any relocation plan for the vulnerable communities.
- Government does not have strong policy to stop misappropriation of fund, meant for hazard resistant measures.
- Concerned government and non-governmental organizations are not sincerely working in educating the vulnerable communities about their risk and damage mitigation measures.

Deforestation in watersheds increasing soil erosion and sediment influx

Like this, we can assess hazard specific vulnerability of an area. We can also determine hazard specific disaster risk of the area by assuming probability of loss and damage due to the prevailing unsafe conditions in the area.

3.4.4 PARTICIPATORY VULNERABILITY ANALYSIS (PVA)

It is a community-based approach to study the problem areas, reasons of problems and solution of problems of vulnerable communities involving the community members and other stakeholders. The main aim of this kind of analysis is to aware vulnerable communities about their own problems and motivate them to participate in the process of disaster risk reduction.

Different aspects of PVA

- Direct involvement of vulnerable communities in finding out the vulnerability factors of their own systems and solutions of the problems.
- Proper and timely action on PVA for mitigation of disaster risk of vulnerable areas.
- A multilevel analysis of data involving district, state and national level organizations to study the sources of the local problems.

Basic approaches of PVA to understand the causes of vulnerability

- Identification of probable hazards and their exposures.
- Determination of the levels of susceptibility of the exposures to the probable hazards.
- Identification of unsafe conditions of the vulnerable areas, which are making community people susceptible to disaster risk.
- Determination of other factors, which are responsible for creation of these local unsafe conditions.
- Assessment of the existing capacity of vulnerable community to prevent hazard, mitigate damage and cope with disaster.

Importance of PVA

- This enables the local communities to contribute in the process of data collection, analysis of data, planning and execution of plan.
- This process helps the district level organizations to make hazard specific micro level risk assessment and risk reduction planning for the district.
- This also helps in formulating national policies addressing the problems of vulnerable communities.

Phases of PVA

a) Preparation for PVA

- Educate the vulnerable communities about disaster risk and importance of PVA in risk reduction planning.
- Identify the target and purpose of this analysis.
- Identify the stakeholders, who can contribute in this process.
- Constitute a team for PVA, involving all stakeholders.

b) Framework for analysis

- Study on problem areas and local unsafe conditions responsible for these problems.
- Study on the progression of vulnerability to address the causes of local vulnerability factors.

- Study on the capacity and role of the vulnerable communities in vulnerability reduction process.
- Analysis of data and preparation of action plan.

c) Analysis at multi-level (community to national level)

- Micro-level participatory vulnerability assessment for some selected vulnerable areas.
- District level vulnerability analysis using information of micro level PVA.
- State level vulnerability analysis based on vulnerability analysis of all districts.
- National level vulnerability analysis using the vulnerability analysis of all states.
- Preparation of national action plan considering feedbacks of different countries on vulnerability reduction mechanism.

3.5 VULNERABILITY AND DISASTER RISK

So far, we have discussed in detail about dimensions and assessment procedure of vulnerability. In units (01) and (02), we have discussed about disaster risk and its relationship with hazard and other parameters like vulnerability.

Generally, risk assessment determines the probability of disaster or damage and disruption in an area under the impact of external hazards. As already discussed, the risk of a system depends on both external hazards and internal vulnerability factors of the system.

But, question is that, why vulnerability plays dominant role in determining disaster risk of a system?

The hazards act just like a triggering force for initiating the disaster process. But, vulnerability plays the role of catalyst to complete the process and cause damage and disruption in the system. The unsafe conditions or elements at risk in the system are the media of loss and damage.

Secondly, we can simply study the nature of hazards and their possible impact to the exposures to determine the level of disaster. We have our own limitation to resist the natural hazards prior to their occurrence.

Therefore, disaster risk reduction planning for a system needs genuine assessment of vulnerability and strategy for vulnerability reduction.

A disaster can cause enormous damage and loss to physical environment and national economy. This may also halt the entire process of national development. So, a disaster risk reduction plan based on genuine vulnerability analysis is essential for sustainable development and overall progress of nation.

Understanding the relationship between vulnerability and disaster risk is not that much simple. In general, the disaster risk of a system depends on

- Unsafe conditions or elements at risk of the system, *which may be physical, social, ecological and economical.*
- Susceptibility of these elements to different hazards. Same unsafe condition may behave differently for different hazards.
- Behaviour and attitude of human beings towards environment and nature. Most of the visible unsafe conditions are the byproduct of *human-environmental conflict* or *unsustainable developmental activities*.

Moreover, we cannot reduce disaster risk of our systems simply by taking some remedial measures to remove or reduce the local unsafe conditions. These conditions are regulated by some other pressures and root causes. If we remove these unsafe conditions without addressing their root causes, these will repeat further with time.

Let us consider a place, which is prone to Earthquake and Flood Hazards.

There may be a set of unsafe conditions in this place. We may assume few major vulnerability factors to study the risk factors of the system for Earthquake and Flood hazards.

- The area is low-lying alluvial plain and soil quality is sandy.
- Large numbers of multistoried buildings are constructed in the area violating earthquake resistant building codes.
- To protect this area from flood, one embankment is constructed. But, the condition of the embankment is not good and there is possibility of breaching.
- The area is located close to down stream of a river. One big dam is constructed in the upstream of the river.
- The approach road, connecting the area with other places, is also vulnerable to flood.
- Condition of the bridges on the road is miserable.
- No flood warning system is in place for the area.

Now, let us see the possible impacts of earthquake and flood hazards separately.
In case of a big earthquake in this area, there may be

- Chances of liquefaction in the soil.
- Damage to majority of buildings resulting large-scale loss and damage to life and property. A large section of population may be seriously injured.
- Bridges on the approach road may be collapsed resulting serious problems in rescue, relief, emergency medical care etc.
- If there is any damage to dam on the river or blockade of river by landslide, this area may face flash flood. This may result another series of problems relevant to flood hazard, including crop damage, shortage of drinking water etc..
- Many other secondary problems relevant to health care, communication, essential items for survival etc may arise.

Therefore, the risk of this area for earthquake hazard is very ***high.***

In case of heavy rainfall in the catchment area, there may be heavy discharge in the river.

Since, there is no mechanism for forewarning, people will not get information about the latest situation. In this case, people may not take shelter in safe locations.

Here again, two conditions are applicable

a) If there is no breaching of embankment, there will be no flood.
b) If there is a breach in the embankment close to the area, major problems may arise due to
    - Inundation in the entire area within short time.
    - Damage to the road and bridges.
    - Damage of life, household assets and, crop, food storage.
    - Disruption in rescue, relief, distribution of essential items, etc.

In case of flood hazard, magnitude of damage and disruption in the area may be lower to that of Earthquake. The magnitude of damage will depend on the preparedness level of the local

community. Naturally, risk factor of the area for Flood Hazard could be estimated as ***high*** or ***medium.***
Strengthening the embankment and taking some preventive measures locally addressing the local unsafe conditions, we can reduce the flood risk of the area temporarily. Long-term planning for disaster risk reduction in the area will need watershed management and proper implementation of land use regulations.

As the developmental pattern in the area is favourable for earthquake damage, planning for earthquake risk reduction may be difficult, time consuming and expensive.

3.6 VULNERABILITY OF FLOOD AND EARTHQUAKE

So far, we have discussed about different aspects of vulnerability analysis and its relation with disaster risk. Now, let us discuss specific issues of vulnerability for selected natural hazards like, flood and earthquake.

Flood and earthquake are most common natural hazards in different parts of the globe.

The causes of flood and its problem areas are briefly discussed in unit 02. Environmental degradation and more specifically ecologically destructive practices by human beings have been enhancing the magnitude of flood hazard and its impact on our systems day by day.

More or less 80% of worldwide natural hazard induced disasters occur in Asia and approximately 80% of these disasters are related to hydro-meteorological and climatic hazards. These disasters have close relationship with environmental degradation.

There is no direct affect of environmental degradation to earthquake hazard, since it is a geophysical event. But, magnitude of loss and damage due to earthquake is largely dependent on developmental patterns in the earthquake sensitive zones.

Anyhow, human actions towards environmental degradation and unsustainable development are mainly responsible for increasing trends of damage and disruption in our systems due to natural hazards like flood and earthquake.

Without addressing the reasons for environmental degradation and unsustainable development, it is not possible to mitigate disaster risk of natural hazards.

In this section, we shall try to find out the possible vulnerability factors, which are enhancing the risk of flood and earthquake hazards.

3.6.1 FLOOD

As discussed earlier in unit 01, the magnitude of flood hazard is directly related to ***rainfall pattern.*** Rainfall is dependent on some climatic conditions. Any change in climatic conditions of a region may change the rainfall pattern of this region, resulting a change in flooding pattern. The global and regional climate change due to different environmental factors may also change the timing and trajectory of monsoon and thereby changing the timing of floods in different regions. Similarly, a short time heavy rainfall may cause flash flood due to sudden increase in surface runoff of rainwater.

So, changing pattern of rainfall due to environmental degradation and change in climatic conditions has direct affect on timing and magnitude of flood hazards.

Interestingly, over the years the yearly average rainfall remained normal in most of the regions. So, many people have disagreement over the role of deforestation in rainfall and flood. According to them, geomorphic character of the rivers and human actions to contain rivers are the major reasons for sediment influx and floods (Yin and Li, 2001; Carson, 1985; Rodgers, 1989)

The second reason of flood is the ***discharge*** of river system. The discharge of the river system depends on surface runoff and gradient of the river system. High river discharge results rise in water level of the rivers. The water level of the rivers together with other local factors like embankment breaching, overflow of water etc. may lead a flood situation in the adjacent low-lying area. To some extent, surface runoff and discharge of rivers are dependent on vegetation pattern and soil characteristic of the catchment area.

Another important factor is ***carrying capacity*** of the river. Poor carrying capacity of the rivers may cause flood in the adjacent areas or lateral expansion of the river. The characteristics of catchment areas as well as slope, shape and density of river network have direct influence on carrying capacity of the rivers. The main reason for decrease in carrying capacity of a river is huge sediment influx to riverbed. Reasons for sediment deposition in the riverbed may be

- Large-scale soil erosion in the catchment areas.
- Decrease in flow current due to decrease in gradient of the river.

Failure or wrong design of ***flood protection measures*** may be another reason of flood damage. Most of the engineering flood protection measures are designed either to divert the river flow or to block overflow of the river water. While diversion of flow pattern may lead other problems like erosion in the other side of the riverbank, a breach in the embankment may cause flash flood and sand deposition in the adjacent low-lying areas. Sand deposition in fertile agricultural land may have reverse affect on production for long period.

Violation of land use regulations is another major reason for flood damage. Permanent settlement and developmental activities in low-lying flood prone areas may enhance the magnitude of flood damage and reduce crop production.

Though, there are disagreements about affects of deforestation on rainfall and flood, but in principle deforestation has direct impact on climate change, rainfall pattern, soil erosion, sediment influx etc. Hence, it is one of the major factors for flood hazard and flood damage.

Other reasons of flood damage are related to socio-economic condition and preparedness level of the vulnerable community. Some communities are living on flood prone areas for generations. Their preparedness level in terms of housing pattern, alternative agriculture, safe food storage, flood friendly communication facility, etc. made them less susceptible to flood hazard. Sometime, poor economic condition compels people to live in flood prone areas. In developing countries, poor economy is the main hindrance of disaster risk reduction process.

3.6.2 EARTHQUAKE

Earthquake is a geophysical phenomenon. The occurrence of an earthquake has nothing to do with human activities on the surface of the earth. But, all developmental activities on the earth's surface have direct impact on damage characteristics of earthquake. Hence, vulnerability analysis for earthquake hazard is relevant to human actions towards unsustainable development in the earthquake sensitive zones.

Earthquake risk assessment addresses the following issues

- Seismic zoning.

- Unsafe conditions in the earthquake prone areas.
- Capacity and preparedness level of the vulnerable communities and line departments.

Earthquake zoning

It is the process of identifying the seismically active zones both at macro and micro levels. Geologists and seismologists are working together to find out the vulnerable locations in terms of frequency, magnitude and intensity of earthquake. Geologists prepared geological maps defining the plate boundaries as most sensitive zones for earthquakes. Seismologists have been trying to verify the fact by plotting earthquake epicentral data over geological maps. The epicentral map of earthquake also shows that, the areas close to plate boundaries are most active zones for occurrence of earthquake. Detail about earthquake active belts is discussed in unit 01.

The Bureau of Indian Standard in its latest seismic zoning map shows, more than 65% of Indian territory is vulnerable to earthquake, where the intensity of earthquake may be more than VII in Modified Mercali Intensity Scale. This map divided India into four zones (zone II to V), abolishing the concept of zone I. Entire Himalayan region is considered to be highly sensitive zone with probability of occurrence of earthquake of magnitude greater than 8.0 in Richter scale.

To understand the process of zoning we must have clear idea about ***Magnitude*** and ***Intensity*** of earthquake.

Magnitude defines the ***size of an earthquake*** or ***total amount of energy released*** during an earthquake. It is measured in the unit of Richter scale, a scale developed by Charles. E. Richter in 1935.

Intensity indicates ***ground motion*** or the ***extent of damage*** at a particular place due to an earthquake. Intensity of an earthquake is measured by ***Modified Mercalli Intensity scale*** (MMI), developed by an Italian seismologist, Mercalli in 1902 and modified by Wood and Neuman in 1931.

An ***earthquake has a single magnitude***, but the intensity of an earthquake varies with magnitude of earthquake, distance of epicenter, depth of focus, soil condition and developmental pattern of the localities. The scale of intensity ranges between ***I to XII,*** based on amount of ground shaking and magnitude of damage.

Vulnerability assessment for earthquake hazard

The unsafe conditions of an area for earthquake damage could be identified by considering damage characteristics of earthquake. These are mainly related to

- Soil condition of the area, which determines the possibility of liquefaction during earthquake. Risk of liquefaction is more in sandy or lose soil, as earthquake wave amplifies in lose soil.
- Design perspectives of buildings and infrastructures. Earthquake resistant building codes defined the conditions for earthquake resistant structures. These include
    - ✓ The aspects of earthquake hazards be considered at the time of design of buildings and infrastructure.
    - ✓ Design of structure should be simple, uniform and symmetric.
    - ✓ Structures should be suitable for direct transmission of seismic force to the ground.
    - ✓ Shape and design of the structure should be appropriate to ensure bi-directional resistance and stiffness of the structure.

- Quality of construction materials. The sustainability of buildings depends on design as well as quality of materials used during construction.
- Safety status of non-structural elements of the buildings. Generally the non structural elements of buildings cause maximum damage during earthquake.
- Safety criteria, specifically for fire.
- Status of risk of the public utilities like, water supply, electricity, communication system etc.
- Haphazard town planning in terms of density of buildings, free space, road networks, etc.

The magnitude of damage and disruption is also dependent on capacity and preparedness levels. To estimate earthquake risk of a particular location we must consider

- The status and efficiency of organizational structure for risk reduction in that locality.
- Strength of individual agencies engaged in the process of earthquake disaster risk reduction, in terms of skilled manpower and equipments.
- Awareness and capacity level of vulnerable community of this locality.

A genuine risk assessment may be the guideline for practical risk reduction planning.

3.7 SOCIO-ECONOMIC VULNERABILITY AND DISASTERS

Let us discuss very briefly about the relationship between our socio-economic systems and disasters.

3.7.1 IMPACT ON SOCIETY

In fact, the nature and magnitude of disasters depends on both physical exposures to hazards and human vulnerability. *It has two dimensions*, poor socio-economic conditions of vulnerable community may enhance magnitude of disasters or a disaster may have negative affect on our socio-economic status.

Every disaster, small or big, has a negative impact on our society or community or individual. Depending on nature and dimension of the disasters, the affected community suffers economically, socially and psychologically. These conditions may encourage the hazards to cause another series of disasters.

3.7.2 COMMUNITY FUNCTIONS AND DISASTERS

We consider 'disaster' as a ***humanitarian crisis***. Whatever may be the cause of disaster, unless it affects us, we do not think about its consequences. Naturally, all disasters have close link with the elements of community functioning, like codes and norms for social control; community participation or socialization; production; distribution and consumption.

Individually, we cannot make our platform safe and sustainable. It needs coordination and active participation of community members in assessing risk and risk reduction planning. Every community has a set of codes, norms and traditions based on community's problems and needs for smooth functioning of community without facing disasters. A parallel shift from these codes, norms and tradition, may cause disastrous situation for the community.

Similarly, we have some basic requirements for our security and survival. If we do not have proper mechanism to manage these requirements ***in terms of production, distribution and consumption,*** our community may face a disaster like situation. On the other hand, if we allow a disaster to strike our platform, this will certainly alter the process of production, distribution and consumption.

3.7.3 COMMUNITY CONFLICT AND DISASTERS

It is very interesting to see that, while community conflicts may lead civil unrest, the level of community conflicts reduces significantly just after disaster. Unless a disaster strikes our platform, we do not consider ourselves as a member of vulnerable community. In practice, a disaster affects every one of a community irrespective of rich, poor, and other social status. Affected community members mostly depend on outside support. The outside agencies see community's interest first rather than person concerned.

Moreover, to tackle the problems of disaster, community people stay away from personal conflicts during disaster period. The community conflict may start again during the process of recovery and reconstruction due to political discrimination, unequal distribution of compensations etc.

3.7.4 PANIC

Most of the times, the affected community suffers from panic both sociologically and psychologically. Panic of facing disaster in near future may lead trauma. Loss of family members and damage to property may lead social and economical insecurity. Affected population starts thinking about future potential threats of their life.

3.8 WHAT WE LEARNT FROM THIS UNIT?

Vulnerability of a system is a set of unsafe conditions or elements at risk, which reduces the ability of the community to mitigate their disaster risk by preventing hazards or mitigating loss and damage or preparing them for coping with disasters.

There may be many hidden dynamic pressures on the community to generate such unsafe conditions. Every unsafe condition has some root causes. Without eliminating the root causes, we cannot remove unsafe conditions of our system permanently.

Vulnerability has multidimensional aspects like, physical, social, economical, motivational, organizational, technical, environmental, political, cultural, educational, and institutional. For practical risk reduction planning, we must take care of all these aspects of vulnerability.

Vulnerability is the main parameter of disaster risk. To mitigate disaster risk of a system, genuine vulnerability assessment and proper measures for vulnerability reduction are necessary. Because, prevention of hazards is not possible all the time.

Vulnerability assessment involves; identification of unsafe conditions and elements at risk, determination of dynamic pressures and root causes of the unsafe conditions, probable impact of hazards on the elements at risk, status of counter disaster resources to mitigate unsafe conditions and damage, vulnerability analysis to assess the level of risk and probability of loss and damage.

Participatory Risk Analysis (PVA) is the useful tool to study the problem areas and vulnerability of an area by involving the local people in assessment and planning process directly.

Vulnerability has direct link with unsustainable development and hence disaster risk. The same set of vulnerability may respond differently for different hazards. Hence, determination of susceptibility of the unsafe conditions to different hazards should be done for proper risk assessment.

3.9 PROBABLE QUESTIONS

1. What do you mean by vulnerability?
2. Discuss different aspects of vulnerability.
3. What is vulnerability assessment?
4. Define the steps of vulnerability assessment.
5. What do you mean by progression of vulnerability?
6. Which unsafe conditions may enhance flood risk and what may be the root causes of these unsafe conditions?
7. What do you mean by PVA?
8. What are the different aspects of PVA?
9. How vulnerability is related with disaster risk and unsustainable development?

3.10 SUGGESTED READINGS

1. Participatory Vulnerability Analysis: A Step-to-Step Guide for Field Staff, Actionaid International, 2005.
2. Study material: Fourth International Course on CBDM, ADPC, 2000 (Module-3, pp 53)
3. Reading Material: Training Programme on Environment and Disaster Management, NIDM, 2010 (pp 6)
4. Alexander, D., Natural Disasters, Published by ULC Press Ltd, London, 1993 (PP 554, 555, 557,559)

FUNDAMENTALS OF DISASTER MANAGEMENT (DEM104)
UNIT-4: OVERVIEW OF DISASTER PHENOMENA

UNIT STRUCTURE

4.1 INTRODUCTION

During last few decades, many international and national agencies have undertaken a series of programmes on disaster management. Many countries have already formulated disaster management policies. Different academic institutions have been conducting academic and research programmes on disaster management. The basic objective of all these programmes is to find out the way for mitigation of disaster risk at national and regional levels.

To formulate future strategies for disaster risk reduction at global and national level, it is essential to review the outcomes of our past activities. This can be done by studying the trends of disaster phenomena worldwide. The major constraint for this kind of study is the lack of genuine database. There is variation in data and information collected by different organizations time to time, which makes it difficult to judge the authenticity of a particular set of data.

In units 01, 02 & 03, we have seen major paradigm shift in the approaches and methodologies of studying disaster risk and its mitigation mechanism. This unit is designed to study the global, national and regional disaster scenario and its trends. The risk of different natural hazards in Indian subcontinent and their impacts will be highlighted in this unit. We shall also discuss about the disaster risk factors of different communities in India for different natural hazards.

4.2 OBJECTIVES

The main objectives of this unit are

- To study the global trend of disaster phenomena, based on available data and information.
- To review the status of damage and disruption due to natural hazards in India and world.
- To discuss the nature of threats to different communities in India.

4.3 DISASTER PHENOMENA AND EVENTS *(GLOBAL AND REGIONAL)*

4.3.1 GLOBAL SCENARIO

More or less all parts of our globe are prone to one or more types of natural hazards. The impact of natural hazards, in terms of loss and damage to life and property, is very high in the developing and third world countries in comparison to developed countries due to many social and economical factors. Different organizations like EM-DAT; Centre for Research on Epidemiology of Disaster (CRED); Natcat and Sigms; Munich Reinsurance Company etc. are collecting data and information relevant to occurrence of disasters worldwide to study their nature, types, trends, damage pattern etc.

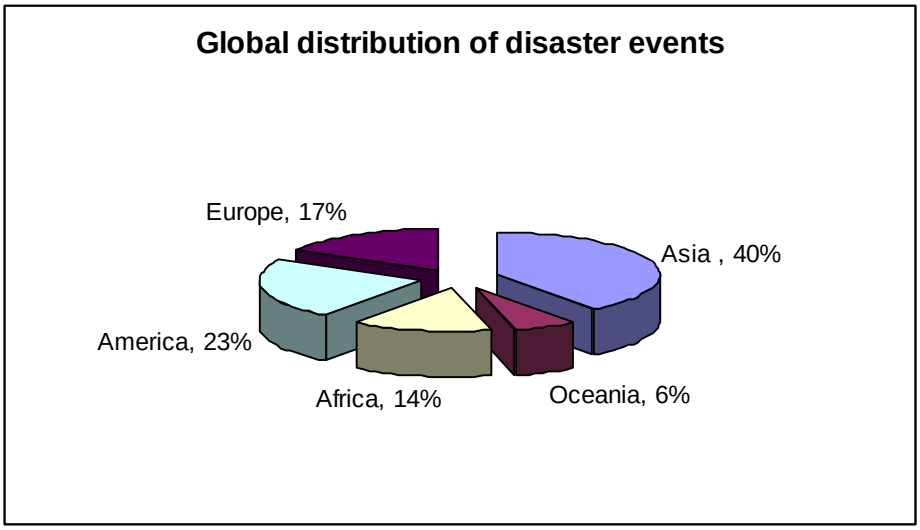
Though, it is difficult to determine accurately the percentage of global or regional land area vulnerable to a specific natural hazard but, works are going on for preparation of global and regional zoning maps for different natural hazards. Zoning maps for most of the natural hazards are available with different organizations, subject to updatation with recent data.

The map below represents global seismic hazard map, produced by ***Global Seismic Assessment Programme*** (DSHAP) under a project of IDNDR. This work conducted by ***International Lithosphere Programme*** and **Assembled by: *D. Giardini; G. GrYnthal; K. Shedlock and P. Zhang.***

The Global Seismic Hazard Map,
Source: geology.about.com/library/bl/maps/n_map_GSHAP1500.htm

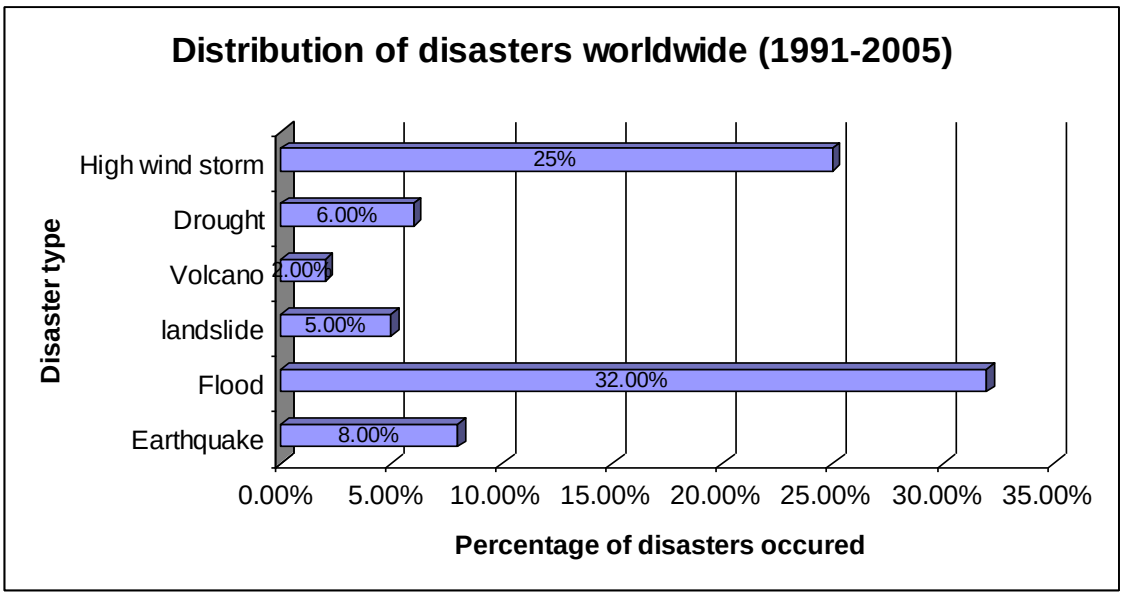
Amongst the continents; the Asia comprising of South Asia, Southeast Asia, East Asia, Southwest Asia and Central Asia; is the most natural hazard prone region of the world. This region covers about 30% of global land area and more or lass 60% of total world's population. According to the ***world Disaster Report, 1997, IFRCRCS***, around 46% of the world's

disasters occurred in Asia and Oceania during 1971-1995. During this period, around 88% of world's total affected population due to natural hazards was from Asia and Oceania. *The criteria for considering a disaster event are death of 10 people or 100 people affected or there is appeal for external support.* (Source: ADPC study material, Fourth International Course on CBDM, 2000).



Data source: Asian Disaster Preparedness Centre, Bangkok
(Study material of fourth International Course on CBDM, 2000)

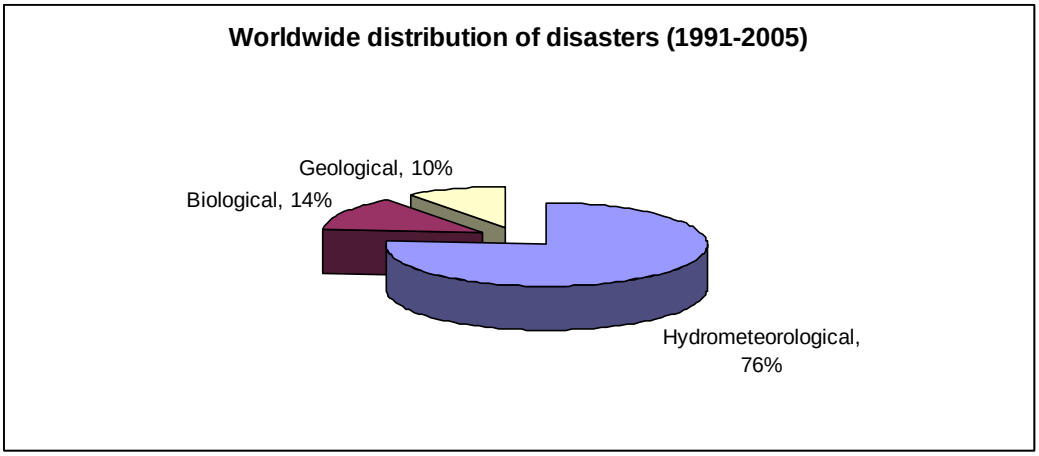
As per data, 23% of world's total disasters occurred in America during 1971-1995, but the population affected was only 3% of total affected population of the world.



[Data source: EM-DAT: Centre for Research on Epidemiology of Disaster / Disaster Management in India, 2011, Published by, Ministry of Home Affairs, Government of India]

The data of ***Centre for Research on Epidemiology of Disaster*** shows, about 32% of total world's disasters during 1991-2005 were originated due to flood hazard followed by high windstorm 25%, earthquake 8%, drought 6%, landslide 5% and volcano 2%. It indicates, yet flood hazard is the major source of disasters all over the world.

The same source of data shows that, the origin of 76% of total world's disasters during 1991-2005 was hydro-meteorological.



The geological hazards caused 10% of total disasters, while 14% of disasters were due to biological hazards.

To see the trends of worldwide occurrence of disasters caused by Hydro-meteorological, Geological and Biological hazards, let us analyze the data of Centre for Research on Epidemiology of Disaster for the period 1900 – 2009.

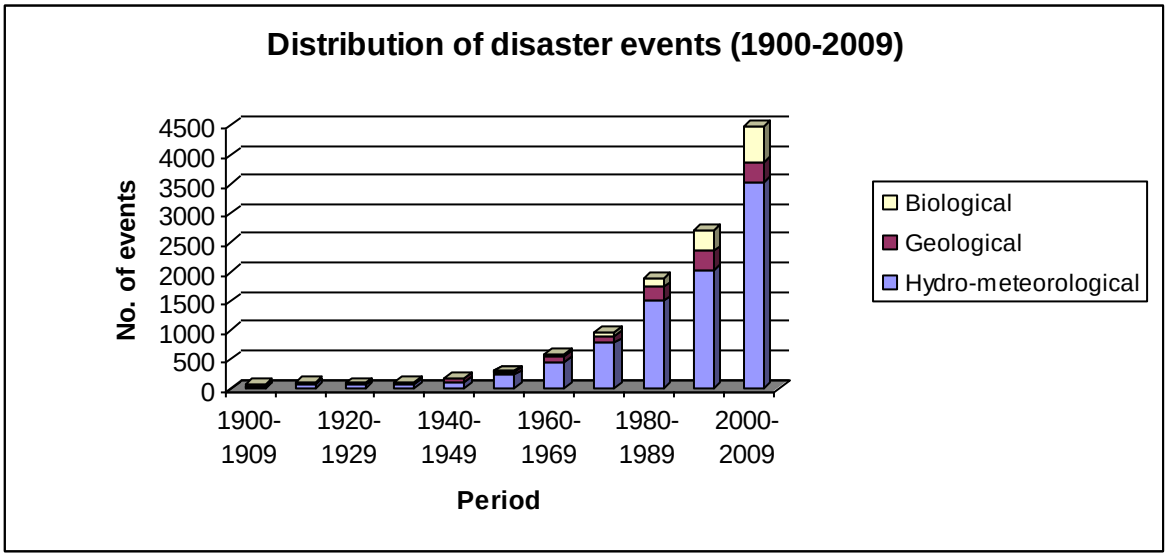


Fig.: Distribution of disaster events during 1900-2009 ***(Data source:*** *Disaster Management in India, 2011, Published by, Ministry of Home Affairs, Government of India)*

It is evident from the above figure that, numbers of disasters caused by different hazards are increasing sharply and disproportionately. Out of which, the increase of disaster events due to Hydro-meteorological hazards is noticeable. This clearly indicates that, over exploitation of natural resources, violation of land use regulations, environmental degradation, and climate change due to human interference to nature, are mainly responsible for sharp increase of hydro-meteorological hazards.

4.3.2 INDIAN SUBCONTINENT

The Indian subcontinent is exposed to most of the natural hazards like flood, earthquake, cyclone, landslide, hailstorm, drought etc.

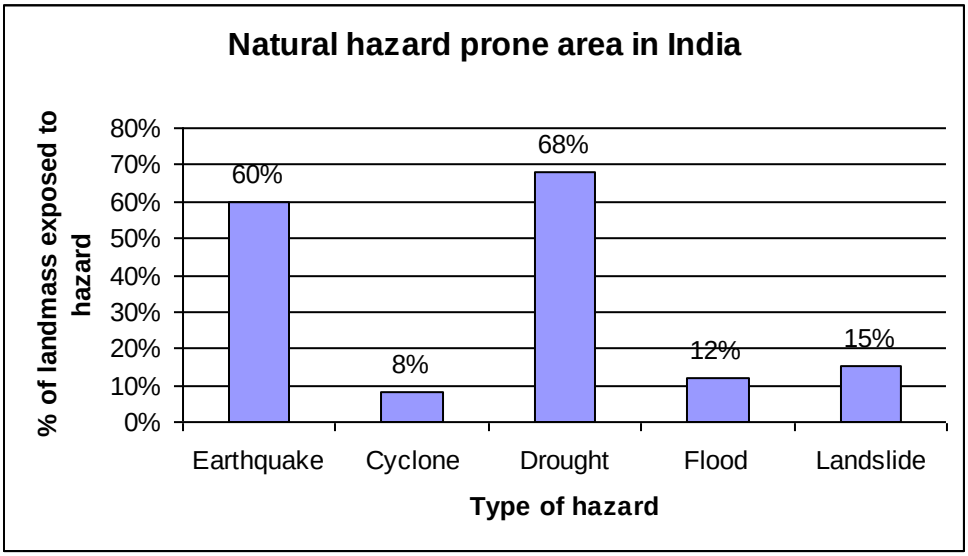


Fig.: Landmass of India exposed to different natural hazards

Data source: *Sharda, Y. R., Landslide Studies in India,* ***Glimpses of Geoscience Research in India,*** *The Indian Report to IUGS 2004–2008, New Delhi, The Indian National Science Academy (INSA).*

Above figure shows that, maximum landmass of India is prone to drought. The loss and damage is not visible in the case of drought, as it does not kill people or damage structures directly. But, if we see the statistics, maximum number of people in India are vulnerable to drought and it has significant negative impact on our national economy.

Though, only 12% of Indian landmass is prone to flood, but it causes significant loss and damage to life, property and economy. Fortunately, the frequency of most dreaded hazard like earthquake is comparatively far below than other natural hazards. Even then, it caused maximum loss, damage and disruption at different times. Landslide hazard is also not a dominant factor in India for direct loss and damage but, it causes enormous secondary disturbances every year, specifically in hilly regions. The hilly ranges of India, highly prone to landslides are

Himalayas	Very high
North-Eastern Hill Ranges	High
Western Ghats and Nilgiris	High to Moderate
Eastern Ghats	Low
Vindhyas	Low

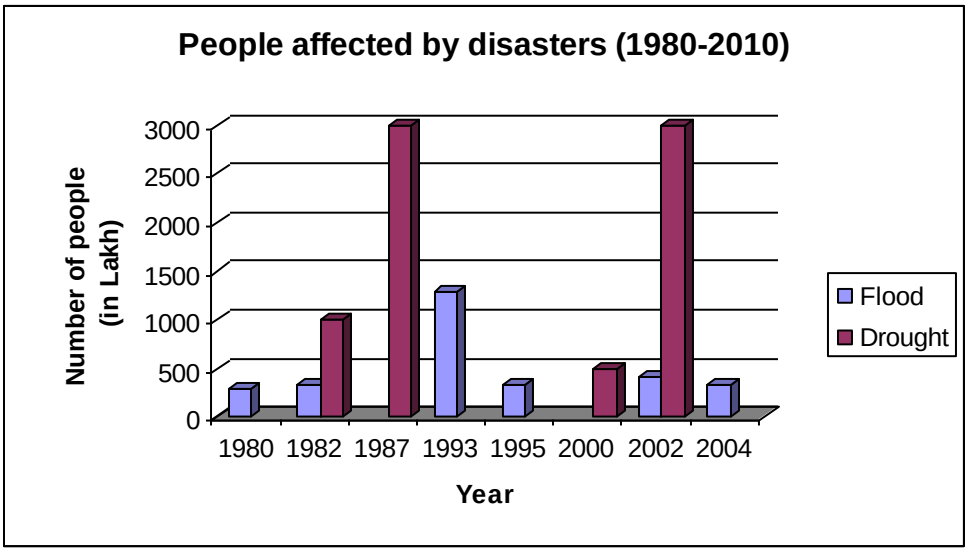


Fig: Number of people affected by natural hazards in India during 1980-2010
Data source: *EM-DAT: CRED / Disaster Management in India, 2011, Published by, Ministry of Home Affairs, Government of India*

As mentioned earlier, the figure above also shows that, the number of people in India vulnerable to drought is much higher than any other natural hazards. Every year, the flood hazard also affects a sizable number of populations in India.

Let us see the pattern of loss of life in India due to different natural hazards induced disasters during the period 1980-2010.

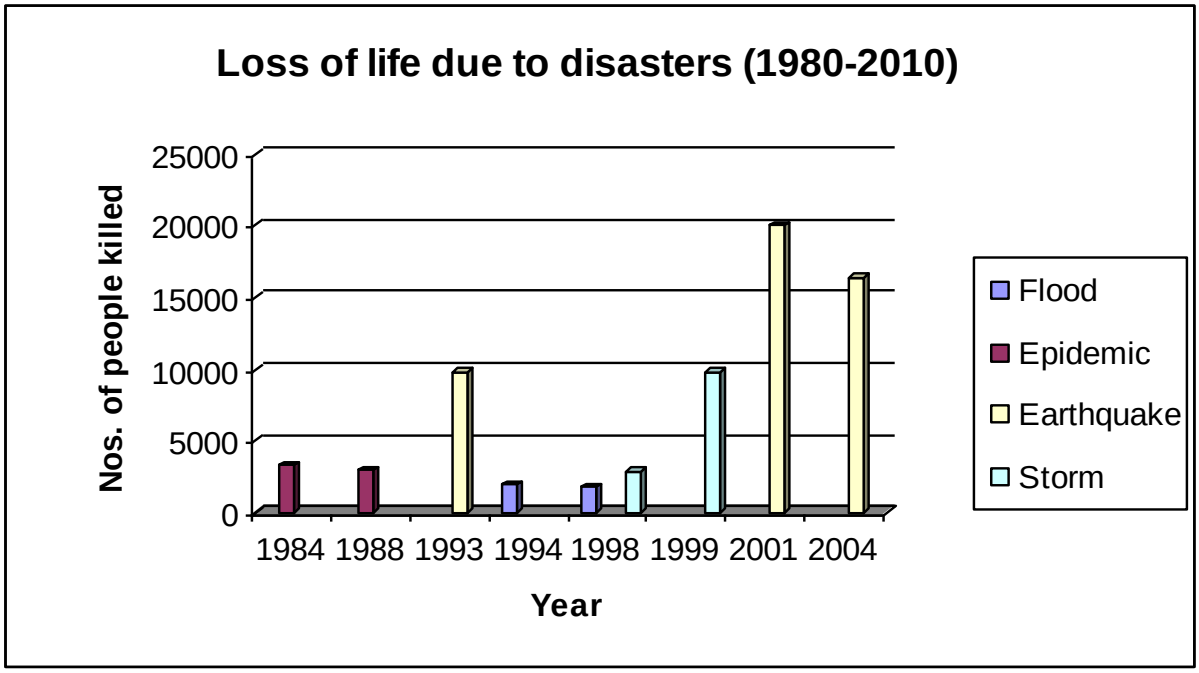


Fig: Number of people killed by natural hazards in India during 1980-2010
Data source: *EM-DAT: CRED / Disaster Management in India, 2011, Published by, Ministry of Home Affairs, Government of India*

Though, the frequency of earthquake is quite low, but it kills maximum number of people in India followed by storm. This is due to haphazard urbanization and unsustainable development in most parts of India. Most people are either not aware about their disaster risk or not in a position to follow the codes and norms for sustainable development due to their poor economic condition.

The alarming rate of the crop damage due to flood, drought, storm etc. is the major concern for India. Figure below shows the nature of loss and damage due to various natural hazards except earthquake for last ten years.

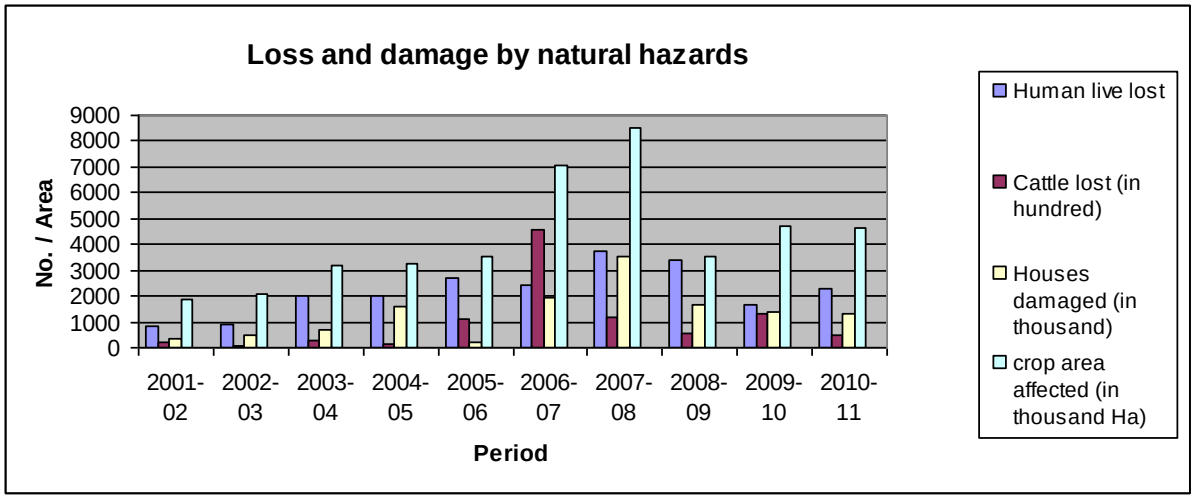


Fig: Yearly loss and damage due to natural hazards like, flood, cyclone, storm, landslide etc. (2001-2010)

Data source: *Disaster Management in India, 2011, Published by, Ministry of Home Affairs, Government of India*

4.3.3 THE FLOOD SCENARIO IN INDIA

Flood is one of the most disastrous annual events in India, which causes enormous damage and disruption to life, property and economy every year. The nation has to bear the economic burden of loss and damage, but yet there is no foolproof mechanism available for practical flood risk mitigation.

The major flood prone zones in India are

- Brahmaputra and Barak Basins comprising mainly the flood prone areas of Assam and West Bengal. This basin covers other North-Eastern States also.
- Ganga Basin covers large areas of West Bengal, Bihar and Uttar Pradesh.
- Central India and Deccan Rivers Basin spread over Orissa, Kerala, Andhra Pradesh and Tamil Nadu.

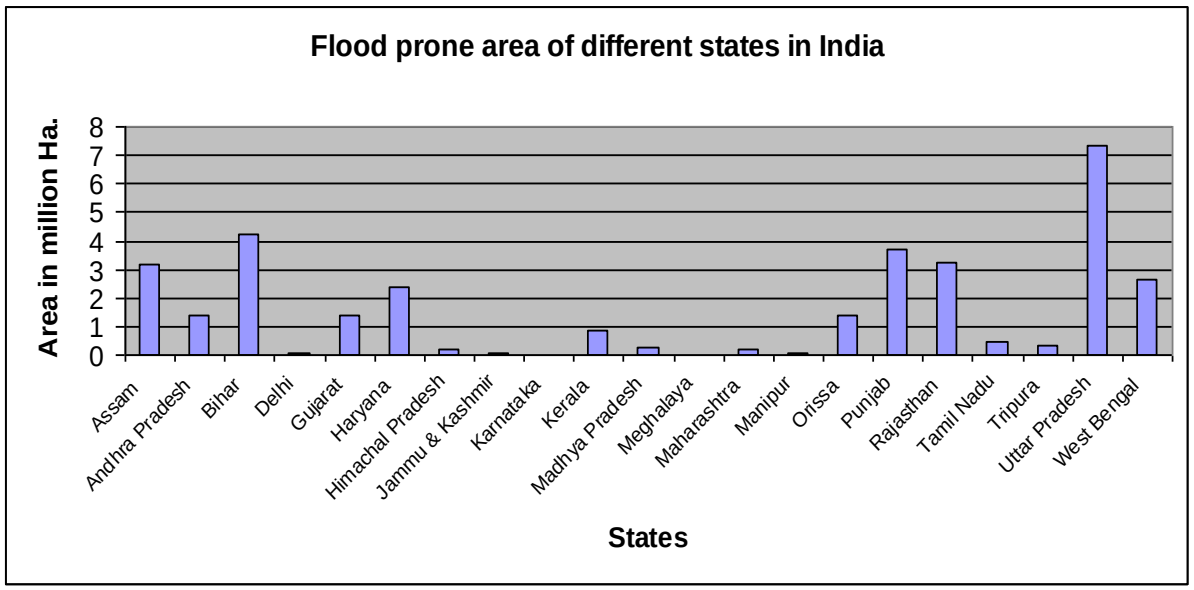


Fig.: Flood prone area of different states

Data source: *mapsofindia.com/top-ten/geography/india-flood.html*

The state Uttar Pradesh has maximum flood prone area followed by Bihar, Panjab, Rajastan, Assam, West Bengal etc. But, the severity of flood in terms of loss and damage depends on geo-climatic and other vulnerable conditions of the states. This loss and damage may not be proportional to total flood prone area of the state.

4.3.4 WORST DISASTER EVENTS (GLOBAL AND REGIONAL)

Ten worst disasters all over the world during the period ***1900-2011*** due to ***Earthquake, flood*** and ***cyclone*** based on ***people killed, people affected*** and ***national economic loss*** are mentioned here.

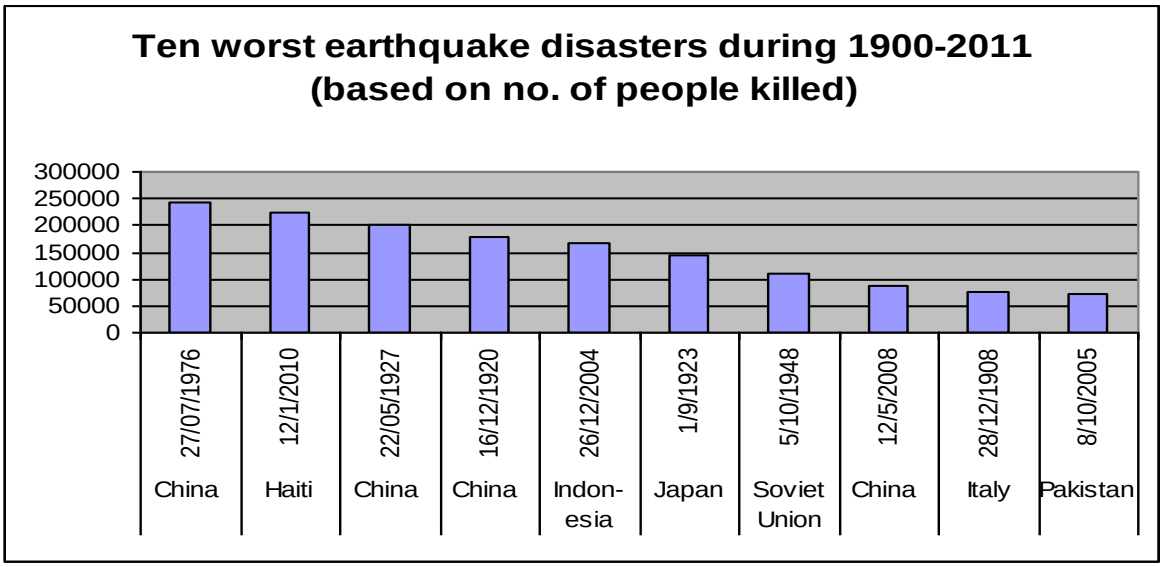


Fig.: Worst earthquake disasters all over the world during 199-2011 based on number of people killed

Data source: *(EM-DAT) - OFDA/CRED International Disaster Database www.emdat.be - Université catholique de Louvain - Brussels - Belgium*

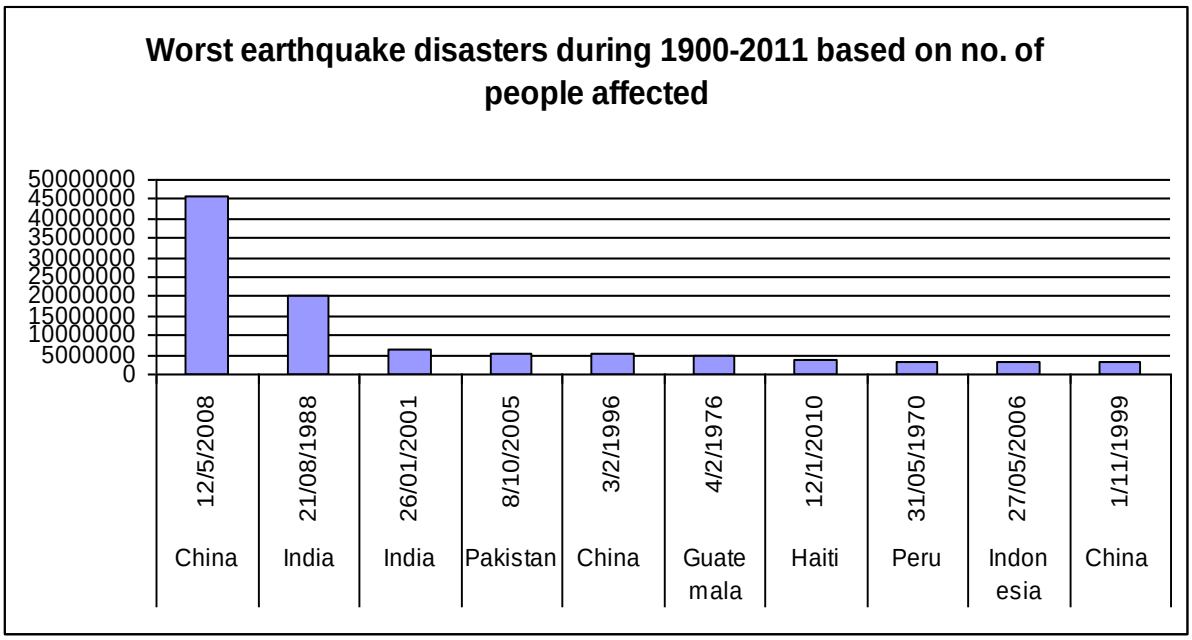


Fig.: Worst earthquake disasters all over the world during 199-2011 based on no. of people affected

Data source: *(EM-DAT) - OFDA/CRED International Disaster Database www.emdat.be - Université catholique de Louvain - Brussels - Belgium*

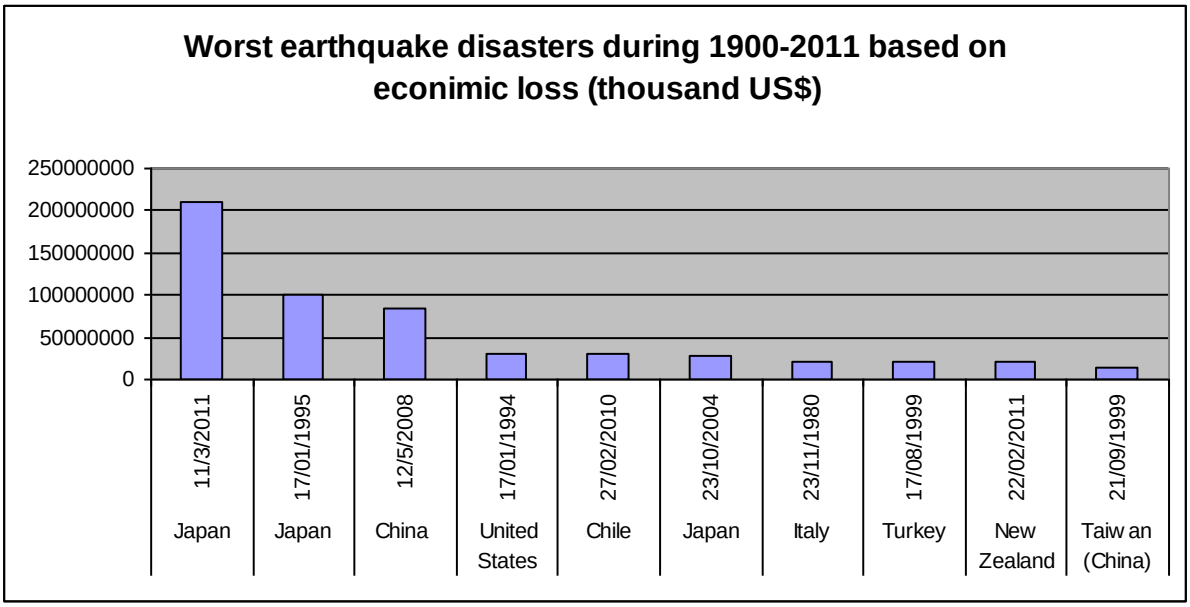


Fig.: Worst earthquake disasters all over the world during 199-2011 based on economic loss (thousand US$)

Data source: *(EM-DAT) - OFDA/CRED International Disaster Database www.emdat.be - Université catholique de Louvain - Brussels - Belgium*

In terms of loss of life and population affected by the earthquake hazard during last century, China and India are much ahead of other countries like, Japan, Indonesia etc. But, disasters due to earthquake hazard caused maximum economic loss in Japan during last hundred years.

It clearly depicts that, population density and unsustainable development are mainly responsible for high magnitude loss and damage to life and property in case of earthquake induced disasters.

The country like Japan is highly prepared to mitigate loss and damage due to earthquake disaster. But, in March, 2011 Japan had to face greatest ever disaster in terms of national economic loss. Such high magnitude economic loss was not due to the impact of earthquake alone. The tsunami caused maximum damage and disruption. May be the country was not prepared to face such high magnitude tsunami or spatial vulnerability factors dominated over preparedness level of the country. So planning for disaster risk mitigation for earthquake hazard is a complex mechanism.

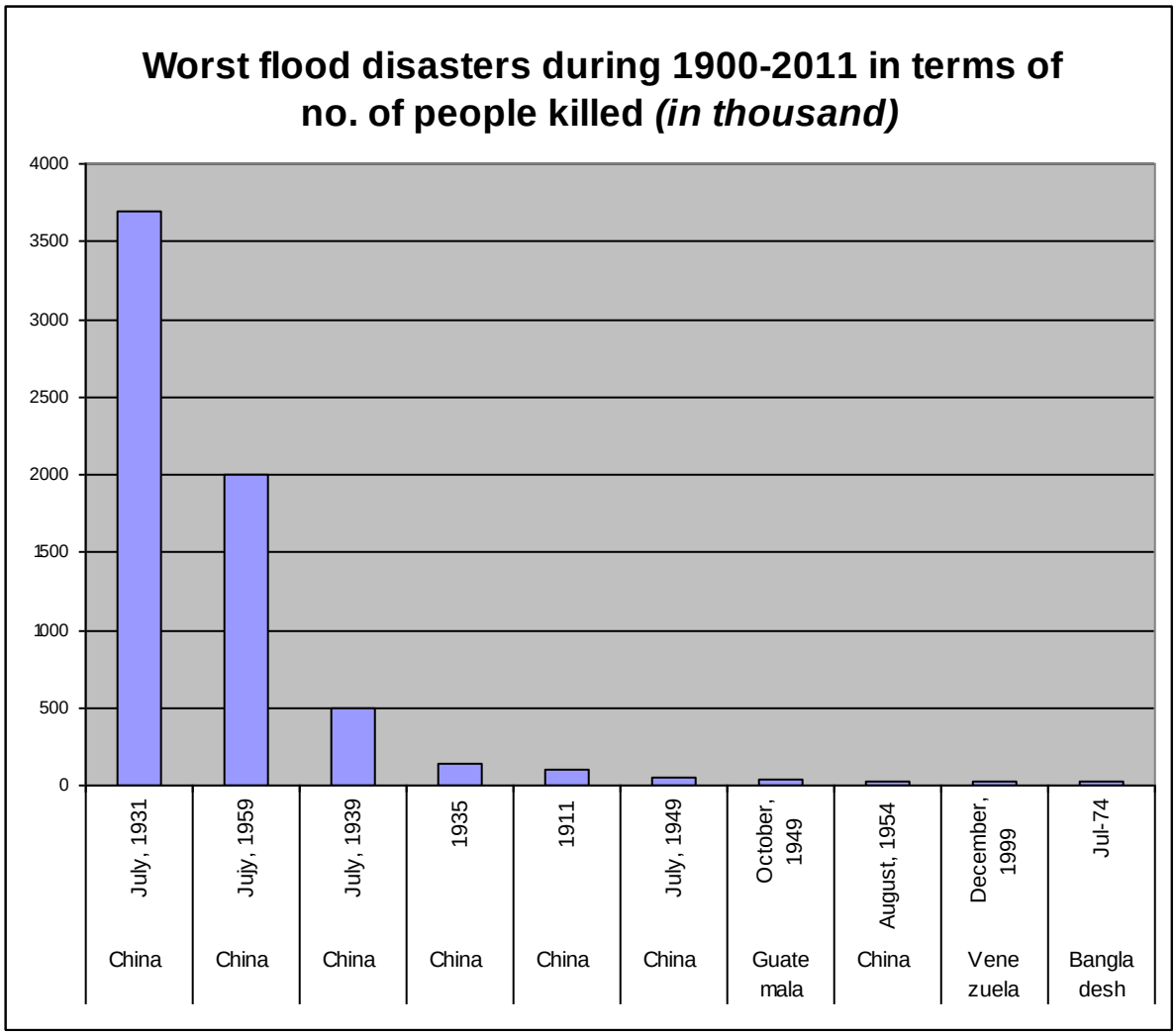


Fig.: Worst flood disasters all over the world during 199-2011 based on no. of people killed

Data source: *(EM-DAT) - OFDA/CRED International Disaster Database*
www.emdat.be - Université catholique de Louvain - Brussels - Belgium

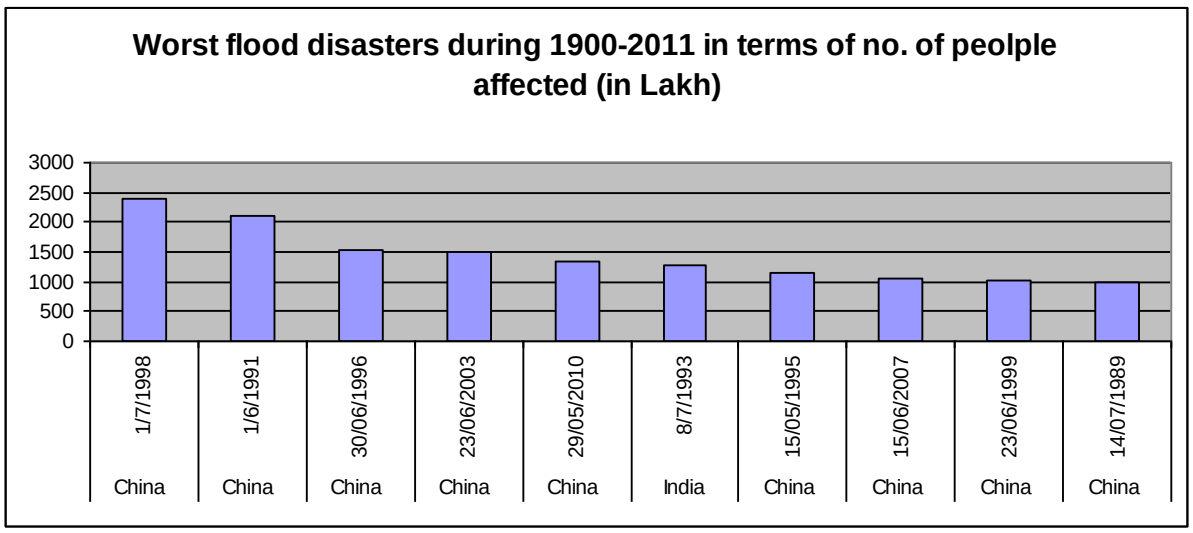


Fig.: Worst flood disasters all over the world during 199-2011 based on no. of people affected in lakh

Data source: *(EM-DAT) - OFDA/CRED International Disaster Database*
www.emdat.be - Université catholique de Louvain - Brussels - Belgium

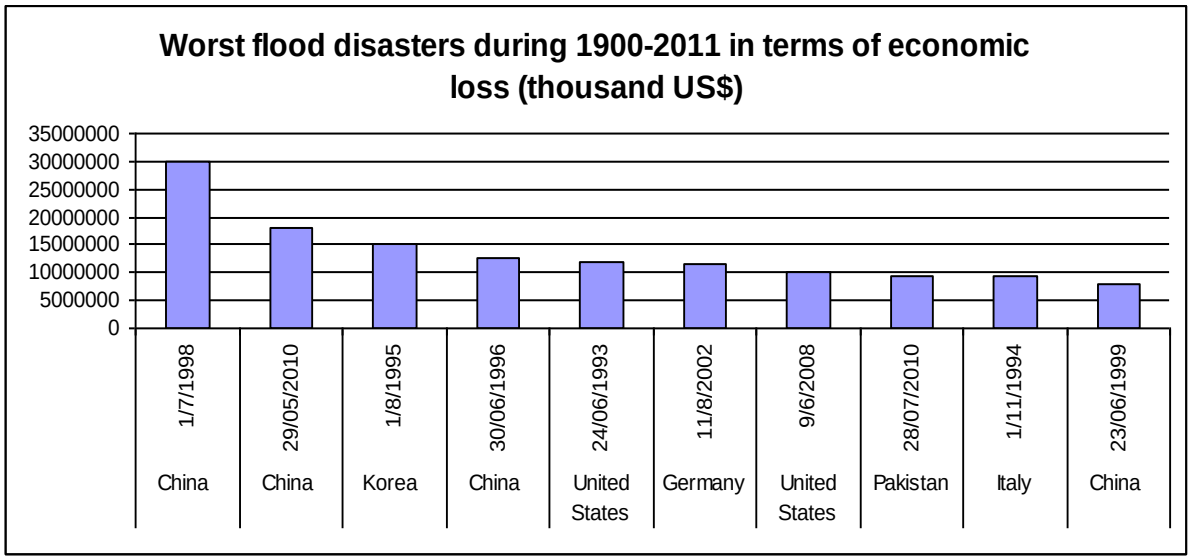


Fig.: Worst flood disasters all over the world during 199-2011 based on economic loss (thousand US$)

Data source: *(EM-DAT) - OFDA/CRED International Disaster Database www.emdat.be - Université catholique de Louvain - Brussels - Belgium*

During last century, China suffered most due to flood hazards in terms of loss of life, people affected and national economic loss. For flood induced disaster loss and damage; the spatial factors along with population density, land use and developmental pattern dominate over other factors.

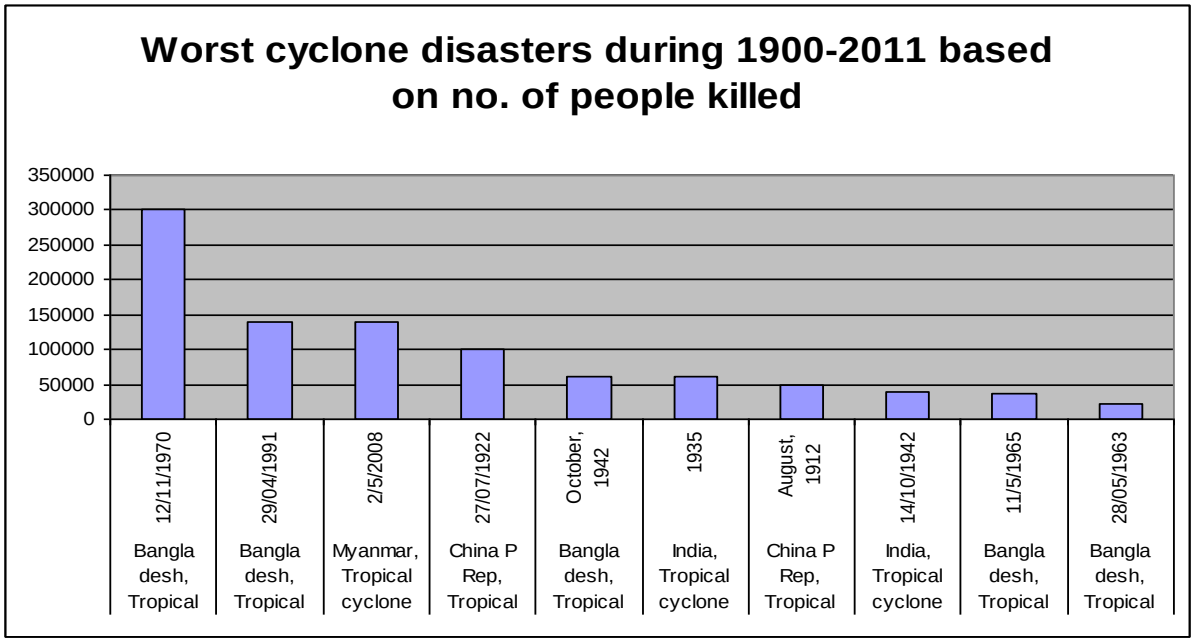


Fig.: Worst cyclone disasters all over the world during 199-2011 based on no. of people killed

Data source: *(EM-DAT) - OFDA/CRED International Disaster Database www.emdat.be - Université catholique de Louvain - Brussels - Belgium*

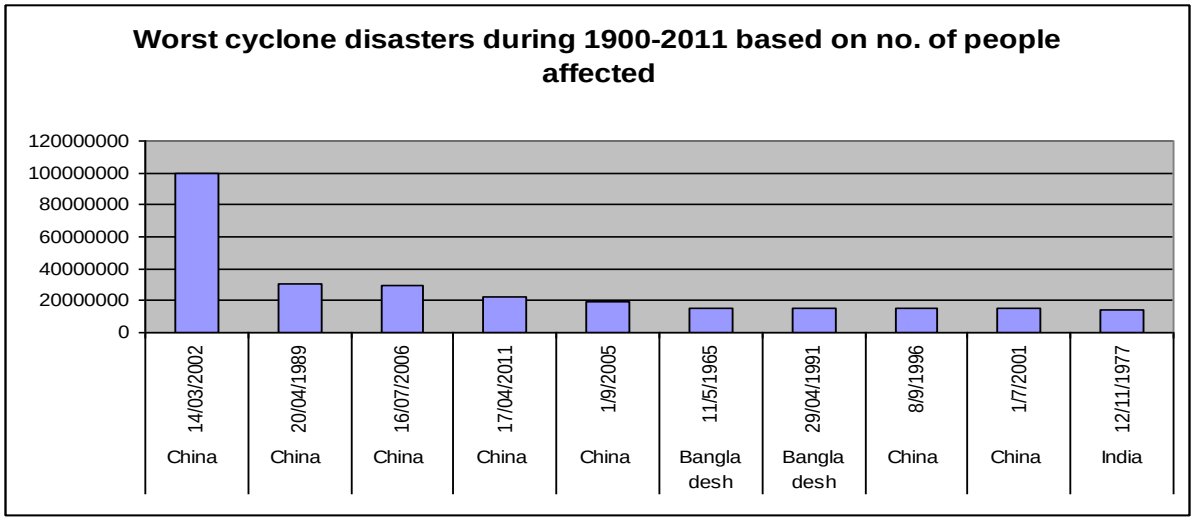
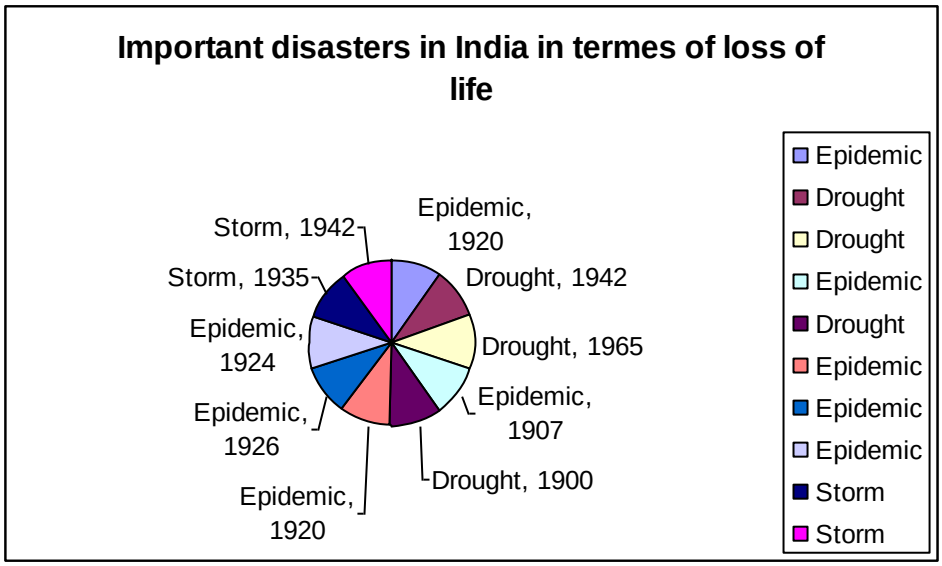


Fig.: Worst cyclone disasters all over the world during 199-2011 based on no. of people affected

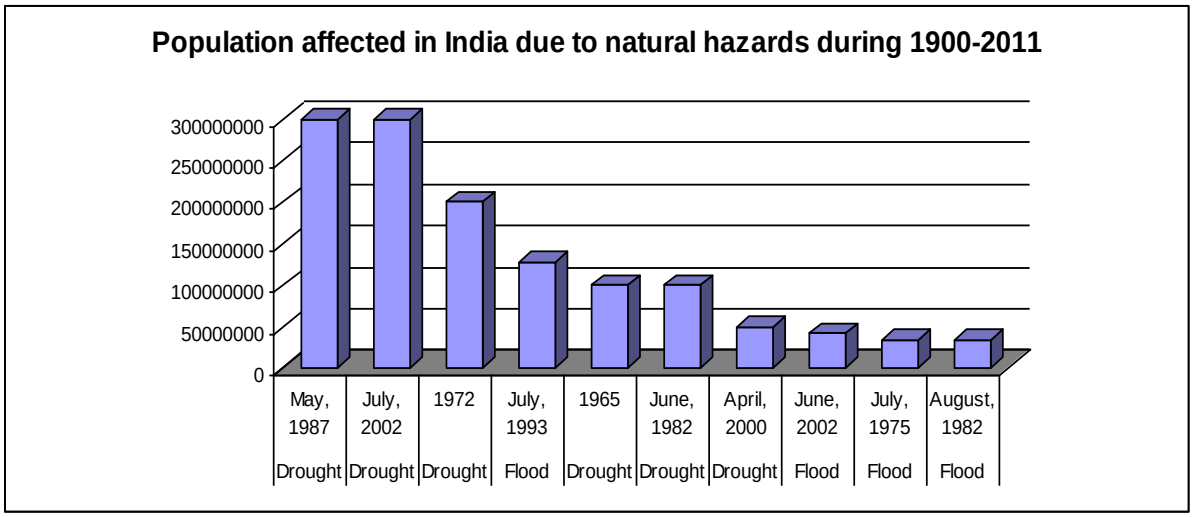
Data source: *(EM-DAT) - OFDA/CRED International Disaster Database www.emdat.be - Université catholique de Louvain - Brussels - Belgium*

The above figures depict, tropical cyclone kills more people in Bangladesh than any other country. Highest numbers of people in china suffered from cyclone. This indicates, spatial factors as well as preparedness level of the community determine the risk of cyclone damage.

4.3.5 IMPORTANT DISASTERS IN INDIA BASED ON LOSS OF LIFE AND AFFECTED POPULATION



Data source: *(EM-DAT) - OFDA/CRED International Disaster Database www.emdat.be - Université catholique de Louvain - Brussels – Belgium*



Data source: *(EM-DAT) - OFDA/CRED International Disaster Database*
www.emdat.be - Université catholique de Louvain - Brussels – Belgium

In India, epidemic and cyclone kill more people than other natural hazards, while major population in India suffers from drought and flood hazards. The epidemic is the secondary hazard of many primary natural hazards. Naturally, this depicts our poor awareness and preparedness levels to cope with such disasters.

4.3.6 MAJOR EARTHQUAKES IN INDIA (1618 – 2001)

Year	**Place**	**Magnitude** *in Richter Scale*	**Intensity** (MMI Scale)	**Features**
1618	Bombay	-	-	2000 lives lost
1720	Delhi	6.5	-	Some lives lost
1737	Bengal	-	-	300,000 lives lost
1803	Mathura	6.5	-	The shock felt up to Calcutta.
1803	Kumaon	6.5	-	Killed 200-300 people.
1819	Kutchch	8.0	XI	Chief towns of Tera, Kathara and Mothala razed to the ground.
1828	Srinagar	6.0	-	1000 people killed.
1833	Bihar	7.7	X	Hundreds of people killed
1848	Mt.Abu, Rajasthan	6.0	-	Few people killed
1869	Assam	7.5	-	Affected an area of 2,50,000 Sq. miles.
1885	Srinagar	7.0	-	Kamiarary area destroyed.
1897	Shillong	8.7	XII	Wide spread destruction in Shillong.
1905	Himachal Pradesh	8.0	XI	Thousands of people killed.
1906	Himachal Pradesh	7.0	-	Heavy damage.
1916	Nepal	7.5	-	All houses collapsed at Dharchulla.
1918	Assam	7.6	-	Heavy damage.

1930	Dhubri, Meghalaya	7.1	IX	Heavy damage in Dhubri.
1934	Bihar, Nepal	8.3	XI	Large number of border area people killed.
1935	Quetta (in Pakistan)	7.5	IX	25,000 people killed
1941	Andaman	8.1	X	Very heavy damage.
1947	Dibrugarh	7.8	-	Heavy damage.
1950	Assam	8.6	XII	Heavy damage to life and property.
1952	NE India	7.5	-	Heavy damage.
1956	Bulandshahar, U.P.	6.7	VIII	Many people killed
1956	Anjar, Gujarat	7.0	VIII	Hundreds of people killed
1958	Kapkote, U.P.	6.3	VIII	Many people killed
1967	Koyna,	6.1	VIII	Koyna Nagar razed.
1969	Bhadrachalam	6.5	1	Heavy damage.
1986	Dharamshala (H.P)	5.7	VIII	Lots of damage.
1988	Assam	7.2	IX	Few people killed
1988	Bihar- Nepal	6.5	VIII	Large number of people killed.
1991	Uttarkashi	6.6	VIII	Lots of damage to life and property.
1993	Latur	6.4	VIII	Heavy damage to life and property about, 000 people killed.
1997	Jabalpur	6.0	VIII	Lots of damage to property, about 39 lives lost.
1999	Chamoli	6.8	VIII	Lots of damage to property about 100 people lost lives.
2001	Bhuj	6.9	X	Huge devastation, about ~ 14000 people lost lives

Data source: *National Geophysical Research Institute, India (Tezpur Centre)*

4.3.7 FEW RECENT EARTHQUAKES IN NORTH-EASTERN REGION OF INDIA

Date	**Magnitude** *(Richter Scale)*	**Epicenter**
August 12, 2009	5.6	Myanmar border
August 19, 2009	4.9	Sonitpur, Assam
August 31, 2009	5.3	Myanmar border
September 04, 2009	5.9	Myanmar border
September 21, 2009	6.2	Bhutan
September 22, 2009	5.7	NE Region
February 04, 2011	6.4	Myanmar Border
September 18, 2011	6.9	Sikkim - Nepal Border

4.4 INDIA – HAZARD SPECIFIC DISASTER RISK AND IMPACT OF HAZARDS

As discussed earlier in this unit, almost all the states of India are multi-hazard prone. The vulnerability of all the states for a specific hazard is not same. The disaster risk factors of different states for different natural hazards are dependent on geo-climatic conditions and other vulnerability factors of the states. The disaster risk of India for some common natural hazards is outlined below

4.4.1 FLOOD

As discussed earlier, almost 12% of Indian landmass is prone to flood. Most of these areas are vulnerable to seasonal flood due to heavy or moderate rainfall over short monsoon seasons, June - September. The rainfall data recorded by meteorological sub-stations spread over the country showed a variation of rainfall in the country from highest 10000 mm in Cherrapunji to lowest 200-300 mm in Jaisalmer. The Ganga-Brahmaputra-Meghna river basin covers almost 60% of the river flow in India. Floods are common and frequent in this basin area.

Assam is suffering from serious flood and erosion problems. Inundation in low-lying areas, close to Brahmaputra and Barak rivers and their tributaries, is a common annual phenomenon due to spilling of river water, drainage congestion, decrease in carrying capacity of rivers by heavy sediment influx, change in river courses etc.

The rivers Tista, Torsa, Jaldhaka, Mahananda are causing threats of flood damage in West Bengal. The areas adjacent to northern bank of Ganga river are vulnerable to flood. Rivers like Gandak, Sharada, Rapti, Ghaghra are causing floods in eastern districts of Uttar Pradesh.

The Mahananda, Kosi, Burhi Gandak, Kamla, Bagmoti etc. are creating flood havoc in Bihar. Some parts of Haryana along the bank line of Yamuna river are experiencing moderate flood problems. Yamuna river also creates flood problem in some parts of Delhi.

Godavari, Krishna and other small rivers are liable to cause floods in Andhra Pradesh and Kerala. While rivers like Tapti, Narmada are responsible for flooding in part of Gujrat. Mahanadi, Brahmani, Baitarni rivers cause flood havoc in Orissa.

Nepal is also contributing inflow in the northern rivers along with rainfall in Indian territory. This makes some parts of northern India vulnerable to flood. West Bengal, Orissa, Assam, Kerala, Andhra Pradesh, Bihar, Gujrat, Uttarpradesh, Haryana and Panjab are the most flood prone states in India.

About 40 million hectares of land in India is prone to flood hazard, which causes an average annual loss not less than 950 Crore.

Few examples are given here to describe the flood prone areas in India and impact of floods in these areas.

Source: Nandy Supriyo, Floods in India – Disaster and Management (www.internationalfloodnetwork.org/AR2006/AR08Nandy.pdf)

In 1993, Panjab, Haryana, Rajastan, Himachal Pradesh, Delhi, Gujrat, North-Eastern States suffered heavy loss and damage of life and property due to floods.

In 1994, more than 150 people died in Kerala due to flood. Over 10000 people affected in Madhya Pradesh. 50 people died in Himachal Pradesh due to cloud burst. Karnataka also experienced worst flood.

In 1995, flash floods claimed more than 215 lives in Uttar Pradesh, Haryana and Arunachal Pradesh. West Bengal and Sikkim also faced severe floods.

In 1996, 150 villages were affected by flood in Rajastan claiming 58 lives. 137 people died in Andhra Pradesh and massive crop damage reported from the state due to severe flood. Cloud burst in Chirgaon of Himachal Pradesh claimed 150 lives in the year 1997.

The Kaziranga National Park in Assam had seen worst ever flood in 1998. 95% of the park remained inundated for long period due to three phases of floods. As a result, a large number of wild animals including one-horn rhinos died or disappeared.

In 2000, more than 130 people died in Himachal Pradesh due to flash flood. Over 60000 population of Tripura suffered from severe floods in 2001.

The flash flood of Mumbai in September, 2005 may be considered as one of the greatest floods in India. The city experienced 37 inches of rainfall within 24 hours. 25 million people affected due to flood in Maharashtra. 1200 people died in the state due to floods. Water born diseases claimed 150 lives. 20000 Hectares farmland destroyed. 550000 Hectares crop area damaged. 26000 Cattles died. 14000 homes destroyed completely and another 350000 houses destroyed partially. Communication facilities disrupted heavily due to damage to roads and bridges.

Let us see few examples of floods in Assam, which is one of the most flood prone states in India.

In 1973, floods in Assam claimed live of 19 people and 3159 cattle. 22 lakh people were affected by flood. 10 lakh Ha. of crop areas destroyed and 29596 houses collapsed due to flood. The state witnessed more or less similar situation in 1974, 1984, 1986 and 1987.

In 1988, more than 232 people died due to severe floods in different parts of the state. 618272 houses destroyed and 45210 cattles died. 1.13 lakh Ha. of crop area damaged due to inundation or sand deposition. The state had to bear the cost of wide range loss and damage due to severe floods and erosion in the consecutive years 1991, 1992, 1994, 1995, 1996, 1997, 1998 and 1999. In the recent years also, the magnitude of loss and damage due to flood and erosion remained unchanged.

Observations: Breaching of the embankments caused most of the floods in Assam. The main reason of perennial flood and severe bank-line erosion in the state lies with continual decrease of carrying capacity of the rivers due to excess sediment transport from upper catchment areas. The failure of flood and erosion protection mechanisms is another reason for severe loss and damage of life and property in the state.

4.4.2 EARTHQUAKE

The Alpine – Himalayan belt, separating the Indian and Eurasian plates, is one of the most earthquake sensitive belts. This often results high or medium range earthquakes in the areas close to this belt. Most earthquakes of varying intensity all over the India are the result of fault lines in Himalayan region, Andaman and Nicobar Islands. More than 60% of landmass of India is vulnerable to earthquake damage of expected intensity ranging from XI to VI.

- ✓ Entire North-Eastern region, Parts of Kashmir, Panjab, Delhi, Gujrat; Western and Central Himalayas fall in zone **V**. These areas are considered to be highest damage zone of earthquake.

- ✓ Indo-Gangetic basin, parts of Delhi, Kashmir fall in zone **IV** and considered to be high damage zone for earthquake hazard.

- ✓ Andaman and Nicobar Islands, parts of Kashmir, Western Himalayas fall in zone **III** and liable for moderate damage to earthquake hazard.

- ✓ Rest of the country falls in zone II of low damage zone of earthquake hazard.

India has witnessed a number of devastating earthquakes during last hundred year.

- ✓ In 1905, over 20000 people died due to an earthquake of magnitude 8.0 in Richter Scale in Kangra of Hilachal Pradesh.

- ✓ In 2001, an earthquake of magnitude 6.9 in Richter scale struck Bhuj area of Gujrat. This earthquake caused enormous loss and damage to life and property of Gujrat state. More than 20000 people died due to this earthquake. The property of an estimated cost of Rs. 21000 Crore had been damaged.

- ✓ Some earthquakes of magnitudes ranging from 6.4 to 6.8 also caused heavy loss and damage in Chamoli (1999); Latur (993); Uttarkashi (1991); Jabbalpur (1997).

Few significant earthquakes in ***North-East regions*** of India, which caused significant loss and damage to life and property

- ✓ Earthquake of magnitude ***7.5*** struck Cachar region of Assam on 10th January, 1869 and caused heavy damage in Silchar, Shillong, Cherrapungi and even in Sylhet. The affected area was 250000 Sq. miles.

- ✓ One of the most destructive earthquake of magnitude ***8.7*** caused heavy damage to life and property in the North Eastern Region on 12th June, 1897. The epicenter was in the North Western part of the Shillong plateau. More than 1500 people died and most of the buildings and structures of this region damaged under the impact of this earthquake.

- ✓ On 9th September, 1923 Assam and its adjoining states witnessed another major earthquake of magnitude ***7.1***, that caused significant damage and disruption in this region.

- ✓ An earthquake of magnitude ***7.1*** struck Dhubri region of Assam on 2nd July, 1930 resulting heavy structural damage.

- ✓ On 23rd October, 1943 an earthquake of magnitude ***7.2*** shattered Assam and its neighboring areas. The epicenter was near Hojai of Assam.

- ✓ The state Assam experienced heavy structural damage under the impact of another major earthquake of magnitude ***7.7*** on 29th July, 1947 with its epicenter near Dibrugarh Town.

- ✓ One of the greatest earthquake of the 20th Century, known as great Assam Earthquake, of magnitude ***8.7*** struck Indo- China Region on 15th August, 1950. This region experienced hundreds of big aftershocks. More than 1500 people died followed by huge structural damage and major floods in Assam due to liquefaction, change of major river courses, earthquake induced landslides and artificial dams in upper catchment areas. The entire Sub-continent felt the affect of this earthquake.

- ✓ The Assam witnessed heavy structural damage due to an earthquake of magnitude ***7.7,*** which struck Manipur-Burma region on 21st March, 1954.

- ✓ Another earthquake of magnitude ***7.0*** struck Indo-Burma border area on 1st July, 1957. The impact was felt all over the North Eastern region.

- ✓ 20 people were killed in Assam by an earthquake of magnitude ***6.0*** with its epicenter in Cachar District of Assam on 31st December, 1984.

- ✓ There was significant damage in the state due to an earthquake of magnitude ***6.6*** with its epicenter Indo-Myanmar region on 6th August, 1988.

- ✓ The earthquake of magnitude ***6.9*** in Richter scale occurred in Sikkim-Nepal Border on 18th September, 2011 resulting heavy loss and damage to life and property in Sikkim and its adjoining states. Heavy landslides also reported in many places of Sikkim.

- ✓ During 12th August, 2009 – 4th February, 2011 Assam and its neighbouring states witnessed 7 medium ranged earthquakes of magnitude ranging from ***4.9 – 6.4***.

Observations: Past two great earthquakes in 1897 and 1950 caused significant structural damages in major cities like Shillong and Guwahati. But, many Assam type buildings of wooden framework remained intact under the impact of such high magnitude earthquake. Huge landslides across the foot hills of Himalaya and Garo Hills resulted artificial dams across the tributaries of Brahmaputra and floods in the lower catchment areas due to sudden washing away of artificial dams. Vast area of land either elevated or subsided altering the drainage network of this region. Worst liquefaction damages were reported from alluvial plains.

4.4.3 DROUGHT

As we have discussed in this unit, drought is the major hazard in India. More than 16% of landmass in India is severely prone to drought due to very low or absence of rainfall for long period of time. Almost 68% of total landmass of India is susceptible to drought like situation due to absence of rainfall for considerable period of time in a year. As a result, major section of population in India is directly or indirectly vulnerable to drought. During 1999-2000, almost eleven states in India suffered heavily due to drought like situation.

The states Rajastan, Gujrat, Maharashtra, and Madhya Pradesh have maximum arid and semi-arid zones. Almost 74 districts of 13 states are identified as drought prone districts covering an area about 51.1 million ha.

Some most drought prone areas in India are Kalahandi region in Orissa; Purulia district in West Bengal; Mirzapur and Palamu regions of Uttar Pradesh; Saurashtra and Kutch region of Gujrat; Coimbatore in Kerala; Tirunelveli district of Tamilnadu.

4.4.4 CYCLONE

The areas having almost 8050 km. long coastline are most vulnerable to cyclone hazard. The East Coast comprises the states of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu. While the states Kerala, Karnataka and Gujrat are part of West Coast.

The districts 24 Parganas and Midnapure of West Bengal are prone to cyclonic storm. The districts, which are exposed to cyclone hazard in Orrissa, are Balasore, Puri, Ganjam and Cuttack. Srikakulam, Vizag, Krishna, East Godavari, Nellore, Guntur are the districts in Andhra Pradesh highly prone to cyclone. In Tamil Nadu; Tirunelveli, Chingleput, Tanjore, Ramnathpuram etc. are highly vulnerable districts of cyclone.

The districts Calicut, Trivandrum, Malapuram, Ernakulam in Kerala are vulnerable to severe cyclonic storms. Cannanore and South Kanara in Karnataka are highly prone to cyclone. Gujrat has many districts like Bhavnagar, Kutch, Jamnagar, Junagad, Baroach etc., which are highly vulnerable to cyclone.

Impact of cyclonic storms in India

The state West Bengal suffered heavy loss and damage due to severe cyclones in 1847, 1874, 1976, 1993 and 1994. Thousands of people died in these cyclones and there were also huge damage to properties, crop and vegetation.

There were severe loss and damage in Andhra Pradesh due to cyclones in 1946, 1977, 1987, 1990 and 1996. Tamil Nadu also experienced similar situations due to cyclonic storms in 1972, 1979 and 1991.

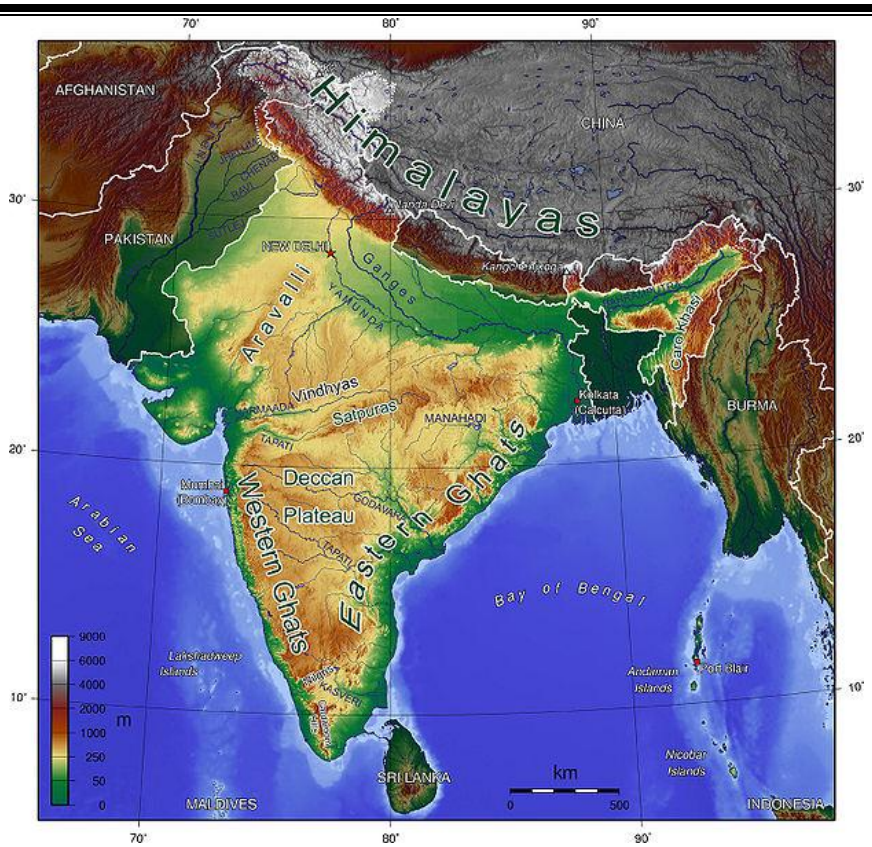
The super cyclone of Orissa in 1999 claimed 10086 lives. More than 200000 houses damaged under the impact of cyclone. The magnitude of loss and damage was uncountable. The state also faced severe cyclones in 1985 and 1989. These are the few examples.

4.5 COMMUNITY PROFILE AND THEIR EXPOSURE TO NATURAL HAZARDS IN INDIA

It is clear from our earlier discussions that, disaster risk is highly location and hazard specific. Moreover, physical and social vulnerability factors also play dominant role in enhancing disaster risk. The disaster risk of a community is largely dependent on geographical set-up of the area, in which the community is living. A group of researchers headed by Dr. V. K. Sharma, the then Professor and Head, National Centre for Disaster Management, New Delhi carried out a case study on disaster risk of the communities living in Hill areas; Plain areas; Coastal areas and Urban areas.

4.5.1 HILL COMMUNITY

People living in hilly regions of India are vulnerable to most of the natural hazards due to wide variation in topography, ecosystem, climatic conditions, geological features, socio-cultural and socio-economic conditions. Seasonal flood, flash flood, earthquake and landslide are some of the natural hazards dominant in hilly regions.



Map source: www.en.wikipedia.org/wiki/File:India_Geographic_Map.jpg

The major hilly ranges in India are

- ✓ ***North East Hill ranges*** comprising all Northeastern states of India and touches Himalayas in eastern side. The Himalayas covers entire northern side of India, starting from Kashmir to Arunachal Pradesh.

- ✓ ***Western Ghats and Nilgiris*** cover the states of Gujrat, Maharashtra, Karnataka, Tamil Nadu, and Kerala.

- ✓ ***Eastern Ghats*** comprises West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Karnataka.

- ✓ ***Vindhyas Range*** touches the states Gujrat, Rajastan, and Madhya Pradesh.

Landslide is common phenomenon for hilly areas. The risk of landslide is high for the regions having fragile landform, high slopes and high rainfall. To some extent, all the hill communities are vulnerable to landside. Landslide affects directly, who are living in unstable hill slopes. Other suffers mainly due to communication disruptions. The landslide risk in North Eastern Hill ranges is extremely high followed by moderate risk to the communities of Western Ghats. Eastern Ghats and Vindhyas are comparatively stable against landslides.

The Himalayas are extremely sensitive to ***earthquakes*** due to tectonic reason. So the communities living in the areas close to Himalayas are highly vulnerable to high magnitude earthquake. Many high magnitude earthquakes struck this hilly range at different times causing enormous damage and disruption to normal pattern of life.

The hill communities are living in both upper and lower catchment areas of river system. Human activities in the watersheds of hilly rivers; like shifting cultivation, deforestation, and other development activities; are enhancing soil erosion in the watersheds, sediment influx to

the riverbeds, surface runoff of rain water, discharge of the river system etc. As a result, the characteristics of river system, including carrying capacity and flow pattern are changing rapidly. Some rivers of hilly belts are unstable and changing their courses on regular basis. In addition, some regions have very high annual rainfall and some places have sudden high intensity rainfall or cloud burst. For all these reasons, the hill communities are more or less vulnerable to ***seasonal*** and ***flash floods***.

4.5.2 COMMUNITIES OF PLAIN AREAS

A large section of population of India is living in plain areas of Northern, Western and Central parts, including alluvial plains and coastal areas. These communities are exposed mainly to ***Flood, Cyclone and Earthquake hazards***.

The major contribution of loss and damage comes from river flood and bank line erosion. The ***flood risk*** of the communities living in plain areas is linked to ***land use pattern*** and ***flood resistance mechanisms*** in the plain areas. The flood risk of plain people is also associated with the activities of the hill communities, as most of the hill communities are living in the watersheds of river system. Moreover, most flood prone areas are protected by embankments. But, poor degree of protection and maintenance of embankments is another reason of severe floods in plain areas.

Major flood prone areas of India falls in Ganga-Brahmaputra_Meghna Basin, covering 15 states. About 47% population of India live in this basin and bear the brunt of flood hazard every year.

4.5.3 COASTAL COMMUNITIES

As mentioned earlier, India has long cost line of 8041 Km. covering the states West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Gujrat. A sizable population of India is residing in the coastal areas. The coastal communities have great risk of ***tropical cyclone*** due to geo-climatic condition of the coastal areas, which is favourable for high winds and storms. The Orissa super cyclone on 29th October, 1999 or cyclone at Gujrat on 9th June, 1998 are the examples, which caused enormous damage and disruption to normal pattern of life of the coastal communities.

Moreover, these communities are exposed to ***flash floods*** due to storm surges and Tsunami. Interestingly, the coastal communities are also suffering form ***drought.***

The Tsunami originated at Indian Ocean on 26th December, 2004 affected twelve countries and killed more than 200000 people. This particular Tsunami affected a large number of coastal communities in India also.

4.5.4 URBAN COMMUNITIES

The assessment of disaster risk of urban communities in India is little difficult because of their heterogeneous characters. Moreover, the urban areas are not confined to a particular region. Communities of hill, plain and coastal areas are also part of the urban communities. As a result, based on geographical locations the urban communities are vulnerable to all the natural hazards.

The urban communities in India bear ***multidimensional disaster risks*** out of ***natural, man made*** and ***environmental hazards.*** One can see, the most haphazard urbanization process in India violating land use and building regulations. High rate of population influx to urban areas for livelihood opportunity and other socio-economic factors is the main reason of physical and

social vulnerability of urban communities. These factors are also responsible for unsustainable developments in urban areas. In the cities like Delhi and Kolkata, population density is more than 150000 per sq. km. Moreover, the urban population is not homogenous in terms of social and economic status. We can see a big economic polarization among urban communities. Both poor and rich communities are equally contributing to disaster risk.

Most urban communities in India have the risk of **flash flood, earthquake damage, scarcity of fresh and pure water, communicable diseases and epidemic; accident and fire related events etc.** Shrinking of open space and overcrowded vertical developments are the main reasons behind depletion of ground water level, drainage congestion, increase in volume of foul and waste water, unsafe physical structures etc., which are enhancing the risk of above mentioned hazards.

Moreover, the secondary ***health hazards*** in urban areas are related to ***poor sanitation, solid waste disposal, contaminated drinking water, vehicular pollution*** etc. The communities of small and big cities in India are also largely ***prone to industrial hazards*** due to presence of ***unsafe and risky industries in thickly populated areas***.

4.6 DISASTER TRENDS AND PROBLEM AREAS

So far, in this unit, we have highlighted the issues relevant to global and regional disaster phenomena, hazard specific disaster risk of different regions, location and hazard specific disaster loss and damage pattern etc.

Every nation has its own plan and policy for mitigation of disaster risk and deal with disaster situations. To review the plans and policies for disaster risk mitigation at global and national level, it is essential to understand the status and trend of natural hazard induced disasters. Equally, it is essential to understand the problem areas and reasons behind such problems.

Let us first see the global trend of disasters caused by different natural hazards, as per EM-DAT: OFDA/CRED international disaster database, for the period ***(1900-2008).***

- ✓ Continent wise disaster loss and damage data shows
    - ➢ ***Flood, earthquake and cyclone*** were responsible for maximum damage and loss in ***Asia.***
    - ➢ ***Cyclonic storm*** was the major natural hazard, which caused maximum damage and economic loss in ***America***.
    - ➢ In ***Africa***, ***earthquake and flood*** caused maximum damage and loss.
    - ➢ ***Flood and cyclonic storm*** caused maximum damage and loss in ***Europe.***
    - ➢ In ***Oceania, Cyclonic storm, flood and drought*** were the major hazards, which caused maximum damage and loss.

- ✓ During this period, ***disaster events*** for all natural hazards ***increased sharply.*** In 1900, there were less than 50 disastrous events. The number of such events were more than ***550*** in 2008.
- ✓ There was ***increasing trend*** in number of ***people killed*** by different kinds of disasters during ***1900-1930*** and then ***decreased continuously*** until ***2008***.
- ✓ Number of ***people affected*** by all kinds of disasters ***increased sharply*** during ***1900-2000***. The number was quite negligible in 1900; but by 2000, the figure crossed 60,00,00,000 marks.
- ✓ There is ***sharp increasing trend*** in ***economic loss*** by the disasters. In 1900, the economic loss due to disasters was very much negligible, but by 2007, the total economic loss due to disasters reached to ~ 210 Billion USD.

- ✓ Maximum number of ***disasters*** occurred in ***Asia*** during 1900-2008 in comparison to other regions, and the number of disaster events are increasing year by year.
- ✓ Disasters ***killed maximum number of people*** in ***Asia*** during 1900-2008. But, the number is decreasing with time.
- ✓ During this period, ***Flood*** and ***Cyclonic Storm*** dominated over other natural hazards to cause disasters. The number of disasters due to these two natural hazards is ***increasing sharply*** with time.
- ✓ Among Asian countries, maximum number of people affected and killed by disasters in China followed by India. Japan incurred maximum economic loss due to disasters.

In Indian subcontinent,

- ✓ There has been an ***increasing trend*** in the number of ***people killed by earthquakes*** during 1980-2010. But, for other natural hazards, the number is declining slowly.
- ✓ The number of ***people affected*** by ***floods*** hazards ***increased sharply*** during ***1980-1993.***
- ✓ The maximum numbers of people in India are vulnerable to drought in comparison to other natural hazards.

It is clear from the above discussion, the number of disaster events are increasing day by day. Among the disaster events, hydro-meteorological disasters dominated over other disasters. Though, there is slight decreasing trend in number of people killed by different kinds of disasters, but natural hazards affected large numbers of people. Most of the disasters occurred in Asia. Highest number of people affected and killed by disasters in China. The damage and economic loss due to disasters are increasing all over the world.

There is increasing trends in numbers of people killed by earthquakes and numbers of people affected by flood in India. Most people in India are vulnerable to drought.

The probable reasons of these problems may be

- ✓ Environmental stress and change in climatic condition in different parts of the world.
- ✓ Rapid population growth and harmful human activities for our ecosystem.
- ✓ Large-scale encroachment in watersheds and naturally hazard prone areas.
- ✓ Haphazard urbanization and unsustainable development, violating land use regulations and hazard resistant structural codes.
- ✓ Relief centric disaster management mechanism, avoiding practical risk reduction planning based on hazard and location specific risk assessment.
- ✓ Lack of coordination and exchange of data and information among national and international agencies, which are involved in planning for disaster risk reduction.
- ✓ Lack of proper and appropriate application of scientific and technical know-how in disaster risk reduction process.

4.7 WHAT WE LEARNT FROM THIS UNIT?

More or less all parts of our globe are prone to natural hazards. But, amongst the continents, Asia is highly prone to natural hazards. This region covers 30% of global land area and shares 60% of world's total population.

Global data shows, more than 75% of world's disasters are originated by hydro-meteorological hazards. Out of which, flood hazard has been dominating over other natural hazards.

Data for the period 1900-2009 shows that, disaster events due to natural hazards have been increasing sharply and the rate of increase of hydro-meteorological hazards is noticeable. This clearly depicts the role of environmental degradation in increasing trend of disaster events.

In India, almost 68% of total land area is drought prone. More or less 60% area is earthquake prone and flood shares 12% of the total land area. But, flood causes enormous loss and damage every year. Though, there is no significant direct loss and damage to life and property due to drought, but majority people are affected by drought. Though, the frequency of earthquake is less than other natural hazards, but most people killed by earthquake. This is probably due to haphazard urbanization and unsustainable development violating land use regulations and building codes.

Countries like China, India and Bangladesh suffered most by the disasters originated from natural hazards in terms of population affected and magnitude of loss and damage. Data shows, America shares significant percentage of world's disaster events, but the loss and damage is comparatively negligible to that of Asian Countries.

Overall trend of disaster events shows sharp increase in the rate of disaster events originated by natural hazards. More and more people are coming under the impact of such disasters year after year. But, fortunately the rate of death of people by the disasters is not significant.

4.8 PROBABLE QUESTIONS

1. Why we need to study the nature and trend of global disasters?
2. What types of natural disasters are dominating all over the globe?
3. Which continent suffers most due to natural hazards?
4. What was the trend of disaster events during 1900 -2009?
5. What was the status of hydro-meteorological hazards during 1900-2009?
6. In India, which natural hazards are dominating in terms of total land area?
7. In India, which natural hazards cause maximum loss and damage?
8. Describe the flood scenario in India.
9. Discuss about few significant disasters in India?
10. From your observations, write down the reasons behind increasing trend of disaster events?

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UNIT-5: DISASTER MANAGEMENT CONCEPT

UNIT STRUCTURE

5.1 INTRODUCTION

Disaster management is a multidisciplinary concept. Generally, we consider disaster as humanitarian crisis and try to manage it according to our requirements for survival. Until a natural hazard affects us, we do not take care of it. Now, slowly our attention is diverting to protection of environment, sustainable development, safety and security of our systems. Because, these are linked to our survival options and the root causes for damage and disruption to our normal pattern of life.

Disaster is part of our life, but its management is a difficult task. Because, hundreds of issues; comprising physical, material, social, organizational, motivational, financial and legal factors; are involved in the process of disaster management. Moreover, it needs academic, administrative, engineering, financial and legal supports.

In the previous units, we have discussed in detail about paradigm shift in concepts of disaster management; different parameters involved in disaster risk; characteristics of natural hazards; dimension and aspects of vulnerability analysis; damage characteristics of natural hazards; trends of disasters etc.
This unit is designed mainly to discuss about disaster management principles, and different aspects of risk and crisis management.

5.2 OBJECTIVES

The major objectives of this unit are

- To discuss about concept of disaster management.

- To highlight the different aspects of disaster management.
- To describe different steps of disaster management.
- To review the status of organizational and financial arrangements for disaster management in India.

5.3 CONCEPT OF RISK AND CRISIS MANAGEMENT

5.3.1 CONCEPT OF RISK

Risk implies the probability of disaster or expected loss and damage under the impact of any external force. Sometime we say, I am at risk ***or*** my family is at risk ***or*** my area is at risk and so on. It means, we have some visible or hidden threats, which may harm our life and property. If there is significant loss and damage to our life and property, we call it a disaster. If our risk is more, probability of loss and damage is also more. That means, if risk is high, expected magnitude of disaster is also high. Therefore, there is a strong bonding between risk and probability of disaster in a system.

If we minimize our risk by taking appropriate measures, magnitude of loss and damage to our life and property will be reduced accordingly. In other word, the probability of disaster will also be reduced proportionately. If we can make our risk zero, we will never face a disaster. But, in practice it is not possible. Every system or individual has some sorts of risk i.e., no system or individual is free from external threats absolutely.

Risk management is the primary and important step of ***disaster management***. If we cannot contain our risk up-to a certain limit, we will certainly face a disaster. A disaster always leads to a crisis situation, in which either we will die or we will not be able to manage basic requirements for our survival. In a crisis situation, the affected population depends largely on outside agencies to meet their basic requirements for survival. The outside agencies try to manage the crisis based on their own capacity.

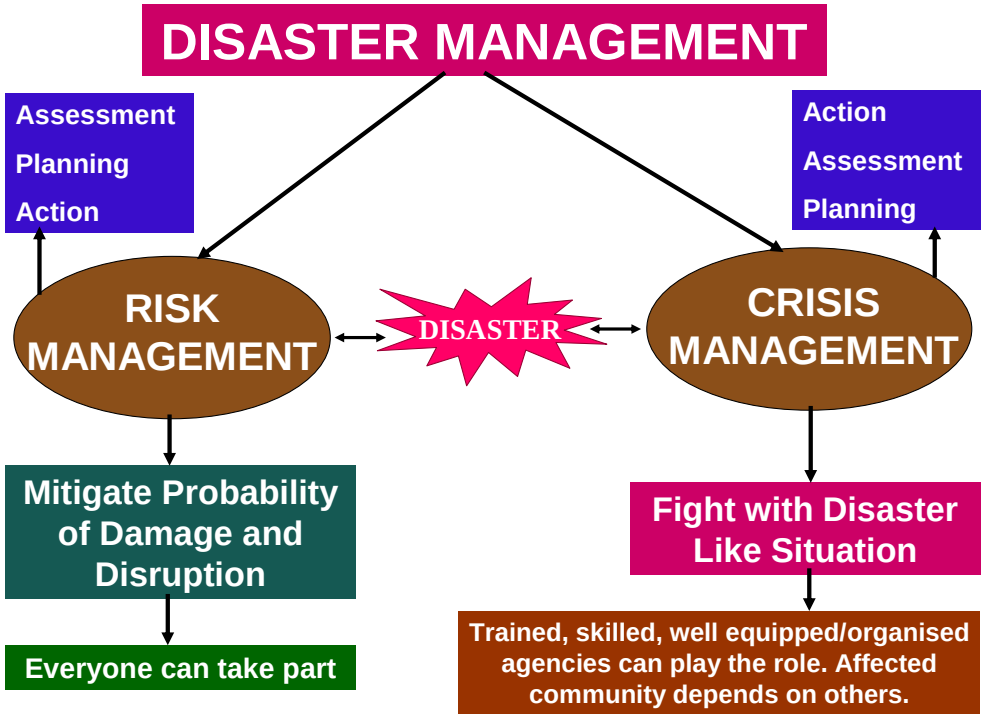
5.3.2 CONCEPT OF DISASTER MANAGEMENT

There are two distinct parts in disaster management.

One is ***Risk Management***, in which we try to do something for mitigation of our risk i.e. reduction of loss and damage, just to avoid a disaster like situation.

Other one is ***Crisis Management***, in which we try to survive by fighting with disaster and take measures for recovery of the normal condition.

Everyone from government departments, non-government organizations and vulnerable communities can take part and contribute our knowledge and resources in the process of risk assessment and risk reduction planning. But crisis management needs trained and skilled manpower, tools and equipments, effective organizational structure, logistics, financial and material supports etc.



For risk management, we get enough time to assess our disaster risk first. Based on risk assessment, we can make our plan for risk reduction and take action according to the plan. But in crisis management, first, we try to make the situation normal by taking appropriate actions i.e. rescue and relief. Then we assess the loss and damage to make plan for recovery and reconstruction. Moreover, action plan for crisis management is done based on risk assessment of a system. Therefore, without risk assessment, we cannot make effective crisis management plan for emergency response and recovery.

For all these reasons, disaster management is a complex and multidisciplinary process having multidimensional management aspects. In reality, the groups of agencies involved in risk and crisis managements are highly polarized. In most of the countries, these agencies are trying to manage disasters on their own formula without proper coordination and exchange of data, information, and technological know-how.

Why we need close coordination between risk management and crisis management groups?

As mentioned earlier, crisis management starts with immediate action. In this process, we do not get much time to assess the situation and plan accordingly to start action. For crisis management, there should be a comprehensive action plan prior to a crisis situation.

For example, flood and earthquake hazards may lead to different types of disasters. Their damage characteristics and problem areas are also different. Therefore, a specific plan with particular set of manpower, equipment and tools may not be suitable for both the disasters. Crisis management planning for a particular area or system needs information about nature of triggering force, probable impact of hazard, nature of damage, and local vulnerable conditions. Risk assessment process generally addresses these issues.

So the basis of the crisis management plan is risk assessment. Without close coordination amongst the organizations involved in the process of risk and crisis management, it is not possible to prepare effective disaster management plan for a system.

5.3.3 PROCESS OF RISK ASSESSMENT

As we have already discussed in previous units, the disaster risk of a system depends on magnitude of triggering force (hazards); internal unsafe conditions of the system (vulnerability); impact of hazards (nature of loss and damage) etc. Risk assessment for a particular area or system needs

- Hazard assessment to identify the types of natural hazards to which the area is exposed.
- Vulnerability assessment to identify the unsafe conditions of the system and their susceptibility to different hazards.
- Resource assessment for identification of the resources at risk and counter disaster resources in the system.
- Determination of the probable impact of different hazards on the system i.e., expected loss and damage for different hazards.

To make a risk reduction plan, it is essential to find out probable threats/hazards; vulnerability and their root causes; impact of hazards to our system. If we can make proper assessment of all these parameters, it would be possible for us to make preparedness plan for coping with disasters. Details about this will be discussed in disaster management cycle.

5.4 DISASTER MANAGEMENT CYCLE

5.4.1 DISASTER MANAGEMENT PROCESS

We have seen that, a practical disaster management plan has two parts, ***risk management*** and ***crisis management***. Now let us discuss in detail about different steps of risk and crisis managements.

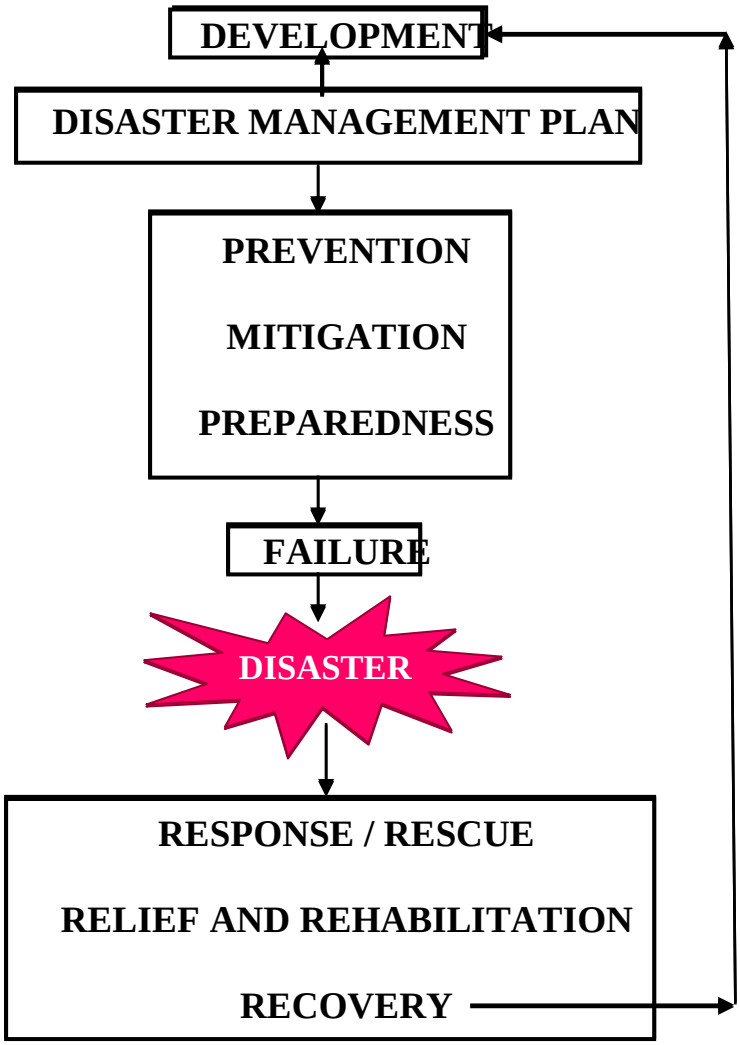


Fig.: Schematic diagram of Disaster Management Cycle

As mentioned earlier, disaster management plans are required to tackle humanitarian crisis. Environmental degradation involving disturbances in our biodiversity and ecosystem may cause many natural hazards, which in turn may lead to humanitarian crisis in the form of disaster.

On the other hand, developmental activities violating the laws of nature may be the source of environmental degradation. Again, unsustainable developmental activities may lead to unsafe conditions within our system. So there is close relationship between unsustainable development and disaster risk.

Suppose an area is exposed to many natural hazards like flood, earthquake etc., but there is no living and physical elements in that area. In this case, even in presence of natural hazards, there is very less possibility of occurrence of a disaster like situation.

Again, if an area is not prone to natural hazards, there is less possibility of occurrence of disasters.

Considering all these, we can say, disaster management plans are required for the areas/systems,

- ✓ Which are prone to natural or man-made hazards.
- ✓ Which are the habitats of human and other living elements.

- ✓ Where some kinds of developmental activities are going on.
- ✓ Which have direct link with livelihood opportunities and production.
- ✓ Which have cultural and religious importance.
- ✓ Which may create secondary disturbances for the people of other regions.

5.4.2 PRE DISASTER RISK MANAGEMENT

For disaster risk mitigation, we can adopt some practices either to prevent a disaster or to mitigate the magnitude of loss and damage. If we do not have strategy for prevention of disaster or mitigation of loss and damage, then we must have a preparedness plan to cope with a disaster like situation.

Therefore, pre disaster risk mitigation planning comprises three basic steps

- **Prevention**
- **Mitigation**
- **Preparedness**

For example,

Prevention

Suppose an area is flood prone, we can prevent flood in this area by resisting overflow of river water. This can be done by constructing an embankment. In this process, we are not allowing the hazard to strike our system and cause disaster. This is one example of prevention. Like this, we can take suitable structural and non-structural measures for prevention of disasters.

Mitigation

All the time it is not possible to prevent natural hazards from striking our systems. For example, we do not have any mechanism to predict or prevent earthquake hazard. In that case, we can mitigate the loss and damage by minimizing unsafe conditions of our system. The strategies for damage mitigation plan may include; land use regulation, micro-zonation, earthquake resistant building codes, safety norms etc.

Sometime the hazard protection devices may fail to prevent hazards. Foe example, a breach in the embankment may cause inundation to large area. Therefore, damage mitigation strategies should be integral part of our risk reduction plan.

Preparedness

If we do not have strategies for prevention of disaster or mitigation of loss and damage, then we must have a preparedness plan to cope with the situation. The preparedness plan must include alternative adjustment processes, survival kits, communication facilities etc. Education and awareness of vulnerable communities about warning signs of natural hazards and their damage characteristics, damage mitigation strategies etc. are also integral parts of the preparedness plan.

5.4.3 DISASTER PHASE

Failing to adopt a suitable pre disaster risk reduction plan, we may face a crisis, involving large-scale damage and disruption to our life, property, environment, health, livelihood, production, communication etc. The affected community becomes helpless and depends on

outside agencies for their rescue, safe shelter, relief, and rehabilitation. Here, the role of Crisis Management group is important.

5.4.4 CRISIS MANAGEMENT

As discussed earlier, for effective crisis management there should be a comprehensive action plan based on risk assessment of vulnerable communities for immediate response to a disaster situation. This includes rescue and safe shelter of affected population. Trained and equipped persons from outside agencies generally get involved in this process.

In practice, the government response forces take considerable time to start rescue operation in disaster-affected areas due to some administrative formalities. Non-government organizations also have their own limitations to participate actively in rescue operation. Sometime communication disruption and other local factors also make barriers in rescue operation. Therefore, the role of vulnerable community is equally important in this phase of disaster management.

If a vulnerable community has proper preparedness plan for quick response to a disaster situation; ***in terms of trained and skilled volunteers, equipments and tools, evacuation centre, emergency kits, essential items etc.;*** then they will be able to mange the crisis situation more efficiently. If the vulnerable community can manage the situation temporarily, subsequently the government support systems will take up the action automatically.

The most important step for post disaster crisis management planning is ***relief***. The affected population needs basic supports for their survival. The relief operation is a complex mechanism. Detail about relief will be discussed in the following sections.

Once the situation becomes normal, the affected population may need government support for their ***rehabilitation and recovery.*** This phase is very troublesome for the affected population. The affected population may face many problems to manage their basic requirements for survival. They realize the impact of disaster and meaning of loss. In this phase, the affected people need physical, material, financial, medical, and psychological supports from outside agencies to get back to their original status.

Sometime disaster helps the vulnerable communities to learn lesson from their practical experiences and respond appropriately for sustainable developments.

5.5 PREVENTION, MITIGATION AND PREPAREDNESS

We have seen in our previous discussion, the complete disaster management cycle has two distinct parts, ***Risk Management*** and ***Crisis Management***. Proper risk assessment is necessary to formulate action plan for crisis management. Risk management for a system or area includes three important steps; ***Prevention, Mitigation*** and ***Preparedness***. Crisis Management includes ***Rescue, Relief, Rehabilitation*** and ***Recovery*** phases.

In previous section, we have discussed briefly about different phases of disaster management. Now we will discuss in detail about the principles and mechanisms of these management phases.

5.5.1 PREVENTION

Prevention of disaster means, not allowing a disaster to occur in a system. In other words, prevention of disaster in a system means complete elimination of disaster risk of the system. How can we prevent disaster in an area, if this area is prone to natural or man-made hazards?

There are three ways,

- ✓ Resisting the hazard itself from striking the area by means of suitable hazards protection devices.
- ✓ Reducing the unsafe conditions or vulnerability of the area to zero
- ✓ Staying away from settlement or any developmental activities in hazard prone areas.

In practice, it is very difficult to adopt above-mentioned practices for prevention of disasters. Even than it should be our effort to find out the ways for prevention of disasters. We must be careful, from the very beginning of our development process, to make all the elements of our system hazard resistant.

Some of the important aspects for prevention of disasters are

- ✓ Identification of hazard prone locations in an area.
- ✓ Planning for sustainable development in hazard prone areas, considering the types and damage characteristics of hazards.
- ✓ Engineering structural protection measures synchronized with suitable nonstructural measures for prevention of hazards.
- ✓ Protection of the habitats of hazard prone areas from natural hazards.
- ✓ Protection of crop area and agricultural land.
- ✓ Retrofitting or demolition of the unsafe structures in hazard prone areas.
- ✓ Formulation of proper policies for prevention of disasters in hazard prone areas.
- ✓ Implementation of land use regulations and urban planning.
- ✓ Proper legislation for implementation of the disaster management policies.
- ✓ Planning for counter-disaster mechanism.
- ✓ Separate budgetary provisions in the national plan budget for disaster risk reduction programmes.
- ✓ International and corporate financial support for disaster prevention schemes/devices with the conditions of maintaining safety standard.
- ✓ Staying away from the activities, which may create suitable environment for disasters.

Constraints of disaster prevention

The above-mentioned aspects of disaster prevention are achievable. At the same time, many constraints are there for genuine implementation of these issues. Let us discuss few of our constraints, which are creating hindrance in disaster prevention mechanism.

- The most important factor is uncontrolled population growth, especially in developing and third world countries. People are bound to live in hazard prone areas despite knowing the disaster risk. National governments and political parties are also reluctant to introduce policies for proper implementation of land use regulations in hazard prone areas due to the facts that,
    - ✓ Such policies may upset the interest of vulnerable communities and thereby the interest of political parties too.
    - ✓ Such policies may need relocation plans for vulnerable communities, for which the national or regional governments are not capable.
- Most countries have relief centric disaster management plans, considering the natural hazard induced disasters as routine phenomena.
- The natural hazard protection devices/mechanisms are highly expensive. The national governments of developing and third world countries can not afford such highly expensive hazard protection devices.
- Some national developmental projects may increase the disaster risk of certain areas.

- The production based industries of developing and third world countries do not take appropriate protection measures due to cost-benefit reasons. Extra expenditure for protection measures always increases the cost of production, which may not be affordable for common people. Such uncontrolled production industries are also enhancing disaster risk.
- Lack of awareness among vulnerable communities about disaster risk ***or*** the vulnerable communities have no role in counter-measures for disaster prevention.

Whatsoever be the case, disasters always cause great loss to national economy and affected population become burden of the nation. Therefore, despite all these constraints, the national governments of most of the nations are now giving due emphasis on formulation of proper plans and policies for reasonable prevention of natural hazard induced disasters, as part of their disaster risk reduction (DRR) programmes. The countries like India have undertaken many important steps to reduce disaster risk at national levels involving prevention of disasters. Some of these steps are

- ✓ Adopted of National Disaster Management Act.
- ✓ Formulated disaster management policies and legislations for proper implementation of disaster management policies at all levels in the country.
- ✓ Disaster Management Institutes and Centres are established for conducting academic and research activities, involving risk assessment and risk reduction planning at micro and macro levels.
- ✓ Separate disaster management divisions are established under different ministries for assessment, planning and monitoring of the progress.
- ✓ It is now mandatory for State Governments to formulate disaster management plans at state and district levels, elaborating hazard and location specific risk factors and measures to be taken for prevention of disasters.
- ✓ Created separate budgetary provisions for implementation of hazard protection measures on priority basis.
- ✓ Separate disaster management wings are established at districts levels for conducting training, awareness and skill development programmes.
- ✓ Priorities are given for impact assessment of national developmental projects and environmental safeguard. Pollution control and safety norms have also been adhered for production industries located in populated areas.
- ✓ Different advisory boards and expert committees are constituted; comprising bureaucrats, technocrats, scientists, and administrators; for risk assessment and risk reduction mechanisms.
- ✓ Capacity building programmes for planning authorities, government line departments, disaster management institutes and authorities, non-government agencies, and other counter disaster agencies of the country.

5.5.2 MITIGATION

In most of the cases, complete prevention of disaster is not possible. In these cases, we can take appropriate measures in advance to reduce the effects of disasters, i.e., reduce the magnitude of damage and disruptions.

Damage mitigation strategies are required mainly for reducing the unsafe conditions of the hazard prone areas addressing the root causes of these unsafe conditions. The process for recognition of the root causes of vulnerability factors is discussed in unit 01, under progression of vulnerability.

The dimensions of vulnerability factors and their assessment principles are discussed in unit 03. The relationship between vulnerability and disasters, vulnerabilities of different hazards etc. are also discussed in unit 03.

From our previous discussions, it is clear that, vulnerability plays major role in damage and disruption. If we can reduce vulnerability factors of hazard prone areas, the magnitude of damage and disruption will be minimized automatically.

The different aspects of disaster prevention mechanism are also integral parts of damage mitigation planning. The approaches for overall damage mitigation process are complex and multidisciplinary, which involve,

- ✓ ***Multi-hazard zoning of hazard prone areas:*** For example, a state is prone to flood, earthquake, cyclone, landslide etc. For damage mitigation planning of the state, it is essential to identify the specific areas, which are prone to one or more hazards. The hazard zoning of the state can be done based on the level of disaster risk of different areas for different hazards.

- ✓ ***Damage characteristics of different natural hazards:*** From past records of disasters in a particular area, it is possible to understand the of damage characteristics of different hazards. The nature of damage varies with type of hazard and developmental pattern in the hazard prone areas. Without knowing hazard specific damage characteristics, it is not possible to plan for damage mitigation.

- ✓ ***Planning for sustainable development:*** The lesson learnt from past disasters helps the planners to make suitable plans for sustainable development in hazard prone areas. Such plan includes land use regulations, design and safety norms, and other damage mitigation mechanisms. Such a plan for sustainable development is necessary for reconstruction in disaster affected areas or new developmental activities in natural hazard prone areas. For example, after Gujarat earthquake in 2001, the government of Gujarat had adopted certain policies and norms for sustainable developments in earthquake affected areas. The vulnerable communities living in the flood prone areas of Assam have their own traditional methods and techniques, including flood resistant housing and food storage, for flood damage mitigation.

- ✓ ***Coordination among disaster management agencies and vulnerable communities:*** Active participation of government line departments, academic institutions, and vulnerable communities is required for damage mitigation planning. The government agencies and academic institutions, involved in disaster management, try to assess the disaster risks of different hazard prone areas and make disaster risk reduction plans accordingly. The vulnerable communities are responsible for proper implementation of the disaster risk reduction plans. Moreover, for proper risk assessment, the disaster management agencies need huge data and information of the hazard prone areas. The vulnerable communities are the genuine source of all these data and information. Therefore, strong coordination amongst disaster management agencies and vulnerable communities is required for damage mitigation in hazard prone areas.

- ✓ ***Relocation plans and incentives for vulnerable communities:*** In most of the cases, the vulnerable communities live in the hazard prone areas under compulsion mainly due to their financial constraints. In addition, they may not have the capacity to follow the codes and norms for sustainable development. So, the most effective method for disaster risk mitigation is relocation of vulnerable communities from hazard prone areas to safe locations ***or*** extending some financial support from government for sustainable development.

- ✓ ***Preparedness and capacity building:*** If a vulnerable community is not prepared to face a disaster, then the disaster may cause maximum damage and disruption for that community. Therefore, preparedness with adequate capacity, to deal with disaster like situations, in terms of resources, means and strength is the most effective method for disaster risk mitigation. In the next section, we will discuss in detail about preparedness mechanism.

- ✓ ***Monitoring and early warning:*** Disaster risk of a particular hazard prone area may be associated with several remote factors. For example, the root causes of flood disaster in a particular area may be related to mismanagement of catchment areas. The source of tsunami in coastal areas is the earthquake in ocean. So, for damage mitigation planning, we need careful observations on changing pressures and root causes of different hazards. Development of early warning mechanism for natural hazards is another effective tool for damage mitigation. An early warning for tsunami can save thousands of lives. Early warning for flood may reduce the loss and damage of life and property significantly.

- ✓ ***Structural and non-structural measures:*** Planning for sustainable development to mitigate disaster risk of the vulnerable areas includes both structural and non-structural measures. Detail about structural and non structural measures will be discussed in the next unit.

In developing and third world countries, over population and poverty are the main reasons behind violation of land use and building regulations; unplanned and unsustainable development; haphazard urbanization etc. It is also difficult for the governments of these countries to enforce the codes and norms for risk mitigation all over the country due to financial and political reasons.

5.5.3 PREPAREDNESS

Preparedness is one of the most important aspects of risk management. Preparedness enables the disaster management agencies as well as vulnerable communities to respond quickly and effectively to a disaster situation. Preparedness is a set of measures that makes vulnerable communities resilient to hazards and capable to cope with disasters.

The mitigation measures can minimize the magnitude of loss and damage, but cannot eliminate the disaster risk completely in a hazard prone area. Moreover, there is no foolproof protection mechanism, which can prevent disasters caused by natural hazards. Therefore, we should always be ready to face a disaster like situation, if we are living in hazard prone areas.

Though, preparedness is a part of risk management, but it has great role in the process of response and recovery. In fact, the different aspects of preparedness cover the whole disaster management process. Preparedness should be hazard and location specific. One specific set of measures may not be suitable for different hazard prone areas. For example, preparedness plans for hilly earthquake prone areas and low-lying flood plains are different in nature. Planning for preparedness for a particular hazard prone area involves

- ✓ ***Location specification*** by defining geo-climatic and geological conditions of the area. It needs in-depth analysis on geological set-up, topography, climatic condition, river network etc. This is the primary step to identify the natural threats and vulnerability factors of the area.

- ✓ ***Hazard specification*** by defining the external threats or hazards to which the area is exposed. An area may be prone to one or more hazards. If an area is multi-hazard

prone, the preparedness plans should be different for each hazard. Because, the damage characteristics of different natural hazards are not same. Hazard resistance devices are also part of preparedness process.

- ✓ ***Vulnerability analysis*** to identify the set of unsafe conditions of the hazard prone location, which are related to physical structures, socio-economic condition of vulnerable community, hazard protection devices etc. The status of susceptibility of *elements at risk* in the area to different natural hazards gives us guideline for preparedness measures. Without vulnerability analysis, it is not possible to make a genuine preparedness plan for a vulnerable community. For example, the communities living in flood plains are better prepared to cope with flood or respond to flood disaster efficiently. Because, they understand their disaster risk and take proper measures on right time.

- ✓ ***Resource management*** involves identification of the counter disaster resources which may be useful for response and recovery; allocation of role and responsibilities of the counter disaster resources; and mobilization of these resources at proper time and place. To control a fire disaster, we need the service of fire brigade. Fire brigade is one of the counter disaster resources. But, in most of the cases we find, either there is no fire service station in fire hazard prone area or fire brigade lacks skilled manpower and required equipment. Also in many cases, the fire service department does not respond on time. Therefore, resource management is also an important part of preparedness.

- ✓ ***Command, control and coordination.*** We need a systematic and effective organizational structure involving all government line departments, non-governmental organizations working in the field of response and relief, and volunteer groups from vulnerable communities to conduct disaster management related activities smoothly and efficiently. To utilize the resources, means and strength of individual organizations meaningfully in the field of disaster management, there should be proper coordination among all the organizations. Moreover, proper command and control over all the organizations are also necessary for effective outcome.

- ✓ ***Readiness and supportive resources.*** There should be enough numbers of disaster management sections and centres through out the nation to assess the needs of the vulnerable communities and monitor the status of their preparedness. Recruitment of skilled and trained manpower, procurement of tools and equipments for emergency response and their proper maintenance, development of required facilities and logistics etc. are also integral parts of preparedness process. Maintenance of preparedness level all the time, even in absence of disasters for long time, is the most tedious job. Special emphasis should be given in maintenance of preparedness levels for long time.

- ✓ ***National policy and legislation.*** National policy and legislations are required for formulation and genuine implementation of preparedness plans at national and state levels.

- ✓ ***Education and awareness.*** Education and awareness of vulnerable communities about disaster risk and risk mitigation measures are also essential for preparedness of the vulnerable communities.

5.6 RESPONSE AND RECOVERY

Planning for response and recovery during and after disasters is required for

- Timely rescue of the affected population and their safe shelter.

- Maintenance of evacuation centers.
- Conducting relief operation smoothly.
- Timely supply of essential items like food, dirking water, cloth, medicine etc. to affected population.
- Appropriate medical care to injured persons.
- Providing health care and sanitation facilities.
- Disposal of dead bodies and removal of debris.
- Control over communicable diseases.
- Maintenance of law and order situation.
- Mobilization of resources.
- Restoration of communication systems.
- Proper coordination among response forces.
- Rehabilitation of the affected population.
- Damage assessment.
- Subsequent recovery of the normal situation.
- International support for response and recovery.

The requirement of organizational supports; manpower; equipment and tools; facilities and logistics etc. for response and recovery depends on nature of disaster i.e., characteristics of damage and disruptions. Therefore, genuine risk assessment is essential for response and recovery planning.

5.7 RELIEF MECHANISM AND PROBLEM AREAS OF RELIEF

In general, ***Relief*** means the measures to meet the immediate requirements of victims of a disaster. But, with the changing concept of disaster management, the jurisdiction of disaster relief widened over entire process of disaster management.

The process of disaster relief has many dimensions. Some of the important aspects of disaster relief are mentioned below.

- ✓ ***Needs analysis:*** Needs of a vulnerable community in disaster situation could be assessed well before the occurrence of disaster by analyzing the community's risk, capacity and preparedness levels. For this, census data is required to have an idea about population pattern and gender ratio. Analysis of needs of the vulnerable communities is essential to respond appropriately in relief operation during a disaster.

- ✓ ***Arrangements for relief operation:*** Based on needs analysis, advance measures could be taken for arrangement of essential items and facilities. The process may involve management of evacuation centres; provision of drinking water and sanitation facilities in evacuation centres; arrangement of food, cloth, medicine and other essential items for distributional arrangement of logistics for relief operational arrangement of other relevant facilities for relief operation etc.

- ✓ ***Storage and transportation:*** Safe storage and proper distribution of essential relief items are challenging tasks for disaster management agencies. Provisions should be made for storage of relief items at safe locations. In most of the cases, communication disruption creates major problem in distribution of relief materials to marooned people. During flood, disruption of road communication is a common phenomenon. Arrangement of alternative means of transportation is essential for conducting relief operation smoothly.

- ✓ ***Relief network:*** There should be an effective relief network comprising government line departments, non-government agencies, corporate and financial organizations, volunteer groups and community based organizations for management of logistics, facilities and essential items required for relief operation during disasters. Proper training and coordination among these organizations are also essential for smooth conduct of relief operation.

- ✓ ***Control room:*** The district administration should establish a control room during warning phase of disaster to deal with disaster situation.

- ✓ ***Administration of relief:*** This process involves management of requisite resources for distribution of relief materials to affected people, assessment of loss and damage, appropriate measures for rehabilitation and recovery.

- ✓ ***Military assistance:*** If the magnitude of disaster is high and beyond the control of district administration, the services of military response force could be utilized.

- ✓ ***Health and medical care:*** During disaster, the affected population generally needs special and emergency medical care. Provision should be there to extend appropriate medical support to affected communities and prevent outbreak of epidemic.

- ✓ ***Disposal of corpse:*** Disposal of dead bodies from disaster affected areas should be the top priority to control nuisance and epidemic.

- ✓ ***Salvage operation:*** Early recovery of essential services and repairing of damaged structures are essential for restoration of normal situation.

- ✓ ***Outside and special relief:*** In special cases, the district disaster management authority may seek national support to handle a disaster situation. If the magnitude of disaster is too high, the national government may look for international helps. In that case, there may be huge flow of relief materials in disaster affected areas. Genuine strategy and coordination are required for proper management and distribution of relief materials.

- ✓ ***Monitoring:*** Constant monitoring is required to review the disaster situation and damage characteristics. This is essential to formulate strategies for further relief to the affected communities. A particular affected community may need long time outside support and compensation for recovery. The local authority may need special financial support from national government for reconstruction and rehabilitation of affected population. That is why, review of information is mandatory in relief exercise.

5.8 ORGANIZATIONAL AND FINANCIAL ARRANGEMENTS FOR DISASTER MANAGEMENT IN INDIA.

This section is prepared based on latest report published by Ministry of Home Affairs, Government of India in 2011 on Disaster Management in India.

There has been a complete paradigm shift in the approaches of Disaster Management in India during last century. The British administration established relief department in India to deal with emergencies. In the post independent period, each states of India had Relief Commissioners to deal with relief operation during disaster situation.

In 1990, the Government of India set-up a separate Natural Disaster Management Division under Ministry of Agriculture and Cooperation to look after the activities related to disaster management. After Bhuj earthquake in 2001, the Government of India constituted a High

Power Committee under the Chairmanship of Sri J. C. Pant to draw the guidelines for holistic disaster management in India. In 2002, the Disaster Management Division came under the Ministry of Home Affairs, Government of India.

One Joint Secretary of Ministry of Home Affairs was nominated as Head of the disaster management division. There were also few Directors, Under Secretaries, Section Officers, Technical Officers, Senior Economic Investigator, Consultants and supporting Staff in the division. The Home Minister, Home Secretary, Secretary (Boarder Management) were the hierarchies of the organizational structures. Some Ministries were designated as nodal authorities for specific disasters. High power group was constituted with the representatives from different ministries.

In continuation with earlier structure, National Disaster Management Authority (NDMA) has been established in the centre followed by State Disaster Management Authorities in the States. Subsequently District Disaster Management Authorities are established in all the districts to look after the disaster management related activities.

The National Crisis Management Committee is also part of disaster management structure in India. The National Centre for Disaster Management established in 1995 was converted into National Institute of Disaster Management in 2003 mainly to carry out training, research, case studies, documentation etc. Under National Centre for Disaster Management, many state level Centres and Administrative Training Institutes are working.

The Ministry of Finance, Government of India deals with the budgetary provision of relief fund as per recommendations of Ministry of Home Affairs, Government of India. Based on recommendation of 13th Finance Commission, National Disaster Response (NDRF) Fund and State Disaster Response Fund (SDRF) are created for the period 2010 – 2015. There are also provisions for Calamity Relief Fund (CRF) and National Calamity Contingency Fund (NCCF) for assistance to state governments.

5.9 WHAT WE LEARNT FROM THIS UNIT?

Disaster management means, mitigation of disaster risk of a system by preventing external hazards or reducing internal unsafe conditions or preparing vulnerable communities for living with disasters.

The complete disaster management process comprises two distinct parts. Risk Management and Crisis Management. Risk management is the most important aspect of disaster management. If we cannot manage the risk of our system up-to a certain limit, the system is bound to face a disaster. A disaster always leads a crisis situation. In crisis situation, the affected people depend on external supports to manage their basic requirements for survival.

Everyone can take part in the process of risk assessment and risk management based on their levels of knowledge, expertise and resources. But, for crisis management, we need trained and skilled manpower, equipment, organizational structure, logistics, material and financial supports etc.

In risk management, we get time for assessment of our risk and plan accordingly for disaster risk reduction. But, crisis management starts with action i.e., rescue and relief operations. For crisis management also, we need specific action plan. The preparation of action plan for crisis management is done based on risk assessment of the system. Therefore, without genuine risk assessment, we cannot make crisis management plan for effective management of crisis situation.

Both the risk and crisis management plans are hazard and location specific. Therefore, the disaster management plans are also hazard and location specific. One particular disaster management plan may not be suitable for different hazard prone areas. Even a single disaster management plan for a particular location may not be effective for different hazards.

Risk management includes Prevention, Mitigation and Preparedness. Crisis management comprises Rescue, Relief, Rehabilitation and Recovery. We can also adopt prospective, corrective, or compensatory risk management measures for mitigation of our disaster risk.

Now many countries including India have adopted Disaster Management Act and Policies for formation of strong organizational structures and effective management of disasters at different levels.

5.10 PROBABLE QUESTIONS

1. What do you mean by Disaster Management?
2. What is risk management?
3. What is crisis management?
4. Describe the complete process of Disaster Management.
5. Describe prevention, mitigation and preparedness mechanisms.
6. Describe the response and recovery mechanisms.
7. What are the steps of relief mechanism?
8. Write down about organizational structure for disaster management in India.

5.11 SUGGESTED READINGS

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UNIT-6: CAPACITY BUILDING

UNIT STRUCTURE

6.1 INTRODUCTION

Capacity building is the most important process of disaster risk reduction. So far, in our previous discussions, we have described different aspects of disaster risk. Now the concept of Disaster Risk Reduction (DRR) mechanism is getting importance in the disaster management process.

We have seen that disaster risk of a system depends primarily on hazards to which the system is exposed and vulnerability factors of the system. Both the hazards and vulnerability have many dimensions. So the analysis of risk is also complex. But some methods are there to estimate disaster risk based on hazard and vulnerability analysis. Capacity building process for disaster risk reduction has also multidimensional aspects, as the process is linked to prevention of hazards and mitigation of vulnerability factors.

In this unit the issues relevant to capacity building will be highlighted.

6.2 OBJECTIVES

This objective of this unit is to outline

- Concept and methodology of capacity building.
- Different aspects of capacity building process.
- Principles of capacity assessment.
- Correlation between development and disaster.
- Capacity building for risk reduction.

6.3 CONCEPT OF CAPACITY BUILDING

6.3.1 WHAT IS CAPACITY?

First, let us define capacity to understand the capacity building process. Capacity is the resources, means or strength, which enhances our ability to prevent disaster or mitigate loss and damage, or withstand with disastrous situation.

Resources are the sources from which we get benefits. Resources may be physical resource, natural resource, and human resource that are linked to conservation and sustainability.

Here ***means*** implies the ways, methods, techniques, methodologies and technologies that are useful to evolve the mechanisms for sustainable development.

Strength may be defined as ability to do something in terms of physical (skilled manpower, trained volunteer, equipments, tools etc.); economical; organizational or moral strengths.

The major goal of capacity building is to develop suitable means and strength to generate resources for sustainable development. It is the process, which minimizes the risk of vulnerable communities by reducing unsafe conditions of the system or resisting external threats to the system.

6.3.2 MAJOR ASPECTS OF CAPACITY BUILDING

Development of human resources: This is required to improve the status of knowledge and skill of the people to enable them to work effectively for capacity building of the system. Genuine human resource having proper knowledge, skill and access to up-to-date information is the pillar of capacity building process. Without this it is not possible to develop suitable methods, techniques, strengths and resources for sustainable development.

Institutional/organizational capacity building: This process involves enhancement of capacity of the institutions or organizations for developing useful methods, techniques, plans, policies and legislations; building strong and efficient organizational structures; producing skilled and trained manpower etc. Good institutions are also required to generate valued human resources. Genuine human resources are also strength of good institutions.

Development of infrastructure, facilities and resources: Strong physical resources, well-equipped infrastructures and useful facilities are the basic components of sustainable development. Without these, it is not possible to reduce risk of our systems.

Detail about structural and non-structural measures for capacity building is discussed in the following sections.

Example of capacity building,

An embankment is useful for minimizing flood risk of an area. Thus, the embankment is one of the ***physical resources***, which can resist flood hazard from striking the area.

Again, for construction of an embankment, we need

- ✓ Proper design based on data, information and technological know-how.
- ✓ Necessary fund, quality construction material and skilled manpower.

So, the process of capacity building has multidimensional aspects associated with physical, material, ecological, social, organizational, economical, motivational, and technological factors.

6.3.3 WHY WE NEED CAPACITY BUILDING?

Capacity building process is the most important step of disaster management, because

- ✓ It reduces disaster risk by resisting hazards.
- ✓ It minimizes disaster risk by reducing vulnerability of the systems.
- ✓ It enhances the ability of the vulnerable communities to cope with disaster.
- ✓ It addresses the needs of vulnerable communities.
- ✓ It helps to generate suitable methodologies and technologies for sustainable development.
- ✓ It addresses the economics for sustainable development.
- ✓ It helps to educate and aware vulnerable communities about disaster risk and risk reduction measures.
- ✓ It helps to build strong organizational structure to deal with disaster events.
- ✓ It enhances the personal capacity like leadership and management skills.
- ✓ It provides the scopes of good practices for damage mitigation like early warning, preparedness measures, and trainings for construction workers and volunteers etc.

6.4 STRUCTURAL AND NONSTRUCTURAL MEASURES

The capacity building process to mitigate disaster risk of a system has two distinct parts.

- ✓ Structural measures.
- ✓ Non-structural measures.

Structural measures involve physical constructions comprising engineering and non-engineering structures which are useful to reduce risk or avoid possible impacts of hazards. There may be application of engineering techniques to develop hazard-resistance devices or structures resilient to natural hazards. Some common structural measures for disaster risk reduction are dams, flood levies, Embankments, ocean wave barriers, earthquake-resistant construction, evacuation centres etc.

Non-structural measures do not involve any physical construction. Non-structural measures are the codes, norms, policies, legislations, knowledge, practice and agreement relevant to sustainable development and mitigation of disaster risks. Public awareness, training and education are also parts of non-structural measures. Examples of non-structural measures are proper application of earthquake resistant building codes, land use regulation, forest laws etc.; Hazard-Vulnerability-Capacity (HVC) analysis; risk reduction planning and its implementation, public awareness and training programmes etc.

Non-structural measures are also considered as part of structural measures. For example, to construct a hazard resistant structure, we need to follow the building codes and land use regulations.

6.4.1 STRUCTURAL MEASURES

Structural measures include both engineering and non-engineering structures for damage mitigation.

Engineering structures

The structures, which are constructed based on engineering planning, architecture and design following relevant codes and safety norms for hazard specific disaster risk reduction. Engineering structures may be small houses, high-rise buildings, small or big dams, bridges, embankments, roads, railways, airport, other infrastructures and facilities.

For planning and design of hazard resistant or resilient engineering structures, inputs from trained and experienced engineers and professionals are required. Hazard proof or hazard resistant structural development involves

- ✓ Zoning maps to understand the nature and magnitude of external forces that may cause damaging affect to the structure.
- ✓ Planning and design of the structure considering geographical and geological set-up of the location, soil characteristic, probable impact of hazards to the structure, safety measures and impact of the structure to other elements and conditions of the area.
- ✓ Construction phase involving trained and skilled workers, quality construction material and proper supervision by experienced engineers.
- ✓ Maintenance of the structure based on regular monitoring of the condition of the structure.

Non-engineering structures

The structures, which are not constructed based on engineering planning and design. The following factors should be considered during construction of non-engineering structures.

- ✓ The construction site is not in a hazard prone area like floodplains, hill slope, earthquake prone area etc.
- ✓ The structures are comparatively small and less important.
- ✓ Skilled and trained workers are involved in construction of the structures.
- ✓ Traditional knowledge and experience are used in design and construction. The structures are suitable for local geo-climatic condition.
- ✓ The local risk factors are considered during construction of the structures.

Otherwise, these structures may enhance the disaster risk of the system.

6.4.2 NON-STRUCTURAL MEASURES

Non-structural measures generally improve our knowledge and skill to deal with disasters. These are also the foundations of structural measures for sustainable development. Some of the important non-structural measures, useful for disaster risk mitigation, are mentioned below.

Building codes

Most of the countries have their own hazard specific building codes for sustainable development. In India, ***Bureau of Indian Standard*** formulates the ***Indian Standard Codes*** on different subjects of engineering. The Civil Engineering Division Council of the Bureau formulates the hazard specific ***codes and standards*** for construction of structures involving planning, design, construction and maintenance, building material and components, construction practices, safety norms etc. Indian Standard Codes are formulated considering the factors like forces of natural hazards, climatic and soil conditions, and other adverse conditions of nature, for mitigation of damage and disruptions under the impact of natural hazards.

Some of the Indian Standard Codes, useful for construction of structures in hazard prone areas are

IS 1893:1984, defined the criteria for earthquake resistant design of structures.

IS 1893 (Part 1):2002, described the criteria for earthquake resistant design of structures (General provisions of buildings)

IS 1893 (Part 4):2005, explained the criteria for earthquake resistant design of structures (Industrial structures including stack like structures)

IS 4326:1993, defined the codes and practice for earthquake resistant design and construction of building.

IS 13827:1993, defined the guidelines for improving earthquake resistance of earthen buildings.

IS 13828:1993, defined the guidelines for improving earthquake resistance of low strength masonry buildings.

IS 13920:1993, defined the codes and practice of ductile detailing of reinforced concrete structures subjected to seismic forces.

IS 13935:1993, defined the guidelines for repair and seismic strengthening of buildings.

IS 6922:1973, defined the criteria for safety and design of structures subject to underground blasts.

IS 4967:1968, recommendations for seismic instrumentation for river valley projects.

Land use regulations

Land use regulations are a set of guidelines that regulates or defines the types of activities to be carried out in different locations of a particular area, based on hazard zoning and contour map of the area.

Hazard map of an area identifies the locations prone to different hazards. The contour map of an area gives idea about topography or shape of surface of the area, showing high land, low-lying area, depression etc.

A suitable land use planning is required for sustainable development and disaster risk mitigation. The land use plans generally identify the locations suitable for different kinds of activities, like important buildings and infrastructures, water bodies, wet land, cultivation, drainage network etc.

Legal framework

To achieve the sustainable development for disaster risk mitigation, we need to follow some codes, norms and legislations. Land use regulations and building codes are integral parts of the legal framework for risk mitigation. Worldwide the disaster risk is increasing significantly mainly due to violation of land use regulations, building codes and other laws of nature. So, legal framework is required to define codes and norms for sustainable development and proper legislations for genuine implementation of these codes and norms. Such legal framework should have the provisions for eviction and relocation of vulnerable

communities living in the hazard prone areas; punitive measures in violation of codes and norms; etc.

Compensation and incentives

As stated earlier, most of the population in developing and third world countries do not have ability to follow the codes and norms for disaster risk mitigation. People live in hazard prone areas without any safety measures and preparedness under compulsion. It is better to provide financial support to this section of people as one time incentive for taking proper measures for disaster risk mitigation, rather imposing strict codes and norms for sustainable development. In this case, it is important to impose certain norms for proper utilization of fund allocated for risk mitigation measures. Government can provide loan and insurance on subsidized interest rate and low premium to vulnerable communities.

National governments of different countries including India have separate funds in their plan budgets to provide compensation to the victims of disasters for recovery and reconstruction. Proper utilization of such funds based on genuine damage assessment is a difficult task. Strict legislations are required to stop misappropriation and biased distribution of such fund.

Training and awareness

Planners, executives and members of vulnerable communities need to understand the concept of disaster risk and damage mitigation approaches for preparation of practical disaster management plans. Without having in-depth knowledge and practical experience, it is not possible to contribute much in the field of disaster management.

Moreover, developmental activities avoiding disaster risk always increase the probability of damage and disruption. To mitigate damage and disruption, the vulnerable communities must be aware about their own risk and risk reduction mechanism.

To educate and train up the members of line departments and vulnerable communities, the Disaster Management Agencies and Institutes should develop suitable training modules. The training modules for different target groups like, government officials, engineers, executives, managers, construction workers, technical students, NGOs and CBOs should be different and appropriately balanced. In India; National Institute of Disaster Management, state level Administrative Training Institutes and Disaster Management Centres are organizing training programmes for different target groups on different aspects of Disaster Management.

Awareness programmes in the form of lectures, demonstration, street drama, puppet show etc. are also equally important to educate common people about disaster risk and measures for disaster risk mitigation. Such programmes are also helpful to aware people about do's and don'ts for different disaster situations.

Organizational structure

In most of the countries, the government line departments are playing vital role in planning and execution of Disaster Risk Reduction (DRR) programmes. The success or failure of these programmes depends largely on capacity and efficiency of individual organizations and their coordination with each other. We need a strong organizational structure for proper command, control and coordination. Recently, many countries, including India, have adopted separate ***Acts and Policies*** for disaster management with the provisions of independent organizational structures to deal with disasters.

There should be genuine efforts to enhance the strength of the organizations involved in disaster management, in terms of practical knowledge, skill, equipment, tools and other facilities. Exchange of data and information among different organizations are also equally important for practical disaster management planning.

Early warning system

To mitigate damage and disruption due to natural hazards, we must have some sort of early warning mechanisms to alert people well before the occurrence of a disaster. Different natural hazards have different warning signs. The most critical part of the early warning process is proper analysis of the warning signs of a particular natural hazard. As for example, there is no specific warning sign for short time prediction of an earthquake. But, long time prediction on probability of occurrence of earthquakes in an area is possible by analyzing geological and seismological data. Similarly by analyzing meteorological and hydrological data early warning for cyclone and flood can be given. Therefore, only the experts of relevant subjects can issue a warning for probable natural hazard.

The second complex part of early warning mechanism is mode of transmission of warning to common people. Nowadays, the electronic communication systems are playing vital role in communicating warnings for occurrence of natural hazard induced disasters. Many vulnerable communities have their own traditional methods for transmission of warning for probable disaster by studying warning signs of a particular hazard.

The most important issues of warning mechanisms are reliability and authenticity of the early warning process. Wrong prediction of a disaster may have adverse affect on the vulnerable community.

Adjustment processes

Most of the time, it is not possible to resist natural hazards for prevention of disasters. The vulnerable communities also may not have capacity to mitigate their disaster risk by reducing vulnerability factors of their systems. In this case, the vulnerable communities may adopt some adjustment processes like hazard friendly housing pattern, alternative agriculture, alternative means of livelihood and production, safe storage of food and essential items etc. to cope with disaster situation. Details about alternative adjustment processes will be discussed in the next unit.

6.5 DISASTER AND DEVELOPMENT

There is an interesting relation between development and disaster. A disaster may have many negative effects on our developmental process due to large-scale damage and disruption. On the other hand, unsustainable and haphazard developmental activities may lead to a disaster like situation under the impact of a natural hazard. In any case, a disaster has great negative impact on our national economy. So finding out the ways to mitigate disaster risk should be the top priority of national governments.

6.5.1 PROBABLE OPTIONS OF DISASTER RISK MITIGATION.

- ✓ The first option for damage mitigation may be prevention of hazards or mitigation of impact hazards by protecting our environment, conserving natural resources, and improving the capacities of counter disaster resources.

- ✓ The second option may be hazard friendly sustainable development obliging land use regulations, building codes and other natural laws.

To achieve these, we need very strong national policy for ***Disaster Risk Reduction*** (DRR). The basic problem of the poor countries is their inability to implement the national policy for risk reduction. Generally, the poor countries do not have enough strength to respond appropriately for disaster risk mitigation. These countries are largely dependent on international agencies for financial and other basic supports. Of course, many international donors are now extending financial support to developing countries for training and research to enhance knowledge and skill, planning for disaster risk mitigation, strengthening of counter disaster resources, improvement of infrastructure and facilities for response and recovery, technology development, technology transfer etc. The GoI–UNDP-DRR (Government of India - United Nations Development Programme - Disaster Risk Reduction) programme is the perfect example of such international cooperation.

For such international cooperation, provision should be there in national policy to develop link for coordination with international agencies. International agencies generally extend their supports to disaster-affected countries for relief, rehabilitation and recovery based on the affected country's international policy to accept such external support. For example, country like China is least interested to take international support during disaster situations. On the other hand, the country like Afghanistan is very much dependent on America and few other nations to tackle disasters due to natural and man-made hazards.

After all, it is the responsibility of a national government to adopt a strong national policy for Disaster Risk Reduction. Otherwise, a disaster may cause adverse affect on national economy and development.

6.5.2 POSSIBLE IMPACTS OF DISASTERS ON NATIONAL ECONOMY AND DEVELOPMENT

- ✓ Heavy economic loss may have negative impact on infrastructure development.
- ✓ Wide range of damage to crop may lead to food scarcity.
- ✓ Siltation on fertile agricultural land may have long time negative impact on cultivation and hence food production.
- ✓ Large-scale physical damage and disruption to infrastructures and facilities like road, bridge, airport, railways, public and government buildings, communication network etc. may lead to national crisis.
- ✓ In case of a big disaster, a country may need to divert its major budget, allocated for other developmental works, to recover vital resources. Under this situation, a country may face serious problems in completion of its major developmental projects.
- ✓ As the recovery process is complex, time consuming and costly affair; the national government may face problem to manage the situation with its own available resources or convince the international donors to continue financial and other supports for long time.
- ✓ A big disaster may have long standing affects on production based industries, socio-economic condition of affected communities, livelihood opportunities, health and medical care, agro based industries, human psychology, research and development etc.

Thus, the national development plan of a country should address the issues related to disaster risk mitigation to make the existing infrastructure and facilities resilient to natural hazards. Stress should be given to make the counter disaster resources capable to prevent disasters or minimize the magnitude of loss and damage. In general, the national planning departments do not give due weightage to disaster risk assessment based on possible impact of natural hazards, needs of vulnerable communities, strength of counter disaster resources, status of

organizational structure, legal and financial framework etc. So, involvement of subject experts in the planning process is necessary.

Considering the long-standing affects of disaster on national economy and development, many countries including India have changed their policies for disaster management. The Government of India has enacted ***Disaster Management Act in 2005*** followed by ***National Disaster Management Policy in 2009*** for effective management of disasters and disaster risk mitigation.

6.6 CAPACITY ASSESSMENT

As discussed earlier in this unit, capacity-building process involves enhancement of resources, means and strength to prevent disasters or mitigate loss and damage due to disasters. Nations having poor capacity to deal with disasters suffer maximum loss and depend more on international support for response and recovery.

Capacity assessment is necessary to find out the gap between disaster risk and capacity building process of a nation. Disaster risk of a system is directly related to hazards to which the system is exposed and vulnerability factors of the system. Therefore, capacity-building process is also hazard and location specific. For genuine capacity assessment, in-depth analysis of hazards and vulnerability is also necessary.

Basis of capacity assessment

Capacity assessment of the vulnerable community and organizations involved in disaster management should be done based on

- ✓ Nature, magnitude, frequency and damage characteristics of the probable hazards of the area.
- ✓ Vulnerability factors of the area, i.e., existing unsafe conditions, which are enhancing the probability of loss and damage.
- ✓ Available resources, devices or mechanisms useful to prevent probable hazards of the area.
- ✓ Existing counter disaster resources to reduce loss and damage in the area.
- ✓ Status of physical, organizational and financial capacities of different organizations, government departments and vulnerable community to deal with probable disasters in the area.
- ✓ Strategies and adjustment methods adopted by the vulnerable community to cope with the probable disasters.
- ✓ Preparedness level of the vulnerable community to mitigate disaster loss and damage.
- ✓ Status of organizational structure to deal with probable disasters in the area.
- ✓ Assessment of needs for capacity building of the community.

For example, capacity-building processes to deal with disasters due to flood and drought hazards are completely different. Capacities required for reducing loss and damage in flood and drought prone areas are also different.

Here, only few examples are given. We can make a complete list following above mentioned principle.

For first case

Hazard type: Flood

Magnitude of hazard: Depends on rainfall

Frequency of hazard: May be seasonal or sudden

Damage characteristics of flood: Depending on local environment, damage may be to houses, infrastructure, crop, life, communication system etc.

Vulnerability: Houses constructed in low-lying area, crops in flood prone area etc.

Status of hazard resistance resources: Embankment is there to protect the area from flood, but not maintained properly. So, there is possibility of breaching.

Counter disaster resources: Water Resources Department, Civil Defense department, Medical centre, etc.

Other physical, organizational and financial capacities: Boats, evacuation centre, life saving equipment and tools, emergency survival materials, trained volunteers, non-governmental organizations (NGOs), Community based organizations (CBOs), disaster response fund, calamity response fund etc.

Adjustment methods: Flood friendly housing pattern, alternative agriculture, safe storage of food, indigenous communication modes etc.

Preparedness: Storage of food, water and other essential items; water purifier; survival kits for flood; training for flood rescue etc

Organizational structure: District disaster management committee comprising members of line departments, NGOs, CBOs is there to deal with disaster situation. But most line departments are lacking trained manpower, equipment, tools, funds etc.

Need assessment for capacity building: Based on these data we can identify the resources, means and strength required for proper capacity building of the community and management agencies to mitigate flood risk and damage in the area.

For second case

Hazard type: Drought

Magnitude of hazard: High due to lack of rainfall for long time and extreme dry weather.

Frequency of hazard: Continuous for long time.

Damage characteristics of drought: Damage to crop, negative affect on production, health hazard, malnutrition etc.

Vulnerability: Poor irrigation facility, poor medical care etc.

Hazard resistance resource: No mechanism exists.

Counter disaster resources: Irrigation department, FCI, Medical Centre etc.

Status of other physical, organizational and financial capacities: Reservoirs have limited capacity to store water for few days; supply of food, drinking water and other essential items not adequate for affected community; medical facilities are not up to the mark; government incentive and compensation are limited for selected section of affected population etc.

Adjustment methods: People used to survive with limited food, water and other essential items; during peak drought season people migrate to other places for livelihood etc.

Preparedness: Preparedness level is not up-to-the mark in terms of food storage, alternative agriculture, use of drought resistant crop varieties etc.

Organizational structure: District disaster management committee comprising members of line departments, NGOs, CBOs is there to deal with disaster situation. But, most line departments are lacking trained manpower, equipment, tools, fund etc.

Needs assessment: Similar to earlier case, we can identify the resources, means and strength required for proper capacity building of the vulnerable community and organizations to manage drought disaster in the area.

6.7 STRENGTHENING CAPACITY FOR RISK REDUCTION

The basic aim of capacity building is to enhance the ability of vulnerable communities for mitigation of loss and damage to their life and property.

As described in the previous topics, to strengthen the capacity of communities, organizations or the system as a whole for risk reduction; we need to improve the status of our resources, means and strength at the level, adequate for prevention of external hazards and mitigation of vulnerable conditions. Capacity assessment gives us guidelines and information about appropriate resources, means and strength required for disaster risk mitigation of a particular vulnerable system. Capacity building process involves both structural and non-structural measures addressing physical, material, social, organizational, legal and financial issues.

We have already discussed about capacity assessment process for two natural hazards "flood and drought". So, let us see the example of capacity building process for flood risk mitigation.

Using the concept of Disaster Crunch Model, we can find out the possible reasons and root causes of flood damage in a flood prone area. Disaster Release Model gives us idea about the method of mitigation of disaster risk. Applying the idea of Disaster Release Model, we can identify the appropriate method of flood risk mitigation. The concepts of Disaster Crunch and Release Models are discussed in unit 01.

Capacity building process for flood risk mitigation mainly covers two broad areas

- ✓ Resistance to the forces of flood hazards.
- ✓ Reduction of unsafe conditions, responsible for flood and flood damage, by addressing the root causes of these unsafe conditions.

The basic forces of flood hazard are high surface runoff and heavy river discharge resulting from high rainfall.

The most possible reason for flood in a floodplain is inundation due to rapid accumulation of runoff water or overflow of river water.

The possible reasons for overflow and water accumulation may be drainage congestion and poor carrying capacity of river network.

The root causes of these reasons may be related to high soil erosion and heavy sediment influx to drainage and river network due to mismanagement of catchment areas. The possible reasons of damage and disruption in flood prone areas are linked to different physical, social,

organizational and financial factors, which are location and community specific. Examples of such factors are discussed earlier.

We can adopt many structural and non-structural measures either to resist forces of flood hazard or to mitigate vulnerability factors responsible for damage and disruption.

Some common structural measures for flood risk mitigation are

- ***Storage reservoir*** to get control over river flow. This can be done by constructing dams across rivers, to store excess water during monsoon period and release water as per requirements. This kind of structural measure has many positive and negative impacts. Along with flood control, dams can be used for irrigation, water supply, hydropower generation etc. But big dams are not beyond the controversy of causing damage to our ecosystem and bio-diversity. Sometimes dams may be the reason for flash flood, if these are not designed and managed properly.

- ***Embankment*** for resistance of overflow of river water**.** This is a short time approach to reduce flood damage in a particular flood prone area. The concept of earthen embankment to control floods was implemented in India after 1954. Now it has become the most common practice for controlling flood and mitigating flood damage because of easy means of construction norms, easy access of construction material, cost benefit factors, easy maintenance and enhancement of carrying capacity of river. But such structural approach for flood risk mitigation has many negative impacts. Most of the floods in Assam occur due to breaching of embankments. If the embankment is not constructed and maintained properly, it enhances the risk of flash flood rather than flood control. Embankment also helps to increase the rate of sediment deposition in the riverbed by reducing the velocity of river flow. Sudden breaching of an embankment may lead huge sand deposition in fertile agricultural lands, resulting long time negative affect on crop production.

- Many other structural measures are there to improve carrying capacities of the rivers, divert river course to protect important areas, divert river flow to check bank line erosion and damage to embankment, regulate river flow, reduce surface runoff, check sediment influx to riverbed, built flood resistant houses and evacuation centres etc. These are mainly sluice gates, deflectors, spurs, revetment of slopes, check dams, retaining walls, etc.

Many non-structural measures are also equally important for reducing risk of flood damage

- Flood zoning and land use regulations are most important parts of flood risk mitigation. Flood zoning helps us to identify the flood prone areas according to frequency and magnitude of floods. Based on flood zoning, planners make land use planning for the floodplains to regulate the activities responsible for enhancing flood risk.

- Early warning mechanism allows us to get information in advance about probability of occurrence of flood in a particular area and respond appropriately for damage mitigation. On getting warning, vulnerable people can move to safer locations along with their belongings.

- Catchment area management, mainly to reduce soil erosion and surface runoff, is one of the important measures for long time flood risk mitigation.

- Public awareness and advocacy are also important tools for educating people about flood damage mitigation approaches, formulating policies favourable for vulnerable communities, gathering public opinion, mobilizing people and organizations etc.

- Alternative livelihood opportunity for vulnerable communities is another useful aspect of flood risk mitigation.

- Training and drill to improve preparedness level, skill and ability of vulnerable community to mitigate flood damage or cope with flood disaster are also essential.

- Flood insurance, compensation for flood damage, incentive for damage mitigation measures, alternative cultivation etc. are some other non-structural approaches useful for flood risk mitigation.

Like this, we can take appropriate structural and non-structural measures to improve our capacity for reducing disaster risk, based on genuine capacity assessment.

6.8 WHAT WE LEARNT FROM THIS UNIT?

Capacity building is the most important step of disaster management which helps to resist external threats from causing disaster in a system or mitigate the magnitude of loss and damage to a system due to the hazards by reducing internal vulnerability of the system or enhance the preparedness levels of the community to cope with disasters.

Capacity may be resources, means or strength, which enhances the ability of the communities to deal with disasters.

(i) Resources may be physical, natural or human resource from which we get benefits.
(ii) Means implies the ways, methods and technological know-how required to develop sustainable physical resources.
(iii) Strength means the ability to take actions. Strength may be physical, economical, organizational or moral strength, which help to implement the DRR plans.

Capacity building process may involve both structural and non-structural measures. Here, structural measure means sustainable physical constructions comprising both engineering and non-engineering structures. Non-structural measures are the codes, norms, regulations, legislations or processes, which are required for sustainable development and risk mitigation.

Unsustainable development is the main reason for vulnerability of a system and hence disaster risk. So, there is a close relation between developmental process and disaster risk. We need strong policy and action plan for DRR to achieve sustainable development and damage mitigation mechanisms.

Any disaster has significant negative impact on national economy. A big disaster may even disrupt the developmental process of a nation. So, risk assessment and risk reduction plans should be the integral parts of all national developmental projects and programmes.

Capacity assessment is necessary for capacity building planning, which identifies the existing capacity of the system and determines the gap and further needs for genuine capacity building of the community, organizations or system to manage disasters.

6.9 PROBABLE QUESTIONS

1. Define capacity?
2. What do you mean by capacity building?
3. Define resource, means and strength.
4. What is capacity assessment?
5. Why we need capacity assessment?
6. Define different aspects of capacity building mechanism.
7. What do you mean by structural and non-structural measures?
8. Mention few Indian Standard Codes for earthquake resistant structures.
9. What is land use regulation?
10. Give one example of capacity building process relevant to a particular natural hazard.

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FUNDAMENTALS OF DISASTER MANAGEMENT (DEM104)
UNIT-7: COPING WITH DISASTER

UNIT STRUCTURE

7.1 INTRODUCTION

Coping with disasters means preparedness to live with disaster. Disaster is part of our life and we cannot avoid disasters totally. But, we can take appropriate measures for damage mitigation and survival in disaster situations. To do this, we must have practical preparedness plan to cope with disasters, considering the nature of our disaster risk. Preparedness planning is hazard and location specific, because the damage characteristics of different hazards are not same and damage pattern is dependent on local vulnerable conditions. So, to develop strategies for living with disasters, risk and need assessments are necessary. Capacity building process is also a part of coping mechanism.

In the previous units, we have elaborately discussed about disaster risk and its assessment methods, capacity assessment and capacity building process, management principles for disaster risk mitigation etc. The chapter on overview of disaster scenario clearly shows an increasing trend of disaster events and economic loss worldwide. This again justifies the relevance of coping mechanism in present time.

In this unit, we shall try to give a flavour on scopes and strategies of coping mechanism relevant to different natural hazards. Stress will be given to cover physical, social, organizational and psychological aspects of coping mechanism.

7.2 OBJECTIVES

This objective of this unit is to outline

- The requirements for coping mechanism to allow people to live with disasters.
- The adjustment processes useful for damage mitigation and survival options.
- The changing concepts of disaster management.
- The useful safety norms, tools and kits required for damage mitigation.

7.3 COPING STRATEGIES

7.3.1 BASIC CONCEPT

Coping strategies give us guidelines for preparedness to live with disasters. To develop ***strategies of coping mechanisms*** relevant for different natural hazards; we must understand the *nature and characteristics of the risk parameters of our areas, scope of actions for risk mitigation, requirements to develop coping mechanisms, philosophy and fundamental factors relevant to planning for coping with disasters etc.*

The basic parameters of ***specific risk*** of our systems are ***hazard*** and ***vulnerability***. We have already discussed in the previous units that, the nature and magnitude of damage and loss depend on type of natural hazard as well as internal negative factors of our systems. Naturally, ***the needs for our preparedness to cope with disaster situation*** vary with damage characteristics of the hazards. The damage pattern in a particular hazard prone area again depends on physical developmental pattern in the area, resources at risk and susceptible to the hazard, Socio-economic conditions of vulnerable community of the area, status of the organizational structure and capacities of individual organizations to deal with disaster etc. So, the primary requirements for *planning for preparedness to cope with disasters are*

- ✓ Hazard assessment, to identify the probable natural hazards to which an area is exposed.
- ✓ Estimation of the impact of possible natural hazards to the exposures, mainly to physical and living elements of the area.
- ✓ Identification of physical and living elements, which are at risk. i.e., the people, buildings, infrastructures, and essential facilities in the area, which are susceptible to probable natural threats.
- ✓ Capacity assessment to find out further needs to prepare us for living with disasters.

So, the process for developing coping strategies involves entire process of risk assessment and risk management. The detail about the above mentioned steps are discussed elaborately in the previous units. On getting above mentioned information, we shall be familiar with

- ✓ Our threats, i.e., the types of natural hazards, that may strike our area, and their frequency, timing, duration, impact factors etc.
- ✓ Expected loss and damage to our life and property, in case a hazard strikes our area.
- ✓ Resources, which are not safe and need special care.
- ✓ Our existing capacity and further needs for preparedness to cope with disaster.

7.3.2 MEASURES TO IMPROVE CAPACITY AND PREPAREDNESS LEVEL FOR COPING WITH DISASTERS.

- If the frequency of probable hazard is random and does not have any warning sign for its forecasting in advance; then long term preparedness plan based on land use regulations, hazard resistant building codes and safety norms is necessary to cope with disaster. In this case, we may not get enough time for evacuation before the occurrence of disaster. As for example, DRR planning for earthquake needs seismic zoning and implementation of earthquake resistant building codes.

- If the frequency and warning signs of expected hazards are known; then we should try to develop suitable mechanism for forecasting warning of the event to vulnerable communities in advance. As for example, Meteorological Department generally records different climate and weather related parameters to study and forecast the

occurrence of probable atmospheric, climatic and hydrological hazards like flood, cyclone etc.

- For the vulnerable communities living in hazard prone areas; there should be a proper evacuation plan to shift vulnerable people and their valuable assets to safe location well before the occurrence of disaster. In this case, we shall need adequate numbers of well-equipped *(having minimum basic facilities like drinking water, sanitation, power supply etc.)* and properly maintained evacuation centres at safe locations to accommodate vulnerable people, in view of a probable disaster.

- In case, a large section of population is living in hazard prone areas and there is no relocation plan; efforts should be made to encourage the vulnerable people to go for hazard proof housing. Provisions should be there for alternative mode of communication to shift the affected population to evacuation centres during a disaster. The rescue agencies must equip with skilled manpower and equipment to conduct search and rescue operation during disasters. Let us see the status of response forces in India.

  In India, the concept of ***Civil Defence*** was originated during World War II and subsequently it got proper weightage in 1962 with the appointment of a Directorate General of Civil Defence. The Civil Defence is mainly responsible for saving life and minimizing damage to property. Since 1962, the Civil Defence has been operating under Ministry of Home Affairs, Government of India and now it is attached to Disaster Management Division of the same Ministry. The Government of India had adopted Civil Defence Act in 1968.

  Civil Defence is mainly a volunteer based organization and Civil Defence Corps has Headquarter Service, Warden Service, Communication Service, Casualty Service, Fire Fighting Service, Rescue Service, Welfare Service, Salvage Service, Corpse Disposal Service, Depot & Transport Service, Training Service, and Supply Service.

  Recently under section 45 of the Disaster Management Act 2005, ***National Disaster Response Force (NDRF)*** was constituted for specialized response in natural and manmade disasters. Moreover, many national and international agencies are also actively involved in developing alternative methods and skills of community members for proper search and rescue.

- Proper emphasis should be given for management of emergency food and water supplies; medical and sanitation facilities; and other minimum basic requirements for survival of affected communities. Though, the Government line departments are responsible for arrangement of these items and facilities, but the vulnerable communities must try to arrange these on their own to save their life during disaster.
- Another major task is advance preparation for restoration of essential services like communication facilities, water and power supplies etc. as early as possible during a disaster. In this case, the role of concerned government agencies is vital, because the affected communities cannot contribute much and depend largely on outside agencies. For example, in view of collapse of an important bridge, the concerned military wing may take part in restoring road communication by constructing temporary Bailey bridge. The Power Grid Corporation in India has mobile towers for restoration of emergency power supply. The public health engineering department is responsible for management drinking water.

The Indian Army restored road communication by constructing a Bailey Bridge in NH 31 near Nalbari of Assam. The concrete bridge was damaged due to flood in 2004.

- During disaster, the affected communities may lose their livelihood opportunities and means of production. Government schemes and financial assistance are required to rehabilitate production and livelihood opportunities. Public awareness is also equally important for alternative means of production and livelihood. In this case, the relevant departments and agencies may extend counseling to vulnerable communities.

- Another important issue of coping mechanism is proper measures for long time recovery, based on existing codes and norms for sustainable development. Temporary measures can give partial relief but not a permanent solution of the problem.

- Proper management and mobilization of counter disaster resources at right time and place are equally important to deal with disasters.

7.3.3 PHILOSOPHY AND FUNDAMENTAL FACTORS FOR COPING WITH DISASTERS

Why we need coping strategies?

The basic reason is that, a disaster has wide range negative affects on people and government of a nation. We need proper coping strategies to mitigate loss and damage to life and property of the people and hence to minimize national loss. So, it is the responsibility of national government to find out and implement coping strategies for mitigation of disaster risk of the nation. But, without active cooperation from non government organizations and vulnerable communities, government alone can not achieve this goal. Government agencies may face some problems in dealing with a disaster situation.

- ✓ The government agencies may not have enough resources to meet the needs of affected population.
- ✓ The line departments and organization may have to work under tremendous political pressure without having adequate manpower, equipment and fund.
- ✓ Lack of cooperation among different organizations may lead chaos.

Therefore, there should be a dedicated disaster management system administered by the government organizations in coordination with other non-government organizations and community members.

To develop ***major requirements for coping with disasters,*** we must take care of some fundamental factors.

- ✓ The organizational structure responsible for national disaster management should be familiar with the national disaster scenario and its management principles.
- ✓ Micro level risk assessment to understand the nature of disaster risk of different vulnerable communities and their needs to cope with disasters.
- ✓ Active involvement of vulnerable communities in the process of assessment of their risk and needs by outside organizations.
- ✓ Proper training of the members of disaster management agencies to make them familiar with the methodologies of risk assessment and damage mitigation. One wrong decision may enhance magnitude of loss and damage rather than mitigating disaster risk.
- ✓ Proper mechanism and policy for collection of genuine data and information. Usually, the data acquisition processes in most of the countries are not that much reliable due to lack of expertise, facilities and fund. This leads wrong assessment and planning for coping mechanism.
- ✓ A comprehensive national disaster management policy for effective management of disasters.

7.4 ALTERNATIVE ADJUSTMENT PROCESSES

As discussed earlier, the developing and third world countries suffer maximum loss and damage due to natural disasters. Because, the common people of these nations do not have capacity to take proper measures for damage mitigation. The national governments also do not have enough resources and strengths to deal with disasters. So, alternative adjustment processes based on scientific approaches synchronized with available resources, traditional knowledge and practical experiences of vulnerable communities are found to be useful tools for damage mitigation.

Let us start with one practical example.

Observations on damage characteristics of past two great earthquakes in Northeastern region of India in 1897 and 1950 showed,

- In both the cases, there were significant structural damages in major cities like Shillong and Guwahati. But, interestingly many Assam type buildings of wooden framework remained intact under the impact of such high magnitude earthquake.

  This indicates the role of hazard resistant housing pattern in earthquake damage mitigation. While a costly engineering structure may fail to sustain against moderate or high magnitude earthquake hazard, a simple structure constructed based on traditional knowledge and experience may be resilient to the high magnitude earthquake hazard.

- There were huge landslides across the foothills of Himalaya and Garo Hills during 1950 earthquake. This resulted artificial blockade to few major tributaries of Brahmaputra. People living in the lower catchment areas had to suffer heavy loss and damage due to flash floods caused by sudden burst of artificial dams. Vast area of land either elevated or subsided, altering the drainage network of this region. Worst liquefaction damages were also reported from alluvial plains.

  In case of a high magnitude earthquake in this region, the damage and disruption due to earthquake induced flood and liquefaction may be much higher than the past record.

This is because of; human induced disturbances in upper catchment areas, like construction of big dams, shifting cultivation, deforestation etc.; unsustainable structural development in alluvial plains; haphazard urbanizations in the entire region.

Naturally, the government as well as population living in lower catchment areas should be more careful to adopt certain measures for minimizing loss and damage. Disturbances in upper catchment areas of river network and construction of high-rise buildings in alluvial plains/sandy soils could be avoided. To avoid loss and damage due to earthquake, the people of this region needs to enhance their preparedness level for fire, landslide and flood along with earthquake.

We can take some more examples of adjustment methods adopted by the vulnerable communities living in flood prone areas of Assam.

"Dhemaji" is one of the most flood prone districts in Assam. Situated in the eastern most part of Assam, the district is chronically flood affected due to its geographical location. The district is situated in the foothills of lower Himalayas. A good numbers of tributaries of Brahmaputra River, originated from Himalayan foothills, are flowing through the district. The foothills of Himalayas experience heavy rainfall, an average 5000 – 6000 mm per year. The entire riverine system of the district was severely disturbed during 1950's great earthquake. The huge sediment influx from Himalayan foothills reduced the carrying capacity of the riverine system significantly. Flood resistance measures are also not adequate for minimizing magnitude and frequency of floods in the district.

As a result, the local environment of the district becomes extremely favourable for flood disaster. A large area of paddy fields and human habitats of the district and part of NH 52, connecting the district with rest parts of the country, are now extremely vulnerable to flood. During monsoon season, the entire population becomes almost isolated from other parts of the state. Most of the flood-affected people, living in remote areas of the district, do not get proper external supports for rescue, relief and rehabilitation. Moreover, heavy damage of crop and huge sand deposition in paddy fields are major problems for the localities.

Huge volume of send deposited in the paddy field and human habitats due to flood

Despite all these problems, most of the population opted to live with flood disasters rather than migrating to other parts of the state. People have developed and adopted different adjustment mechanisms to cope with flood, based on their traditional knowledge, experience and practices. Interestingly, the loss of life due to flood in the district is also negligible compared to other parts of the country.

A traditional *Chang-Ghar* (House with raised platform) **in a flood prone area**

The vulnerable communities understand their risk of flood disaster and take appropriate measures for mitigation of loss and damage to their life and property. They have great idea about warning signs of flood, but prefer to stay in their own houses during flood period, rather than taking shelter in the evacuation centres. The concept of ***"Chang-Ghar",*** the traditional flood proof housing system with raised platform, is a common practice among vulnerable communities. To construct these houses, people take care of highest flood levels in their respective flood prone areas, construction materials and other safety norms.

People have country boats for transportation

The vulnerable communities assess their needs for survival during floods in advance and make arrangements of emergency items and alternative communication facilities. Normally, the individual household or community as a whole makes advance arrangements for safe storage of food-grains by constructing high platform flood resistant storehouses; alternative drinking water by means of deep tube-wells and flood friendly communication facilities like raft made up of banana plant and bamboo etc. to survive during flood without any external support.

Raft made by locally available resources is used for rescue of flood affected population

People generally use available local resources like bamboo, banana stem etc. to make rafts for alternative mode of communication in flood. Most people are good swimmers and trained to rescue people from floodwater. Most of the households have deep tube–wells to manage drinking water during flood. The vulnerable people store a variety of traditional dry foods, prepared from locally available food-grains, for flood season. Most importantly, people are mentally prepared to live with flood disasters without any psychological stress. Of course, during off-season of flood, people take advantage of government schemes to enhance their preparedness level to cope with flood disasters.

Other means of adjustment

Alternative agriculture is another important mode of adjustment process for managing floodplain agro-system. Researches are going on worldwide to develop flood resistant crops. Cultivation of off-season crops is now getting importance among vulnerable communities to avoid scarcity of food during flood disaster.

But, problem is that, farmers of most of the floodplains in India are dependent on rainfall and hence prefer to go for kharif crops during rainy season. To encourage the farmers of the floodplains for mixed cropping, *kharif and rabi crops*, during rainy season and post-flood periods; government should take appropriate measures for flood resistance devices and irrigation facilities. Efforts should be there to educate vulnerable communities about floodplain farming systems and provide incentives for adopting mixed cropping system to achieve food security.

Flood insurance schemes to regulate land use in flood plains are popular in many countries. The values of premiums of such insurance schemes depend on types of activities and locations of the flood plains. Charge of insurance premium is more for the activities in high flood prone areas. Such step is necessary to reduce risk of the insurance companies and motivate people to follow the land use regulations for flood damage mitigation.

The alternative adjustment processes have some limitations and can not fill up the place of long term risk mitigation measures. We can not apply a standard set of adjustment processes for different disaster situations. It is not possible to fix a particular set of adjustment mechanisms for a particular hazard prone area, because the characteristics of hazard are also

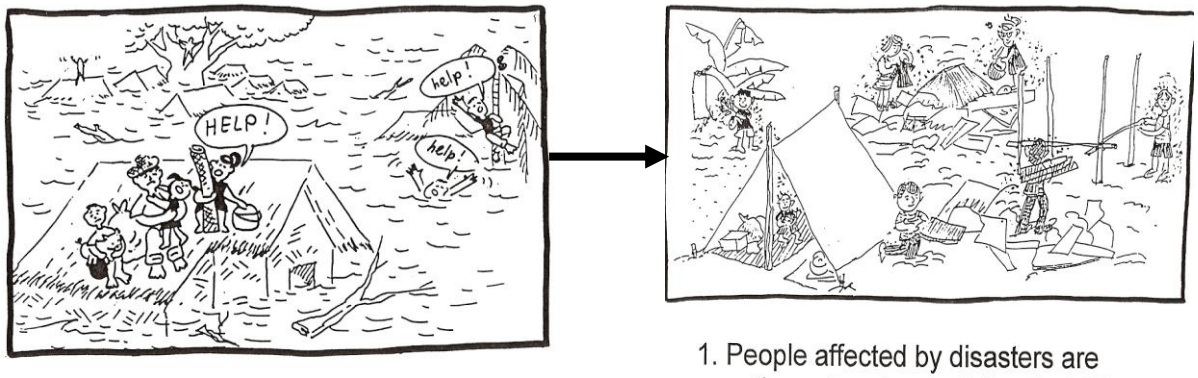
changing with rapid change of climatic and environmental conditions in the area. Of course, it is one of the important aspects of risk mitigation measures and coping mechanism.

7.5 CHANGING CONCEPTS FOR DISASTER RISK MITIGATION

The vulnerable communities living in hazard prone areas may be the first target of any disaster. In case of a disaster, the vulnerable communities suffer most due to direct loss and damage to their life and property. There may be some secondary affects on people living in safe locations and government machineries. Capacity building mechanism of the vulnerable communities has direct relation with national disaster risk reduction policy

Starting with IDNDR programme for international cooperation, numbers of other Disaster Risk Reduction programmes are in place for affective management of disasters worldwide. But in practice, magnitude of loss and damage due to natural hazards are increasing day by day. Without addressing problem areas and enhancing the preparedness levels of the vulnerable communities, it is not possible to mitigate disaster risk of a nation. Hence, we need a paradigm shift in the approaches of disaster management.

Based on study material of ***Asian Disaster Preparedness Centre, Bangkok,*** a standard set of changing concepts for disaster risk mitigation and coping with disaster is presented below.



1. People affected by disasters are helpless victims

1. People affected by disasters are active actors in rebuilding their life and livelihood

In most of the cases, victims of a disaster depend on outside agencies for their rescue, relief and rehabilitation due to their poor state of preparedness level. Under this situation, the vulnerable communities suffer from maximum loss and damage. They may not even get due attention of the disaster management agencies for their rescue and relief on time. Due to several other constraints, the response forces may not be able to extend necessary supports to the affected communities.

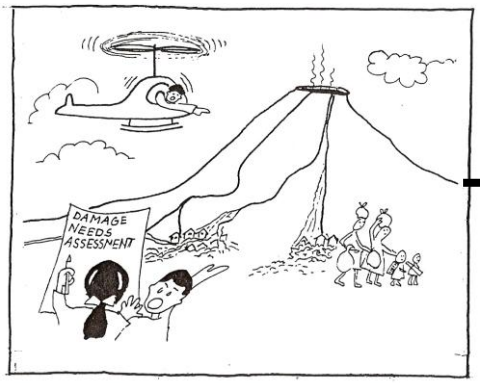
The changing concept for damage mitigation suggests that, the vulnerable communities living in hazard prone areas should assess their own disaster risk and develop coping strategies ahead of a probable disaster. The vulnerable communities should try to arrange basic requirements of their survival in disaster situation, in coordination with government and non-government counter disaster agencies.

2.Victims are passive recipients of external aid

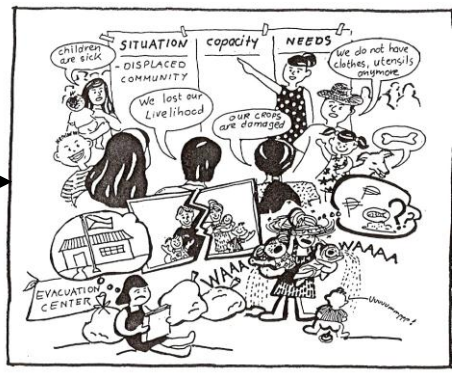
2. People's capacities are used and built on through their participation

In most of the countries, yet the disaster management systems are relief centric. During a disaster, depending on magnitude of disaster, many national and international agencies take part in rescue and relief operations. But, it takes reasonable time for initiating rescue and relief operations by the external agencies due to some administrative and policy related matters. The affected communities have to bear the pain before the external agencies reach to them. Moreover, smooth conduct of relief operation by the outside agencies is another difficult task.

As per the new concept, the national disaster management policy of a country should have the provision to improve the preparedness levels of the vulnerable communities to cope with disasters, based on their own resources, means and strengths. People living in hazard prone areas should get opportunity to prepare their own response plan and act accordingly to manage the situation. The external disaster management agencies should try to contribute in the capacity building process of the vulnerable communities, rather than participating in the relief operation only.

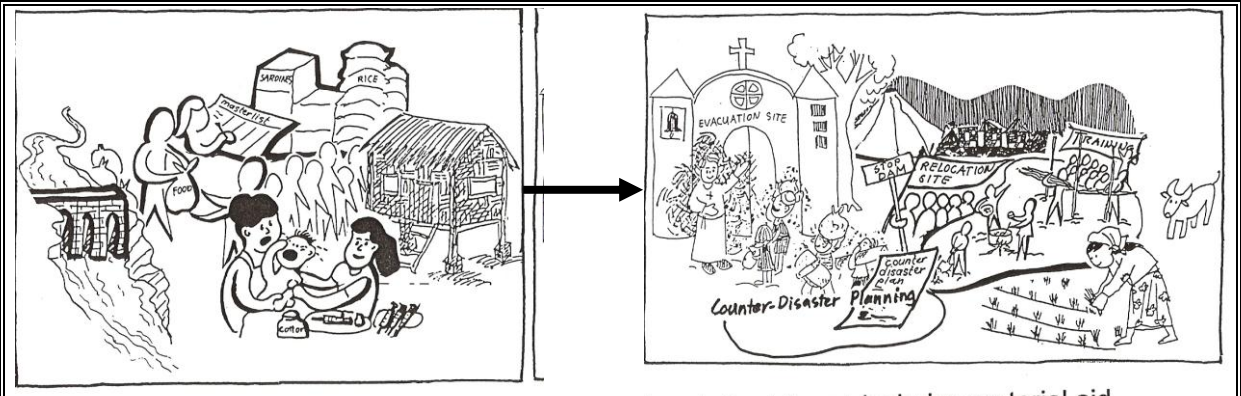


3. Damage, needs assessments, are rapidly done by external experts



3. Damage, needs and capacity assessments are done with people's participation, considering gender, culture, age

In the event of a big disaster, generally disaster management agencies and institutions take part in the process of damage assessment to estimate the total loss and further requirements for recovery of the situation. Without active participation of the affected communities, it is almost impossible to assess the total loss and needs of the people accurately. The affected communities know better about nature of loss and damage and their needs for recovery. Participation of affected communities is necessary in the process of damage assessment and preparation of recovery plan.



4.Focus on physical and material aid and technical solutions

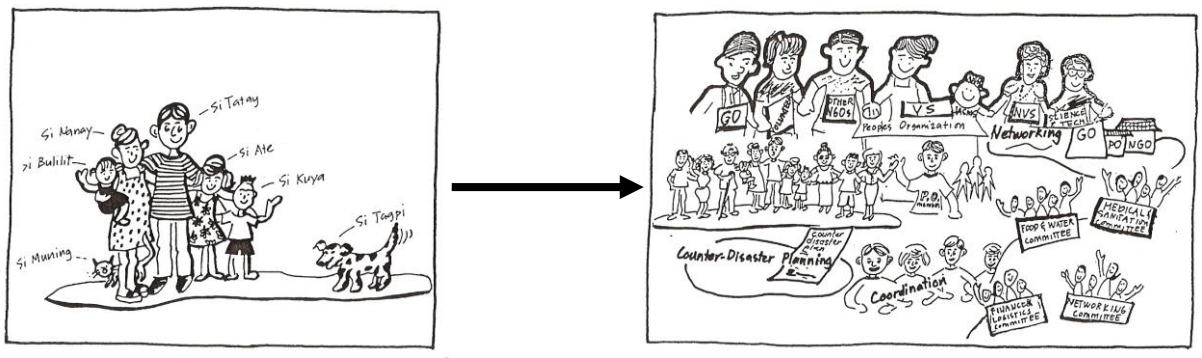
4. Assistance includes material aid, **and** organisational / motivational aspects to address root causes of vulnerabilities

Disaster management activities in most of the countries involve either prevention of hazards by means of hazard resistance devices or physical and material supports to the victims of disasters.

For example, disaster management agencies try to prevent flood hazard by constructing embankments. In case of a flood disaster due to breaching of embankment, they try to manage the situation by providing physical and material supports to the victims. Such kind of disaster management policy is not suitable for Disaster Risk Reduction (DRR) of a hazard prone area to reduce the loss and damage and prevent repetition of same kind of disaster.

For genuine Disaster Risk Reduction of a vulnerable community, it is essential to have a practical plan for reduction of vulnerability factors of the community addressing their root causes. In this case, active participation of the members of the community is necessary for proper identification of their unsafe conditions and root causes of these vulnerable conditions. The people living in the hazard prone areas are also responsible to take appropriate measures for reduction of these unsafe conditions by eliminating their root causes.

Of course, along with vulnerability reduction plan, the disaster management agencies as well as the members of vulnerable communities should have suitable plans for response and recovery. Because, it is not possible to eliminate all the vulnerability factors of a community to make the disaster risk of the community to a zero level.



5. Focus on individual households

5. Focus on community and strengthening its organization

As discussed earlier, disaster is one kind of humanitarian crisis. It affects every members of a vulnerable community irrespective of rich, poor, literate or illiterate. One particular member or family of a community can not contribute much in the process of disaster risk mitigation of the community. Now a days, we are more concerned about our own problems rather than problems of the community. There should be a community based disaster risk mitigation plan,

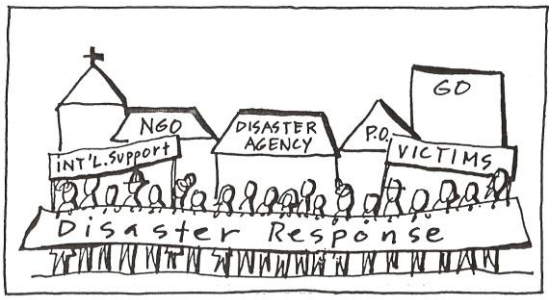
involving all community members and organizations in the process of disaster risk assessment and damage mitigation planning. In this case, proper utilization of knowledge, skill and efficiency of the individual members and organizations is necessary.

6. Donors decide what victims needs

6. Community members participate in decision-making to prioritize needs

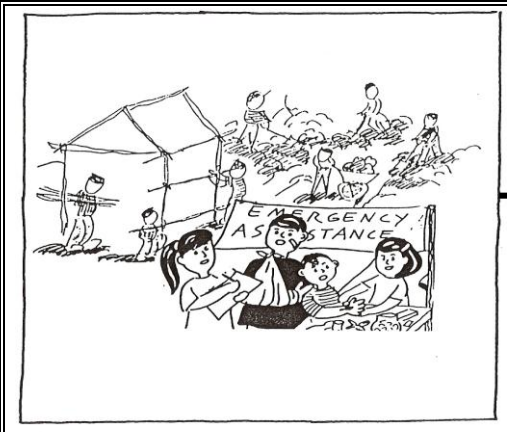
In general, government and non-government organizations, working in the field of disaster management, take part in the process of capacity building and relief operation without genuine assessment of risk and needs of the vulnerable communities. In most of the cases, the relief materials provided by the donor agencies do not match with the needs of the affected people. Such mechanisms create chaotic situation in relief operation. So, prior to planning for capacity building and relief operation; risk and needs of the communities should be assessed properly involving the community members.

7. Providing aid is the responsibility of the disaster agency



7. Disaster management is everybody's responsibility. Disaster agencies have supportive role

In case of a disaster, the affected population becomes helpless victims due to lack of preparedness to cope with disasters. The victims of disaster depend on outside agencies for their rescue, relief and rehabilitation. Unless the vulnerable communities are capable enough to mitigate their own disaster risk and cope with disasters, they are bound to suffer from large-scale damage and disruption. Disaster management agencies may provide academic, administrative, material and financial supports; but ultimately it is the duty of community members to respond appropriately for their risk mitigation.



8. Goal is to meet emergency needs, and to bring things back to normal

8. Goal is to reduce long-term vulnerabilities and to increase people's capacities to better cope with disasters

As stated earlier, the major aim of relief centric disaster management system is to manage a crisis situation by taking some emergency measures. Such a management policy gives stress on response and rehabilitation to make the situation normal before initiating the recovery process. The relief centric disaster management systems are not efficient mechanisms for disaster risk reduction.

To reduce the disaster risk of our systems, we need suitable plans for capacity building to prevent hazards and minimize the vulnerable conditions of our systems, based on risk and needs assessment. In this process the role of community members as well as disaster management agencies are equally important.

7.6 SAFETY NORMS AND SURVIVAL KITS

7.6.1 INDUSTRIAL SAFETY NORMS

Unsafe production industries located in thickly populated areas may become major sources of big disasters. Bhopal gas tragedy is the perfect example of such disasters. So, production based industries must take appropriate safety and security measures to reduce disaster risk of the industry as well as the population living in the vicinity of the industry. Some important aspects of industrial safety plan are presented below based on the contents of the book "Industrial Disaster Management and Emergency Response" written by U. K. Chakrabarty, Published by Asian Books Pvt. Ltd.

- ✓ Location and layout of an industry are the most important factors relevant to disaster risk of the industry. Hazardous industries in thickly populated area generally enhance the disaster risk of the entire area. So, the prime condition for safety is that, such industries should be located in isolated places. Moreover, design and layout for arrangement of processing units and equipments of the industry, utilizing the available space, also play vital role in minimizing disaster risk of the industry.

- ✓ Utmost care should be taken for safe installation and operation of utility systems of the industry. These may include Power sources, fire fighting equipments, arrangements for water and electricity, communication systems, air and inert gas control systems, hazardous waste product disposal system etc.

- ✓ Care should be take for proper functioning of the emergency shut down systems, which generally shut off a particular unit or the entire industry in view of any abnormality in operation or chance of accident.

- ✓ Proper installation and maintenance of flare systems for efficient handling of the discharges of relief systems of different units of the industry.

- ✓ The pressures vessels of the industry for handling the flammable substances should be kept away from ignition sources. Pipe-works of the plant should be done in such a way that, these are isolated from electric cables and slopes are maintained for easy flow of liquid substance. Special blast proof construction needed for utility area, process area and critical process control rooms.

- ✓ Ignition sources, like Fired Process Equipment, should be placed away from processing units of the industry. Special safety provisions should be there for loading and unloading of flammable liquids. Fire station equipped with skilled manpower and equipment, emergency health care centre, Emergency control room etc. should be available and located in safe areas to respond to any accident. Safe storage facility for flammable and toxic substances is a mandatory requirement for any industry.

- ✓ Electrical sub-stations should be located in isolated places, which are free form flammable liquids, gases and vapours. Pipelines carrying flammable liquids, gases, hazardous chemicals etc. should be kept away from populated areas.

- ✓ Special care should be taken for disposal of hazardous solid and liquid waste materials, so that, these should not pollute environment and create health hazards for the people living near the industry.

- ✓ Industries must have their own disaster management plans based on nature of risk factors associated with the industry, impact of probable accidents, nature of expected damage etc. Provisions should be there to aware the people living within and outside the industry about the risk factors of the industry, and safety and preparedness measures to handle disasters, in view of any accident in the industry. If necessary, the industry should provide safety devices/kits to the people.

7.6.2 OTHER GENERAL SAFETY NORMS

To improve our preparedness level to cope with disasters, we must take care of some general safety norms and survival kits. Though, the damage characteristics of different hazards are different; but some common norms, tools and kits are useful to deal with disaster situations.

What measures we can take to mitigate damage and cope with disasters?

- There should be separate disaster management plans for every family and community as a whole, addressing the role and responsibility of every member of the individual family and community, during a disaster.
- Each family should have the information about police, fire service, district control room, response forces and other counter disaster resources to access their services during a disaster.
- The vulnerable community should make provisions for their safe shelter and medical care during disaster.
- The vulnerable community should have evacuation plan for shifting of affected people to safe locations during disaster.
- Special care should be taken for protection and safety of children, old and ill people.
- Important family documents should be kept in hazard proof systems.
- Each family should have minimum basic facilities to deal with disaster situation like, emergency tools and equipments, fire extinguisher, emergency lighting, emergency food, drinking water, emergency medicine etc. for use during disaster.

- People living in earthquake prone areas should inspect their houses on regular intervals, especially after a moderate earthquake. The basic elements to be checked are corner columns and beams; peripheral columns and beam; cantilevered beams (specially beams of balcony); staircase and lifts; water tanks; partition walls; junctions of beam and columns etc. It is advisable to take help of experienced structural engineer.
- Special care should be taken in fittings and fixings of the buildings. Because the falling objects of the buildings cause maximum damage during earthquake.
- People should aware about basic do's and don'ts factors for different natural hazards.

7.6.3 SURVIVAL KITS

Here the lists of general emergency survival kits are given. Individual families or community may acquire these items as per their needs and limitations.

Home and office first aid kits

First Aid Station for
over 100 People.

Source :
keysan.com/ksu0722.htm

Courtesy : ACME UNITED CORPORATION

Medications

- Antibiotic ointment
- Aspirin and / or pain relief medication
- Diarrhoea medication, eye drops
- Cold / cough syrup
- Insect spray, ear and nose drops
- Hydrogen peroxide, skin disinfectant spray
- Extra prescription medication
- Old pair of eyeglasses as spare

Medical materials

- Band aids, medical latex gloves
- Surgical mask , Instant cold packs
- Instant Hot Packs, Ace bandages
- Butterfly bandages, Gauze pads, Cotton swabs
- Adhesive tape, 2" & 4" wide sterile bandage rolls
- Triangular bandage for sling, etc. (37" x 37" x 52")
- Tongue depressors (pop-sickle sticks), Splint material
- Spray bottle with 10% bleach solution for disinfecting objects.

Sanitation items

- Plastic bags (heavy duty and smaller zip-lock types)

- Powdered chlorine lime (proper storage is required, it is an oxidizer and it is corrosive)
- Portable camp toilet with chemicals, toilet paper, handy wipes, etc. for water free cleanup
- Toilet Supplies (Towels, shampoo, toothpaste, deodorant, sanitary napkins, etc.)
- Insect sprays

Emergency items

- Work Gloves, Shovel (flat head and pointed)
- Broom, Hammer and Nails, Screwdrivers, Crowbar or Claw Tool (36" or Longer)

Picture source :
shopping.superpages.com/work+gloves

- Plastic Sheeting Rolls (4 Mil. IO' X 25'), Plastic Garbage Bags

Picture source :
dorlingkoper.co.uk/sportsbag.htm

- Small and Large Plastic Bags, Coils of Rope 1/4", 1/2", 3/4" (25' - 50')
- Coil of Wire, Tent (Family or Tube Type)
- Tarp (PVC or Canvas, Minimum Two, 8' X IO')
- Sleeping Bags, Blanket, or Space Blanket
- Cheese Cloth (To Strain Particles From Water)
- CASH MONEY (Small Denominations & Coin)

Picture source :
hscripts.com/freeimages/icons/electrical/torch-light-clipart.php

- Dry Food, Water, Clothing, Walking Shoes and Socks, Local Road Map

Picture source : cgi.ebay.com/Fire-Extinguisher-Lighter-Keychain-

- Fire Extinguisher (Dry chemical type with a minimum size rating of **2A -IOBC,** with an earthquake restraining strap, a hose type nozzle, and a metal head.)

- Compass
- Flashlight With Batteries, Chemical Light Sticks and Matches, In Waterproof Container
- Small Radio (Battery Powered Portable)

- Entertainment Pack - Family Photos, Notebooks, Literature, and Games

Picture source :

amazon.co.uk/exec/obidos/ASIN/B0000C720L/203-6464294-7632769

Purifying water

- Add eight drops of pure unscented liquid bleach *(available with Public Health Engineering Department and General Medical Stores)* in one gallon of water to reduce the contaminants.
- Add the bleach when you first store the water away.
- Rotate your water in every six months *(one or two gallons of pure and sealed drinking water).*

7.7 WHAT WE LEARNT FROM THIS UNIT?

The concept of coping mechanism conceived with the idea of making the vulnerable people adequately prepared to cope or live with disasters. It is the vulnerable community, who needs to have practical damage mitigation plan and coping strategies for their survival in disastrous situation. Outside agencies can only extend academic, physical, material and financial supports for preparation and implementation of such plans and strategies.

To develop suitable coping mechanism, we must have clear idea about our threats, vulnerability and needs. So, the process of developing coping mechanism for a particular vulnerability community involves entire process of risk management comprising hazard, vulnerability and capacity analysis of the community.

Coping strategy gives us guidelines for enhancing our preparedness level to mitigate disaster risk and live with disasters. The possible measures to improve our preparedness levels for coping with disaster may be; *DRR planning involving all stakeholders, land use regulations, building codes, early warning mechanisms for different hazards, evacuation plan, alternative mode of communication facilities, hazard resistant structures, hazard proof housing, response plan, alternative livelihood opportunities, alternative means of production, management and mobilization of counter disaster resources etc.*

To adopt suitable coping mechanism, we have to follow some fundamental factors relevant to risk and needs of community, organizational structure, training and drill, plan and policy etc.

Alternative adjustment processes based on traditional knowledge, experience and resources of the vulnerable community play vital role in enhancing the preparedness level of the community. The changing concept of disaster management gives stress on active participation of the community members in the process of assessment and planning. At the same time, safety norms and survival kits are also equally important for risk mitigation and coping with disaster.

7.8 PROBABLE QUESTIONS

1. Explain coping mechanism.
2. What is specific risk?
3. What is the role of NDRF?
4. What kinds of information required for making preparedness plan?
5. Discuss some common measures of coping mechanism.
6. What fundamental factors are relevant for coping mechanism?
7. Give some examples of alternative adjustment processes.
8. Give few examples of changing concepts of disaster management?
9. Write few conditions of industrial safety policy.
10. Mention few survival kits.

7.9 SUGGESTED READINGS

1. Carter, W. N., Disaster Management: A Disaster Management Handbook, Published by Asian Development Bank, 1991
2. India: IDNDR & Beyond, NCDM Publication, 2000
3. Study material: Fourth International Course on CBDM, ADPC, 2000
4. Brahmi, A. & Poumphone, K., Case Study Report, Study on Local Coping Mechanisms in Disaster Management, 2002
5. Chakrabarty, U. K., Industrial Disaster Management and Emergency Response, Published by Asian Books Pvt. Ltd., 2007
6. Study material, Training Programme on Environment and Disaster Management, NIDM, 2010

UNIT-8: COMMUNITY BASED DISASTER MANAGEMENT (CBDM)

UNIT STRUCTURE

8.1 INTRODUCTION

Most of the nations have their own disaster management systems and national policies for effective management of disasters. They have government sponsored programmes and schemes to tackle disasters. A large numbers of national and international agencies are also involved with ***Disaster Risk Reduction (DRR)*** programmes. Even then the global risk of disasters is not decreasing. Globally, both the frequency of disastrous events and magnitude of loss are increasing significantly. It shows either our disaster management systems and policies are not effective to reduce disaster risk of our systems or the disaster management plans are not based on genuine risk factors of the vulnerable communities.

To have a practical disaster management plan for genuine risk reduction of vulnerable communities, it is necessary to address community's risk factors and needs for their capacity buildings. In the previous units, we have seen the paradigm shifts in the concept of disaster management. This unit is completely dedicated to discuss about different aspects of community based disaster management.

8.2 OBJECTIVES

Major objectives of this unit are to discuss the

- Concept and approaches of community based disaster management.
- Mechanisms of Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA).
- Role of non-governmental and community based organizations in disaster risk mitigation programmes.
- Psychological impact of disasters on community and its remedial measures.

8.3 CONCEPT OF COMMUNITY AND CBDM

8.3.1 COMMUNITY

The meaning of "Community" varies with purpose and issues and difficult to define. Different sources defined the term "Community" in different ways. Let us see some common definitions of Community (Source: ADPC Study Material for fourth International Course on CBDM, 2000)

- The term "Community" may be defined as a cluster of families or households living in a certain geographical area, which may be a small village or town or city.

- A community may reflect the group of people having similar interest, same age, same language, or form same ethnic group or exposed to similar kinds of hazards.

- A community may be defined as a group of people having similar profession like farmers, fisherman, teachers etc.

- The term "Community" may depict a group of people suffering from similar kinds of problems or engaged in similar kind of work like, Disaster Risk Reduction Programme or working together with a particular objective.

Over and above, the World Health Organization defined "Community" as "a group in face-to-face contact having a harmony of interest and aspirations, and bound by common values and objectives".

But in practice the social concept again divides a community by rich, poor, caste, origin, gender and other social aspects. In reality, it is too difficult to exploit community's strength to reduce disaster risk of a system, without addressing these social aspects of a community.

Now community plays the role of a powerful institution in the entire mechanism of disaster administration. It also plays vital role in information sharing with external disaster management agencies for genuine risk assessment and planning for risk reduction. They form their own organizations to take right initiatives for risk reduction measures. The community based organizations are very much involved in response and recovery process. Yet in developing and third world countries the effectiveness of vulnerable communities are not at par the requirements, due to widespread poverty and low literacy rate.

8.3.2 CBDM

The motto of ***Community Based Disaster Management (CBDM)*** is to assess disaster risk of a vulnerable community and take necessary measures to reduce the disaster risk of the

community, using the resources and services of the community members. In general, the problem areas and nature of interests of the people living in a specific geographical location and exposed to certain natural hazards, are almost same. So, for ***Community Based Disaster Management,*** we can involve the services of people living in a particular hazard prone area based on,

- ✓ Gender
- ✓ Age groups
- ✓ Efficiency
- ✓ Expertise
- ✓ Other conditions like old people, ill people, pregnant women etc.

The ultimate aim of ***Community Based Disaster Management*** is to achieve safe conditions to reduce the probability of loss and damage of the communities, exposed to different natural hazards, by reducing their vulnerability factors. For this, the active involvement of the community members in the process of risk assessment and risk reduction measures is mandatory.

The essential conditions for ***Community Based Disaster Management*** are

- ✓ Define the role and responsibility of the individual members of a vulnerable community for their risk reduction. The target and activities of the programme should have clear link to the problem areas of the local community.
- ✓ The strategies for risk reduction should be based on mitigation of vulnerability factors of the community addressing their root causes, and enhancement of community's capacity to cope with disaster situation.
- ✓ The process of community based disaster risk reduction should be linked to the sustainable development of the locality to check violation of land use regulations and other safety norms.
- ✓ Stress should be given for utilization of the services of majority of community members in improving their physical safety, status on control over local resources, participation in decision making and planning process, involvement in protection of environment etc.
- ✓ It should be assured that, the local community will get maximum benefits of the programme. The CBDM process must give proper emphasis for creating safe livelihood opportunities of the community members.
- ✓ Provisions should be there to access supports from national and international agencies for risk mitigation of the vulnerable community. Resources and strength of the vulnerable community may not be sufficient to reduce their disaster risk.
- ✓ The perception of local community in handling their disaster risk based on traditional knowledge and experience, indigenous methods and tools etc. should be addressed carefully in the process of risk reduction.
- ✓ Strengthening of the capacity of community based organizations for emergency response and recovery.
- ✓ Improvement of preparedness level of the individual families for reducing magnitude of loss and damage of the entire community.
- ✓ Proper coordination between disaster management agencies and community members is necessary for genuine risk assessment and risk reduction planning for vulnerable community.

8.3.3 DIFFERENT STAGES OF CBDM PROCESS

Both the community members/organizations and external disaster management agencies are the actors of Community Based Disaster Management Process. Some common steps of CBDM involving the role of different actors are described below.

Stage 1: This stage involves preparation for risk reduction process, by the external disaster management agencies, for a vulnerable community. It needs,

- ✓ Identification of the community, which is exposed to natural hazards and needs support for their risk reduction.
- ✓ Preliminary assessment of threats and vulnerability of the community.
- ✓ Identification of prominent hazards and probable disasters for which the community needs assistance.
- ✓ Capacity and commitment of the intermediary agencies to work with the community.
- ✓ Proper knowledge about CBDM process, local situation and system as a whole.

Stage 2: This involves assessment of community profile with the help of community members. This includes,

- ✓ Information about existing community based organizations and their integration.
- ✓ Information about active social groups in the community, capable to work for risk reduction of the community.
- ✓ Socio-cultural and socio-economic conditions of the community.
- ✓ Spatial characteristics of the area, where the community is living.

Stage 3: This involves risk assessment of the community in coordination with the community members. This process comprises,

- ✓ Hazard assessment and hazard mapping.
- ✓ Vulnerability assessment to understand progression of vulnerability factors of the community.
- ✓ Resource assessment to assess further needs of the community to tackle the disasters

Stage 4: This stage involves planning for risk reduction of the community, based on risk and capacity assessments. This involves,

- ✓ Measures to mitigate loss and damage of the community by preventing hazards or minimizing vulnerability factors.
- ✓ Requirements of the community for preparedness to live with disaster.
- ✓ Preparation of action plan defining target, schedule, activities, role and responsibilities of community members and organizations, provisions for external supports, possible outcome etc.

In this process, the community members and organizations participate in conducting their own situational analysis, defining goals and objectives, and developing plan for risk reduction. The support systems play the role in developing participatory tools and acting as animators. The linking services between support systems and community are training and education, awareness, networking, coordination, advocacy etc.

Stage 5: Implementation of the disaster risk reduction plan by the disaster management agencies in coordination with community members and organizations. There should be simultaneous monitoring on the progress of the activities.

Here the community members and organizations actively take part in developing their resources and strengths to implement the measures for risk reduction and sustainable development, monitoring the progress of activities etc. The support systems take part in technology development, technology transfer, resource allocation and distribution, monitoring of progress etc. For genuine implementation of action plan and monitoring of

progress; proper coordination, negotiation and partnership are required between community organizations and support systems.

Stage 6: Evaluation of outcome and shortcomings of the programme based on feedback of the beneficiaries.

8.3.4 NEED OF COMMUNITY INVOLVEMENT IN DEVELOPMENTAL ACTIVITIES

For disaster risk reduction planning and sustainable development, active involvement of local community is essential because,

- ✓ For disaster risk reduction planning and hazard resistant developmental activities, we must have clear idea about local conditions like vulnerable conditions of the locality and community, constraints and opportunities of the local community. No outside agency can understand these conditions better than the local community.
- ✓ Vulnerable community is more interested in understanding the issues related to damage mitigation and sustainable development for their survival and well-being. Local community also wants to resolve the issues related to their disaster risk with the help of outside agencies and by actively participating in the process of data acquisition and planning for risk reduction.
- ✓ Evidences show that, most of the Disaster Risk Reduction and Disaster Response programmes fail to achieve the goals of reducing disaster risk and loss of vulnerable communities. This is because these plans and programmes are not based on genuine data and information of local conditions of the hazard prone area. These programmes also do not address the community's risk, capacity and needs properly.

For these reasons, now most of the disaster management agencies have reached to a broad consensus in involving the services of vulnerable communities in the process of formulation of Disaster Risk Reduction plan and its implementation. And hence, the concept of Community Based Disaster Risk Management Programme conceived.

8.4 APPROACHES AND PROCESSES OF COMMUNITY BASED DISASTER RISK MANAGEMENT (CBDRM)

8.4.1 CBDRM APPROACHES

From our earlier discussions, we can summarize the approaches of Community Based Disaster Risk Management (CBDRM). The main features of CBDRM programme are

- ✓ The CBDRM programme considers the role of vulnerable community in handling the disaster situation and mitigating their disaster risk.
- ✓ Major aim of CBDRM programme is to enhance the resources and strength of the community members and organizations to reduce their disaster risk.
- ✓ CBDRM programme always addresses the dynamic pressures and root causes of vulnerability of local community to improve the condition of natural environment of the locality and quality of life of community members.
- ✓ CBDRM programme always considers the community members and organizations as key actors and main beneficiaries of the programme; involving them in identification, analysis, treatment, monitoring and evaluation of disaster risk and risk reduction programme.
- ✓ CBDRM programme is based on close coordination among disaster management agencies and local community.

- ✓ CBDRM programme always gives due weightage on knowledge, experience, traditional methods and tools, and different perceptions of the community in DRR planning.
- ✓ CBDRM programme considers the risk factors and capacity of individual members, families and organizations of the community in formulating DRR plan. Because, risk factors and capacity of handling the disaster situation of different organizations, families and members of a community are not same.

Why we need CBDRM approach

- It helps in taking speedy decision and action for disaster risk reduction and response, as things are pre defined and well communicated with community. It also minimizes the response time significantly, as community members directly participate in response and recovery process.
- It helps to generate close coordination amongst Panchayati Raj Institutions (PRI), disaster management agencies, NGOs, CBOs and volunteers for effective management of disaster.
- It helps in developing a strong organizational structure for disaster risk mitigation and response, at district to village levels, by involving all stakeholders from district, circle, block and village.
- It helps in educating community members about their disaster risk and risk mitigation measures to make them capable of mitigating damage and coping with disaster. In the process of risk reduction, response and recovery; the community members have direct access to the resources of the community and disaster management agencies.
- Most importantly, CBDRM approach encourages community members to develop and adopt cost-effective indigenous alternative adjustment methods and devices to mitigate their disaster risk and cope with disaster.

Community members participating in anti-erosion measure.

8.4.2 CBDRM PROCESS

The CBDRM process comprises a sequence of pre and post disaster measures; involving community's resources and strength; to mitigate loss and damage or reduce future risk of the community. The common steps of CBDRM process are

- ✓ Genuine selection of the community living in a hazard prone area having many vulnerable conditions and needs special attention of the disaster management agencies for its risk reduction and disaster response.

- ✓ Communication with vulnerable community to build-up relationship and trust with community members for understanding their socio-cultural, socio-economic and socio-political status. This is also necessary to understand the nature of community's disaster risk in real sense.
- ✓ Risk assessment of the vulnerable community addressing the hazards, vulnerability and capacity of the community. In this process, local people's knowledge and perceptions about risk are utilized.
- ✓ Preparation of risk reduction plan for the vulnerable community based on community's perception about practical risk reduction measures. In this process, the community members themselves identify the measures suitable for reducing vulnerable conditions and improve their capacity to handle disaster like situation.
- ✓ Training of community members and organizations to improve their skills for proper implementation of the DRR plan and better management of the disaster situation including response and recovery. Community organizations are to play leading role in implementing the plan and motivating community members to respond appropriately to reduce their risk.
- ✓ Evaluation of the activities and monitoring of the progress. In this process, information should flow amongst all stakeholders of the project; community organizations, government disaster management agencies and donor agencies.

8.5 RRA AND PRA

8.5.1 RAPID RURAL APPRAISAL (RRA)

Rapid Rural Appraisal implies a set of guidelines and tools, which enables the community members to work in a structured but flexible manner for quick assessment, analysis of data, and dissemination of findings to take appropriate and timely actions. It is not possible to give a precise definition of RRA, as it varies with objectives and situations. But some common features of RRA are

- ✓ It gives us some important guidelines for collection, interpretation and presentation of information involving local people.
- ✓ It uses some specific methods and techniques, which are easy to understand by the common people, for collection of information, analysis and reporting of findings quickly.
- ✓ It helps to collect primary data and information form the field by making direct communication with the local people.
- ✓ It also helps the group of people from different organizations and disciplines to work together for understanding the local situation and affairs.

8.5.2 COMMON GUIDELINES OF RRA

- ✓ There should be clear objectives for RRA of a situation. Because the types of required data and information, tools and techniques required to acquire the necessary information, people to be involved in the process of collection and analysis of data and information etc. largely depend on objectives of the work. Though, it is a structured activity, but it should be flexible enough to address the local conditions and unexpected events, as and when necessary.
  For example, the main objective of the risk assessment of a particular area is to estimate the probability of loss and damage in the event of a disaster. To assess the risk; we need information about probable hazards/threats to which the area is exposed, vulnerability factors of the area, capacity of local community to deal with disaster etc. We have to adopt suitable methods and tools for collecting these data and information.

Accordingly, we have to select the right group of people, who are capable enough to collect and analyze the required data and information for risk assessment.

- ✓ A clear, simple and systematic checklist is required to collect relevant data and information. For example, hazard assessment needs information about force, frequency, warning sign, forewarning system, exposure time etc. of the hazard. The format for collecting these data and information should be simple and systematic, so that local people can provide these data and information form their knowledge and experience about the particular hazard.
- ✓ There should be an integrated approach, involving people having different technical and scientific skills, to achieve the objectives of RRA. The sequence of activities, role and responsibility of the people involved with different activities should also be clearly defined.
- ✓ The attitude and language of the researchers and field workers should be friendly with the attitude and language of the local people. This is one of the important criterions for collection of genuine data and information. For this, proper training and awareness of the external researchers, field workers and local people are necessary prior to starting the proceedings.
- ✓ One important aspect of RRA is quick assessment of an unknown situation. Therefore, collection of data and information exploiting the knowledge and experience of local people, on-the-spot analysis of data, presentation of findings in the way suitable for both planners and local people, are some other important criteria for RRA.
- ✓ The researchers and field workers should make intense interaction with the local people and listen carefully about their knowledge, experience and perceptions relevant to the objectives of RRA.
- ✓ Cross-checking of information collected form different sources is essential to examine the authenticity of information.

8.5.3 COMMON TOOLS FOR RRA

RRA needs a combination of learning and communication tools for collection and analysis of data, and presentation of findings. The numbers of such tools are unlimited, as the requirements of such tools are increasing with development of new methods and techniques. The learning and communication tools for RRA are also dependent on objectives and nature of work. However, some common tools are more or less useful for all RRA.

Common RRA tools

- ✓ A checklist of the interview topics, relevant to the RRA objectives.
- ✓ Semi-structured interview to give and receive information with local people based on focused, conversational, two-way communication.
- ✓ Key-informant interviews for qualitative and in-depth discussion with the people, who have genuine knowledge and experience on the situation.
- ✓ Focus-group discussion amongst selected groups of people to get idea about issues and concerns of the RRA theme.
- ✓ Individual and household interviews to collect data and information relevant to RRA theme and objectives.
- ✓ Structured observation like transect walk for understanding characteristics of the location and distribution of resources, settlement patterns, problem areas, possibilities, local technologies and practices etc. This involves field survey, selection of transect line or routes based on key informant's advice, discussion with local people and mapping.
- ✓ Secondary data review to select the sources of secondary data and collect relevant data and information from these sources.

- ✓ Community meeting and workshop for evaluation and analysis of data and information.
- ✓ Presentation of findings in terms of mapping like, thematic map, resource map, historical map etc.
- ✓ Presentation of findings in terms of diagrams and graphics like, bar diagram, Venn diagram, pie diagram, flow chart, decision tree etc.
- ✓ Understanding of the processes and changing pattern by means of seasonal calendar, timelines, process diagram etc.
- ✓ Ranking of assessment by matrix ranking, part-wise ranking, local classifications etc.
- ✓ Reporting of findings by suitable modes of communication.

8.5.4 ADVANTAGES OF RRA

- ✓ This is the most flexible and quick method of understanding the ground conditions of a locality or community.
- ✓ It gives us opportunity to understand the processes and dynamics of assessment methods, correlation amongst different disciplines, sequence of conditions and activities etc.
- ✓ On the spot analysis of data gives us opportunity to cross-check the data and findings.

8.5.5 DISADVANTAGES OF RRA

- ✓ The authenticity of the findings largely depends on sampling methods adopted during data collection.
- ✓ Information collected from the field may not be genuine, which may result in wrong assessment.
- ✓ The authenticity of the entire process is dependent on skills, experiences and viewpoints of the people involved in the process.

8.5.6 PARTICIPATORY RURAL APPRAISAL (PRA)

Participatory Rural Appraisal (PRA) is an important tool, useful for community risk assessment and planning for risk reduction. This process involves active participation of community members through exchange of ideas and negotiated decisions between community and other stakeholders. The main goal of using ***PRA*** tool in ***Participatory Disaster Risk Assessment (PDRA)*** is genuine assessment of disaster risk of the vulnerable communities and community empowerment to reduce their disaster risk.

Community members preparing village hazard map before Disaster Management Officials
Photo courtesy: Mr. M. K. Deka, SDMA, Assam

PRA tool facilitates the PDRA practitioner for collection and analysis of information by and for the community members. It is a collaborative process and gives due emphasis on the knowledge of local people. This process discourages the hierarchies and helps to identify genuine needs of the community for risk reduction.

The method of collection of information plays vital role in examining community's problem areas, existing resources, traditional practices, opportunities etc. The PRA facilitating team comprises community members, NGOs, CBOs, and members of local government. So, genuine identification of stakeholders is necessary for constitution of a PRA facilitating team. Prior to constitution of the team, it is essential to judge the background, commitment and willingness of the stakeholders.

Generally, each team has a facilitator to moderate group discussions giving equal opportunity to every team member to share their ideas, views, and observations relevant to the topic of discussion. One note-taker should be there to record the minutes of discussions and observations. During discussions, there should not be any physical barrier between facilitators and team members. The discussion and process of analysis should be done step-by-step to get clear ideas on different issues like,

- Spatial information of the locality
- Problem areas, constraints and opportunities
- Resource assessment and management of resources
- Traditional knowledge and practices
- Priorities

8.5.7 THE PROCESS OF DISCUSSION IN PRA

Semi-structured interviews to obtain valuable information form the community simply by talking with individual community members or small groups. For this,

- ✓ Prior to discussion, select the topic of discussion and identify the individual community members and groups.
- ✓ Select appropriate place and time to conduct interview.
- ✓ Ask selective questions relevant to the topic of discussion and allow the community members or group to express their ideas and views on different aspects of a specific question.
- ✓ Note down the observations of the community members and groups.
- ✓ Prepare the complete report based on in-depth discussion, information and observations.

Group discussions with user groups or multiple stakeholders. This needs,

- ✓ Select appropriate user groups for discussions.
- ✓ Select appropriate place and time for group discussions.
- ✓ Reach to a consensus with participating groups on method and technique of group discussions.
- ✓ Ask open-ended questions to promote discussion and gather information.
- ✓ Take notes of the observations of different groups.
- ✓ Discuss elaborately on the observations and prepare the complete report.

For PRA, the PDRA practitioner must bring some useful materials like, beans, stones of different sizes, leaves, markers, flip charts, colour paper, glues, cello tapes etc.

We can use different methods for analysis of data and presentation of information. Some of the common methods are,

- ✓ Venn diagram and sketch mapping for accumulating information of the locality.
- ✓ Systems diagram to show the interactions amongst different user groups and resources.
- ✓ Seasonal calendar to show the timings of occurrence of events and resource mobilization.
- ✓ Flow diagram to show the status and relationships of different elements.
- ✓ Historical transect to analyze the changing characteristics of management systems.
- ✓ Trend lines reflect the changing patterns of different parameters.
- ✓ List making for classification of different elements and their utilities.
- ✓ Organizational chart shows the status and role of different organizations, involved in managing a situation.
- ✓ Time line to see the sequence and status of past events.
- ✓ Ranking, to identify the relative importance of different elements and priorities of works.

8.6 ROLE OF NGOS AND CBOS IN DISASTER MANAGEMENT

8.6.1 NON-GOVERNMENTAL ORGANIZATION (NGO)

Non-governmental organization (NGO) means a legally constituted non-profit business organization, which works independently from any government and produce benefits for others. Generally, NGOs are self-governed by a managing committee or board of trustees or governing council etc. But, members of NGO are prohibited to enjoy any monetary benefits from the source of income of NGO.

In India, registration of NGOs could be done as Trust, Society or Non-Profit Company. Trusts are registered under State-specific Public Charitable Trusts Acts. Societies are registered under the Societies Registration Act, 1860. Non-profit business companies are registered under section-25 of the Indian Companies Act. 1956.

Those NGOs are getting financial support from government; they generally maintain non-governmental status by excluding government representatives from membership of the organizations. NGOs have their own constitutions reflecting nature and objectives of work, codes and norms for functioning of the organization etc.

8.6.2 COMMUNITY BASED ORGANIZATION (CBO)

Community based organizations are also non-profit business organizations having members from a single local community or a particular area. CBOs are self-funded organizations and work on voluntary basis for different purposes. CBOs are owned and managed by their own members. Most small CBOs function in informal manner, but some CBOs have their own constitution and managing bodies, and maintain separate books of accounts and activities. CBOs should not be affiliated under any religious or political groups.

8.6.3 ROLE OF NGOS AND CBOS

Most of the NGOs and CBOs have enough potential to extend voluntary services in risk and crisis management. Earlier, NGOs and CBOs were involved mainly in post disaster relief operations including humanitarian assistance to disaster-affected people. But now these

organizations are actively working for capacity building of vulnerable communities to enhance their preparedness level to mitigate damage or cope with disasters.

NGOs and CBOs have significant role in educating common people about different aspects of damage mitigation including innovative practices and preparedness through workshop, seminar, mock exercise, street drama, puppet show etc. Many international and national NGOs have started collaborative works with corporate bodies under their Corporate Social Responsibility (CSR) initiatives in the field of disaster management.

International NGOs are also supporting national governments in implementing disaster management programmes. For example, during 2002-2007, UNDP has implemented Disaster Risk Management (DRM) Projects in 176 districts of 21 states in India in collaboration with Ministry of Home Affairs (MHA), Government of India. Now, UNDP is conducting Disaster Risk Reduction (DRR) Projects in collaboration with NDMA, MHA and MoUD of Government of India for strengthening the institutional mechanism for disaster management at state and district levels.

But in reality, still there is lack of proper coordination amongst NGOs, CBOs and Government organizations for effective management of disasters. Moreover, most of the small and local NGOs are engaged in short time relief operations without having any linkage with long term damage mitigation and recovery programmes. Most importantly, the vulnerable communities of remote and inaccessible areas are not getting proper supports form Government and non-governmental organizations.

The Disaster Management Act 2005 provided the scope of formulating some specific guidelines on the role of NGOs in Disaster Management for effective functioning of different stakeholders and minimizing the gap amongst government and non-governmental organizations. Based on this, the National Disaster Management Authority (NDMA) has constituted a National level NGO Task Force to formulate modalities for creating state level NGO Task forces on Disaster Management. The NDMA has formulated a series action points on the role of NGOs in Disaster management based on the recommendations of core and extended groups of experts, suggestions of different ministries and departments of central and state governments.

- The institutional mechanisms for disaster management like NDMA; SDMAs; DDMAs; different ministries, agencies and departments involved in DM activities shall make strong coordination and collaboration with NGOs for
    - ✓ Effective response and recovery activities.
    - ✓ Developing the road map for short, medium and long-term operational strategies and plans.
    - ✓ Involvement of NGOs in planning process.
    - ✓ Updating information about vulnerability and needs of communities.
    - ✓ Engaging NGOs in advocacy to mitigate disaster risk.
    - ✓ Consolidating institutional learning processes and creating public domain knowledge bank for long-term capacity building.
- Involvement of corporate sector in post disaster relief and rehabilitation, as part of their CSR, to be augmented for preparedness and damage mitigation programmes with the help of local NGOs.
- Development of database of all national and international NGOs involved in disaster management activities, reflecting the quantum of supports they provided over the years. A meaningful engagement of these NGOs with different concerned government bodies to be established for better management of disaster situations.
- Inter-agency mechanisms for better coordination and network activities at all levels.

- Establishment of protocols for cooperation of government response agencies like NDRF, SDRD, Civil Defence etc. with local NGOs for effective rescue and relief operations in remote areas.
- Micro level risk assessment, risk reduction planning and implementation of risk reduction plans with the help of local NGOs and CBOs to support the most vulnerable groups.
- Enhancement of capacities of NGOs and CBOs at all levels and their engagement in long term planning for better management of urban and rural disasters.
- Exploring the potentials of other social organizational networks through local NGOs and making them facilitators to introduce good practices for disaster risk reduction.
- Planning for rescue and relief operations including preparation for evacuation centres to be done with the help of local NGOs.
- The national guidelines on role of NGOs in disaster management also formulated action points on role of NGOs in disaster preparedness, mitigation, response and recovery at national, state and district levels.

Details about the action points on role of NGOs in Disaster Management are available in ***National Disaster Management Guidelines: Role of NGOs in Disaster Management***, Published by NDMA in 2010.

8.7 DISASTER PSYCHOLOGY

8.7.1 PSYCHOLOGICAL CONSEQUENCE AND CAUSES

All big disasters have some sort of adverse impacts on affected community in the form of

- Mental ill health called "Psychotism"
- Physical ill health called "Somatoticism"
- Disruption in social and environmental support systems called "Sociotism"

It is difficult to understand the exact reasons of mental ill health or trauma in the aftermath of disasters. But, the degree of psychological instability is much higher for primary victims of disaster than secondary victims.

Primary victims are also known as ***Event Victims***, whose psychological disorders stems from direct loss and damage to the system.

The other types of victims are ***Context Victims,*** who may be psychologically disturbed by witnessing or facing the consequences of disasters.

Peripheral Victims may suffer psychologically due to their relationships with disaster victims.

Entry Victims are those who react psychologically by witnessing the death and disturbances during their engagement in response and relief works.

The mental health problems also arise, when the impact of disaster is sudden, intense and unexpected. Disaster causes stress and trauma for the people, who are well aware about the dangers of disasters.

Other factors responsible for psychological disorders may be linked to nature of loss and damage, homelessness, dislocation, unemployment, conflicts, personal injury etc.

8.7.2 IMPACT ON RELIEF WORKERS

The volunteers of relief works may become psychological victims by witnessing the severity of disaster and people's sufferings in managing their basic requirements for survival. In most of the cases, the volunteers involved in relief works find problems to meet the requirements of the victims and feel tired and demoralized.

In this case, the professional workers can bear the stress better than the volunteers of NGOs and CBOs, as they are the frontline actors of disaster relief.

The injury and problems faced by the fellow workers may lead mental illness to other coworkers of relief team. The other possible reasons of stress of the relief workers may be

- ✓ Hazardous working environment
- ✓ Excessive work load for long hours
- ✓ Deadlines of works and outside pressures
- ✓ Organizational pressures and conflict in conducting relief operation etc.

The common signs of stress are faintness, back pain, headache, stomach upset, muscle pain, memory problem, sleep disorder, anger, guilt, feeling of isolation etc.

Training, experience and practices to deal with emergency situation is necessary to enhance resistance of relief workers to bear the stress. Since, the members of NGOs and CBOs are active volunteers of relief operation; therefore, pre disaster training on stress management is essential to improve their resistively against psychological disorder.

8.7.3 PSYCHOLOGICAL SUPPORT IN DISASTER MANAGEMENT

Psychological support is one of the important aspects of disaster management for overcoming psychological impact of disasters to disaster victims and disaster management workers. Psychological support mechanism should be developed considering the entire continuum of disaster event. Which may be related to loss and damage of own relatives and assets, exposure to dead bodies, trauma due to racial or religious conflicts, forced separation from family members etc.

An acceptable psychological support system needs specialist psychological skills for psychological assessment, diagnoses and interventions. Some important steps of psychological support mechanism are

- ✓ Assessment of people's response to different disaster situations based on past records.
- ✓ Pre disaster psychological first-aid training for vulnerable community and response workers.
- ✓ Mental preparedness to avoid stress and trauma, which may involve; disaster stories of effected communities, professional histories of handling the disasters by individual family, stories of trauma management, people's own response to disasters etc.
- ✓ Recognition of the factors like how and why the people affected psychologically during disaster.
- ✓ Counseling of psychological victims of disaster by the specialists having in-depth knowledge on possible psychological impacts of disasters and counter measures.
- ✓ Providing counter-trauma environment to disaster victims, where people can have safety, security, friendly environment to share each other's pain, expert's support for stress management, basic requirements etc.

- ✓ Relief of specific distress and symptomatic treatment involving proper education to handle a crisis situation.
- ✓ Assimilation of trauma through understanding of disaster event and impact of the event.
- ✓ Reducing workload and pressure of response workers.
- ✓ Providing necessary supports to response workers for dealing with disasters.
- ✓ Training and adequate support to relief workers for conducting relief operations in disaster affected areas.
- ✓ Supply of adequate and need based relief materials is essential to reduce the stress of relief workers in fulfilling the demands of disaster victims.
- ✓ Yoga and meditation programme for response worker.

8.8 WHAT WE LEARNT FROM THIS UNIT?

It is little difficult to define the term "Community" very precisely. In general, community means a group of people; living in a particular geographical area or having same interest or sharing similar problems or from same profession or of same age or of same language or from same ethnic group or exposed to similar hazards etc.

Again, socially a community may be divided by rich, poor, caste, origin, gender and many other social factors. But, for CBDM programmes, we may consider community as a group of people or cluster of families living in a particular geographical area and exposed to similar kinds of hazards. Of course, for proper implementation of CBDM programmes, we must give due weightage on the social aspects of vulnerable communities to motivate community members for their active participation in the process of assessment, planning and implementation of plans.

The purpose of community based disaster management is to involve the vulnerable community in the process of risk assessment and risk reduction planning. CBDM also addresses the knowledge, experiences and resources of the local people in formulating the DRR plans. The basic aim of this process is to improve the capacity and preparedness levels of the vulnerable communities for genuine risk reduction of the community.

There are certain conditions and stages for proper implementation of CBDM programmes. These conditions are relevant to the status of external agencies as well as community's problem areas, risk, vulnerability, socio-economic conditions etc.

There are also different approaches and processes for conducting the CBDRM programmes. Without following these approaches and processes, it is not possible to get active support of the community members and implement the programme effectively.

There are also two general methods for community based rural appraisal for genuine assessment, analysis, planning and execution of plans for disaster risk reduction of the vulnerable communities. One is Rapid Rural Appraisal (RRA) and other one is Participatory Rural Appraisal (PRA). The targets of both the methods are almost same but approaches are little bit different.

In CBDM programmes, along with community and government agencies, NGOs and CBOs also play vital role. But, for proper implementation of the CBDM programmes, we need strong coordination amongst all the stakeholders including NGOs and CBOs.

To minimize the gap between government agencies and non-governmental organizations, Disaster Management Act of India provided the scope of formulating the guidelines on role of

NGOs in disaster management. The NDMA has formulated a series of action points to define the role and responsibility of NGOs in disaster management and ensure proper coordination and collaboration of government agencies with local NGOs.

In this chapter, we have also highlighted issues related to psychological consequences of disasters on disaster victims and relief workers. There are many causes for such psychological impacts of disasters.

8.9 PROBABLE QUESTIONS

1. What do you mean by community?
2. What is CBDM?
3. Discuss the importance of CBDM in DRR programmes.
4. What are the essential conditions of CBDM?
5. Define general stages of CBDM process.
6. Discuss few important approaches of CBDM process.
7. What is PRA?
8. What are the common tools for RRA?
9. Distinguish between NGO and CBO.
10. Discuss few points of Indian National Guidelines on role of NGOs in DM.

8.10 SUGGESTED READINGS

1. Abarquez I. and Murshed Z., Community Based Disaster Risk Management: Field Practitioner's Handbook, Published by ADPC, 2004.
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3. Study material: Fourth International Course on CBDM, ADPC, 2000 (Module-2, pp 21; Module 3, pp 1)
4. Alexander, D., Natural Disasters, Published by ULC Press Ltd, London, 1993 (PP 560, 566, 568)
5. India: IDNDR & Beyond, NCDM Publication, 2000, pp 5