

Paper IV
Disaster Risk Management

Unit - 1 □ Disaster, Hazards & Vulnerability

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1.1 Necessity of studying Disaster Management

The word 'Disaster' has been derived from Middle French *desastre* and from Old Italian *disastro*, which in turn comes from the Greek pejorative prefix "dus" - means "bad" + "aster" means "star". Thus the root of the word "disaster" emanates from an astrological theme in which the ancients used to refer to the destruction or deconstruction of a star as a disaster.

Disasters are not new to mankind. They have been occurring constantly and showing

their ugly face to the human civilisation since time immemorial. However, whenever it occurs, a disaster is always accompanied by widespread damages to the nature and huge losses to mankind. It sets back the development trek of the human society and needs pooling of enormous resources from various sources to restore normalcy. Such resources could have been beneficially used for development works had there been no disaster. So a disaster is understood to be an extreme disruption of the functioning of a society that causes widespread human, material, or environmental losses that exceed the ability of the affected society to cope with its own resources. In recent times the incidents of disaster has increased considerably.

Disasters are often classified according to whether they are "natural" disasters, or "human-made" disasters. For example, disasters caused by floods, droughts, tidal waves and earth tremors which occur due to natural forces are generally considered "natural disasters." Disasters caused by chemical or industrial accidents, environmental pollution, transport accidents and political unrest are classified as "human-made" or "human induced" disasters since they are the direct result of human action.

A more modern and social understanding of disasters, however, views this distinction as artificial since most disasters result from the action or inaction of people and their social and economic structures. This happens by people living in ways that degrade their environment, over-population, rapid urbanisation and creation of social and economic systems that disturbs the natural balance of the environment. Communities and population settled in areas susceptible to the impact of a raging river or the violent tremors of the earth are placed in situations of high vulnerability because of their socio-economic conditions.

In fact, in the last few decades, the frequency and intensity of disasters have increased manifold. No wonder why the losses due to disasters are compounding every year. A study released at the World Conference on Natural Disaster Reduction, convened by the General Assembly in May 1994, showed that the previous three decades had seen a steady and rapid increase in the number of significant natural disasters and in the number of people affected. The trend continues to date and the situation seems to have worsened even further. The following table gives an idea of the global trend of occurrence of disasters during the period 1900 - 2009.

Table 1.1: Events of Disasters globally during the period 1900 - 2009

Disaster Types	Decades										
	1900 -09	1910 -19	1920 -29	1930 -39	1940 -49	1950 -59	1960 -69	1970 -79	1980 -89	1990 -99	2000 -09
Hydro meteorological	28	72	56	72	120	232	463	776	1498	2034	3529
Geological	40	28	33	37	52	60	88	124	232	325	354
Biological	5	7	10	3	4	2	37	64	170	361	612
Total	73	107	99	112	176	294	388	964	1900	2720	4495

Source: Centre for Research on Epidemiology of Disasters (CRED)

As is evident from the above table, there has been a rapid increase in incidents of disasters in the world. The increase in absolute number terms of such incidents has been the highest in the last decade. Incidentally, the last few decades have also experienced the very rapid growth in population and urbanisation. This clearly indicates that the frequency of disasters increases with the rise in human population.

The correlation becomes clearer from the fact that most of the disasters occur in the developing or third world countries where the population density is much higher than the developed countries. Asia, the most populated continent, accounts for 43% of the disasters 54% of the damages and 68% of the human lives lost globally (see table - 1.2).

Table: 1.2: Continent-wise disaster occurrences and damages (as a percentage of the world figure) in the last decade:

Continent	Asia	Europe	Africa	America	Oceania
No. of disasters (%)	43	19	14	22	2
Human lives lost (%)	68	3	14	14	1
Estimated damages (%)	54	19	3	23	1

India's geo-climatic conditions as well as its high degree of socio-economic vulnerability, makes it one of the most disaster prone country in the world. Earthquakes in Latur (1993), Bhuj (2001), Kashmir (2005) and Sikkim (2011); floods in West Bengal (1978, 2000), Uttar Pradesh (1998, 2005), Maharashtra (2005), Assam & Bihar (2004, 2007, 2008) and Andhra Pradesh & Karnataka (2009); Super Cyclone in Orissa (1999); Tsunami in Tamil Nadu & Andaman & Nicobar islands (2004) and Bhopal Gas tragedy (1982) are some of the most devastating disasters that have occurred in various parts of India. We will discuss about this in details in later chapters. The sufferings due to disasters are heart rending. People are forced into uncalled for misery. The condition of the poor and less resourceful becomes even more pathetic.

It is thus necessary to find ways to minimise the effects of disasters. This however can only be accomplished by acquiring detail knowledge of disaster management and mastering the relevant skills for its application. So the study of Disaster Management is inevitable in facilitating proper functioning of today's civilization.

Over the years, a paradigm shift has occurred in the theory and practice of disaster management. Earlier disasters were treated as a one-time event with focus on geophysical and engineering knowledge without considering the social and development aspects. Gradually the attitude shifted towards preparedness with emphasis on 'contingency planning' and relief supplies. However, as disaster losses continued to increase, there is a shift from response approach to a more proactive attitude. It is now being understood that disasters are related to vulnerability of the people, which in turn is dependent on the development pattern of the region.

With the experiences and new learning's in the field of disasters, there is demand for a human rights approach with focus on vulnerability reduction. It is therefore extremely important that we follow the culture of 'Disaster Risk Reduction', which means we PLAN, and undertake ACTIONS in a manner which reduces vulnerability and helps to prevent hazards from taking the shape of a disaster. Though we have moved ahead in theoretical construct, there is still a long way to go before substantial achievement is made in building resilient communities and a safe living environment.

Many of us, who start probing deeper into the subject area, find themselves amidst many queries like: Are natural disasters a consequence of the natural forces or are they a result of human activities? Do disasters differentiate between developed and developing countries or are disasters a manifestation of the development activities? Do disasters

discriminate among communities and between men and women? A frequently asked question by many individuals is how I can be prepared to deal with such events. How can I contribute for reducing disaster risk?

By studying disaster management like taking this course on 'Disaster Risk Management' one will be in a position to find answers to all such questions. A fair knowledge of the nature and characteristics of various disasters would make the people aware about the dangers waiting in disguise and motivate them to learn ways of mitigating the effects of the disasters or preventing them. Moreover there is a crying need for trained Disaster Managers who would be able to work with various organisations to help them prevent unnecessary disasters and facilitate capacity building necessary to bring about a culture of preparedness and mitigation among them. This course is designed to train the students to be good Disaster Managers. By undertaking this course one will also be equipped to help the society in augmenting its coping capacity so as to mitigate and overcome disasters.

1.2 The scope for a Disaster Manager

Students with education in Disaster Management along with a general subject have higher rate of employability in the country. Ensuring environmental sustainability being one of the Millennium Development Goals, the international community is committed towards integration of the principles of sustainable development into country policies and programmes and reversing the loss of environmental resources. The interlink between impact of disasters on development and global economy having been established for quite sometime, students taking up subjects relating to disaster management would definitely have an edge over others as far as opportunities in governments, companies, and non-profit organizations employing persons in the field of Development or Disaster Management is concerned. Further with the sustained effort of the international community towards eradication of poverty the opportunities for Disaster Managers are also growing.

Scope for Disaster Managers in NGO's: There are over 4,000 NGOs actively working in the State of West Bengal, and another 6,000 NGOs are working in the neighbouring states of Sikkim, Jharkhand, Bihar and Odisha. Out of these, over 200 NGOs are registered members who regularly work on Disaster Preparedness and Mitigation measures. They have some program or the other that has something to do with Disaster Management. This includes UN agencies (Unicef, UNDP, WWF), IRCS, International NGOs like World

Vision, Save the Children, Caritas, Oxfam, Concern Worldwide etc, and hundreds of mid-level NGOs. Such organisations quite often announce vacancies for jobs related to disaster management.

Scope for Disaster Managers in the Corporate and service sectors: The need for persons with education in Disaster Management is ever increasing. Today, even the malls are looking for Floor Managers who have knowledge and skills in disaster management such as crowd management, information management, response and first aid, knowledge of rescue mechanisms. The hospital administrators, NGO administrators, school principals, construction companies, transport industries, large industries and even banking sector is on the lookout for people with skills in disaster management. There is a need for engineers and skilled construction workers with knowledge of disaster management. Even in the agriculture sector there is a huge need for people who have knowledge of disaster management so as to successfully undertake risk planning and risk avoidance in case of agricultural produce.

Thus the field of disaster management is an ever expanding one with corresponding rise in job opportunities for persons with formal education in that field.

1.3 Definition of Disaster

The definition of 'disaster' is now all encompassing, which includes not only the events emanating from natural and man-made causes, but even those events which are caused by accident or negligence. Thus the Disaster Management Act, 2005 defines disaster as "a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area".

1.3.1 Types of Disasters

Disasters are often classified according to whether they are "natural" disasters, or "man-made" disasters depending upon the causes of such disasters. For example, disasters caused by floods, droughts, tidal waves and earth tremors which occur due to natural forces are generally considered "natural disasters." Disasters caused by chemical or industrial accidents, environmental pollution, transport accidents and political unrest are classified as "man-made" disasters since they are human induced and a direct result of human action.

The various kinds of disasters occurring around us can be classified under the above two broad types as follows:

I. Natural Disaster:

a) Flood, b) Cyclone, c) Earthquake, d) Hailstorm, e) Drought, f) Landslide, g) Erosion, h) Heat wave, i) Cold wave, j) Cloud-burst, k) Avalanche, l) Tornado, m) Tsunami.

II. Man-made Disaster:

a) Transport (Road, Rail, Air and Sea) disasters, b) Fire accidents, c) Building Collapse, d) Industrial accidents, f) Explosions, g) Terrorism h) War and i) Epidemics.

In India, we have experienced each and every kind of the above mentioned disasters at various points of time in the past. A description of this will be given in the next section. However, the point to be noted here is that on taking a closer look at the root causes of disasters, the distinction between natural and man-made disasters gets blurred. This is because most disasters result from the action or inaction of people and their social and economic structures. This happens by people living in ways that degrade their environment, over-population, rapid urbanisation and creation of social and economic systems that disturb the natural balance of the environment. Communities and population settled in areas susceptible to the impact of a raging river or the violent tremors of the earth are placed in situations of high vulnerability and are bound to be affected by disasters, sooner or later.

1.4 History of Disasters

As discussed in the previous chapter, disasters are worldwide phenomena. No part of this world can be claimed with certainty to be totally safe. In fact, in modern times the disasters are on the rise. A glance of Table-1.1 would make the picture clearer that how the frequency of disasters has increased phenomenally from 1900 to 2009. However, here we will focus our discussion on occurrence of disasters in India only.

India, due to its geo-climatic and socio-economic conditions, is prone to various disasters. During the last thirty years, the country has been hit by as many as 431 major disasters resulting into enormous loss to life and property. According to the Prevention Web statistics, during these three decades 143039 persons were killed and the cumulative figure for the number of people affected comes to around 150 Crores in the country. The disasters caused huge losses to property and other infrastructures, the total estimate of the damages amounting to US\$ 4800 Crore. The most severe disasters in the country and their impact in terms of

people affected, lives lost and economic damages is given in the Table 2.1 below.

Table 2.1: People affected, lives lost and economic damage due to Disasters in India between 1980 to 2010

Year	Type of Disasters	People affected	Life Lost	Economic Damage (USD x)
1980	Flood	30,000,023		
1982	Drought	100,000,000		
	Flood	33,500,000		
1984	Epidemic		3290	
1987	Drought	300,000,000		
1988	Epidemic		3000	
1990	Storm			2,200,000
1993	Flood	128,000,000		7,000,000
	Earthquake*		9,748	
1994	Flood		2001	
1995	Flood	32,704,000		
1996	Storm			1,500,300
1998	Storm		2871	
	Extreme Temp.		2541	
	Flood		1811	
1999	Storm		9,843	2,500,000
2000	Drought	50,000,000		
2001	Earthquake*		20,005	2,623,000
2002	Drought	300,000,000		
	Flood	42,000,000		
2004	Flood	33,000,000		2,500,000
	Earthquake*		16,389	
2005	Flood			3,330,000
	Flood			2,300,000
2006	Flood			3,390,000
2009	Flood			2,150,000

Source: EM-DAT: The OFDA/CRED International Disaster Database

* (includes Tsunami)

In India, the cyclone which occurred on 25th November, 1839 had a death toll of three lakh people. The Tsunami (2004) in Tamil Nadu and Andaman & Nicobar Islands, the Bhuj earthquake of 2001 in Gujarat and the Super Cyclone of Orissa on 29th October, 1999 are still fresh in the memory of most Indians. The most recent natural disaster of Cloud burst in Leh resulting in flash floods and mudflow in Leh and surrounding areas in the early hours of

6th August, 2010, caused severe damages in terms of human lives lost and property damaged. It was reported that 196 persons had died of this disaster, 65 persons were missing, 3661 houses were damaged and 27350 hectares of standing crop was affected.

Floods, earthquakes, cyclones, hailstorms, etc. are the most frequently occurring disasters in India. The following table gives an account of the loss due to above disasters during decade of 2001- 2010.

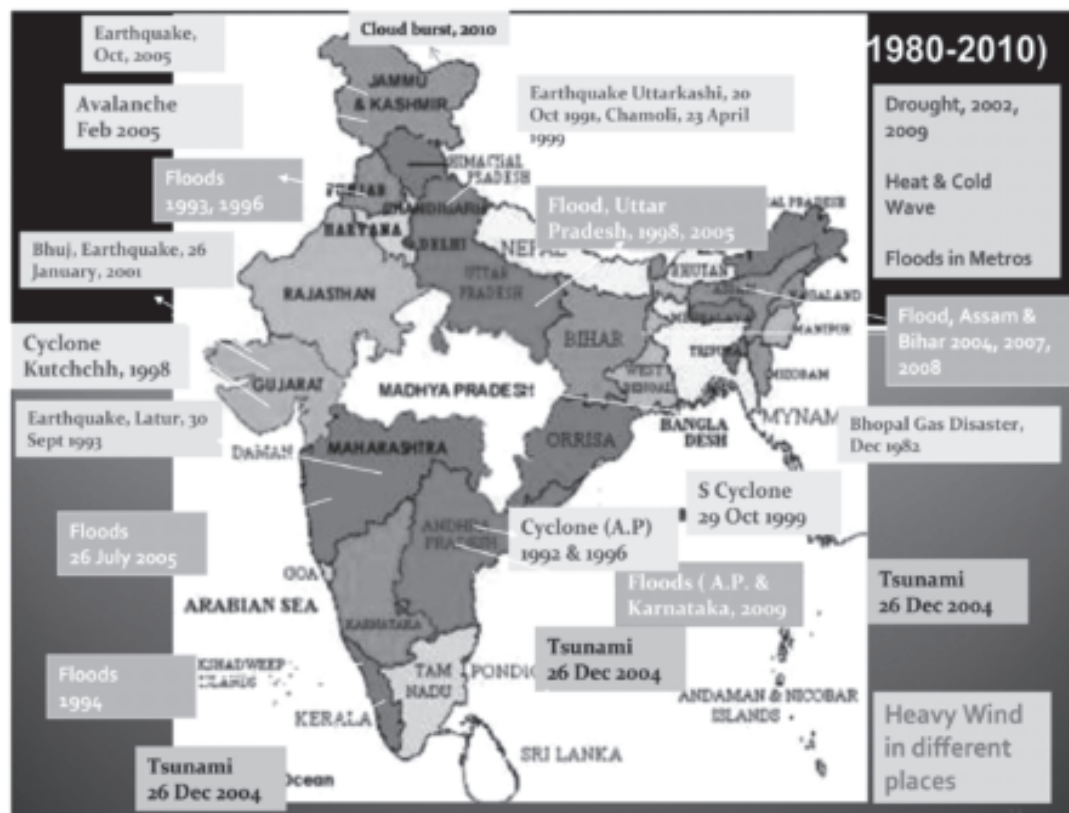
Table-2.2: Year-wise damage caused due to floods, cyclonic storms, landslides etc. during last ten years in India

Year	Loss of human life (in No.)	Cattle Lost (in No.)	House damaged (in No.)	Cropped Area affected (in Lakh hectares)
2001-02	834	21269	3,46878	18.72
2002-03	898	3,729	462700	21.00
2003-04	1992	25,393	682209	31.98
2004-05	1995	12,389	1603300	32.53
2005-06	2698	1,10,997	2120012	35.52
2006-07	2402	4,55,619	1934680	70.87
2007-08	3764	1,19,218	3527041	85.13
2008-09	3405	53,833	1646905	35.56
2009-10	1677	1,28,452	1359726	47.13
2010-11	2310	48,778	1338619	46.25

Source: Ministry of Home Affairs (MHA)

Figure 1 gives a quick view of the major disasters that have occurred in the country from 1980-2010. During this period of 30 years the country has been hit by approximately 25 major disasters apart from the heat wave, cold wave and heavy winds affecting some areas of the country.

Figure 1: Major Disasters in India from 1980 - 2010



Source: NIDM

As is evident from the above picture there is a history of occurrence of major disasters all over India. Consequently, it is very important for us to know why so many disasters occur here and what are the factors contributing to occurrence of such disasters.

1.5 Factors causing Disasters

From the discussion in the previous sections it is clear that disasters occur quite frequently and cause heavy losses to life and property. Secondly, a continent-wise break up of the occurrence of disasters and losses incurred due to such disasters in the last decade given below indicates that Asia, the most populated continent, accounts for 43% of the disasters 54% of the damages and 68% of the human lives lost globally (see table - 1.2).

Table: 1.2: Continent-wise disaster occurrences and damages (as a percentage of the world figure) in the last decade:

Continent	Asia	Europe	Africa	America	Oceania
No. of disasters (%)	43	19	14	22	2
Human lives lost (%)	68	3	14	14	1
Estimated damages (%)	54	19	3	23	1

This brings out the fact that disasters do not occur uniformly throughout the world. Some parts of the world are more prone to disasters than others. What might be the reason for this?

To answer this question we need to go back to the definition of disaster. We defined disaster as an event or a series of events which gives rise to casualties and/or damage or loss of property, infrastructure, essential services or means of livelihood on a scale that is beyond the normal capacity of the affected communities to cope with unaided. An interpretation of this definition reveals that a disaster is brought about by "an event or a series of events" and affects "a community which is unable to cope with such an event on its own". These "events" are actually known as "hazards" and the "inability" of the community to cope with the hazards on its own is called its "vulnerability".

So there are the two factors leading to disasters -

1. Hazard or the event such as flood, earthquake, fire etc. which triggers the disaster and
2. Vulnerability or the inability of the community to cope with such hazardous events using its available resources.

So for a disaster to take place a hazardous event must occur in such an area where there are vulnerable people, infrastructures, services or means of livelihood that should get affected on a large scale leading to widespread losses. We can express this as follows:

$$\text{Disaster} = \text{Hazard} \times \text{Vulnerability}$$

i.e. disaster is a product of hazard and vulnerability. In other words, both hazard and vulnerability has to exist simultaneously at the same location. In the absence of either of the two factors, disaster cannot occur. A few examples may establish the above argument.

For example, vast areas on both the banks of the river Ganga gets flooded in the region called taal in Bihar but that never leads to any disaster because there is no habitation

in that area. This region is used only for agriculture after the water recedes. Here the vulnerability component is absent and hence no disaster occurs. Again, earthquakes of moderate strength occur regularly in Japan. But neither any person dies because of such earthquakes nor any property is damaged. This is so because the Japanese have constructed their structures in such a way so as to withstand the tremors i.e. they have minimized their vulnerability to almost zero.

Further, the Purulia district in West Bengal is inhabited by vast majority of poor people who hardly own resources worth mentioning. However, the district is located in a geo-climatic zone that has the least possibility of being struck by flood, cyclone or earthquake (see Hazard-Vulnerability map of West Bengal, pp). In the absence of such hazards there is least possibility of occurrence of corresponding disasters although there is a huge population of vulnerable people residing in the district. Thus a disaster occurs only when a hazardous event strikes in any area which is vulnerable to damages.

1.5.1 Dimensions of Disasters

The extent of damage from the disaster depends on:

1. The impact, intensity and characteristics of the hazardous phenomenon, and
2. How people, environment and infrastructure are affected (due to their inherent vulnerability) by that phenomenon.

In other words, if the intensity (i.e. damaging potential) of a particular hazard and vulnerability is low, the disaster is of moderate dimension. On the other hand if either the hazard or the vulnerability of the elements concerned is high then the dimension of the disaster is also large. Again, if both the intensity of the hazard and vulnerability of the hazardous terrain are high then the magnitude of the disaster is very large leading to devastation. This can be represented pictorially as follows where the size of the letters depicts the magnitude:

$$\text{Disaster} = \text{Hazard} \times \text{Vulnerability}$$

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For example, Japan has been experiencing numerous earthquakes and tsunamis. However, the scale of loss and damage in Japan is far less as compared to the tsunami or an earthquake of same magnitude experienced in India. This is because Japan has increased its capability to face such disasters through concerted efforts of capacity building and mitigation measures over a long drawn period of time. In that respect, India is far behind. It only overcame its slumber after the Gujarat earthquake started taking capacity building and mitigation measures seriously. So, in this case the intensity of the 'Hazard' is large but the 'Vulnerability' in case of Japan is low while that in case of India is high thereby causing bigger disaster in India than in Japan for earthquakes of the same intensity.

Again, in 1993, the Latur earthquake in India caused about 10,000 deaths and 200,000 households were affected due to damaged property and houses. However, a technically much more powerful earthquake in Los Angeles in 1971 caused only about 55 deaths. Los Angeles is far well-developed with use of the latest technologies to prevent damages from earthquakes and the people there are much aware and well-prepared to face any sort of natural calamity and as such the 'vulnerability' is quite low. So even though the intensity of the earthquake was much larger the damages were much lower than that in India.

Floods are a regular feature in West Bengal. However the floods of 1978 and 2000 were of highest magnitudes. So the damages were also the highest compared to the other flood years. Again, the population density was much higher in 2000 compared to 1978 thereby increasing the vulnerability. Incidentally, the damages in 2000 floods were much higher. So it implies that when 'Vulnerability' is high and magnitude of 'Hazard' is large, the dimension of the disaster is also very high.

Thus the above case studies indicate that the dimension of a disaster is directly proportional to the intensity of the hazard and the degree of vulnerability.

1.5.2 Phases of Disaster

To have a clear view about a disaster, one has to perceive the different phases of a disaster based upon its timeline. If we take the case of a cyclone, before its on-set there appears a low pressure formation over the sea, which gradually deepens and keeps gaining energy until it attains sufficient wind speed to move towards land. During this time nature gives enough indications about the imminent disaster. This phase is known as the pre-disaster phase.

Again, when the cyclone starts moving and makes the land-fall, the strong wind which is often accompanied by heavy rains creates havoc leading to damages to life and properties

and disrupting the normal functioning of the society. All of a sudden there are lots of people without homes and belongings, the near and dear ones often go missing, many are injured and a number of them die. The essential services get disrupted roads get damaged, trees and electric poles get uprooted and even some bridges collapse. After some time the cyclone loses its vigor and dies down but leaves behind a trail of destruction, chaos and confusion everywhere. This may be called the disaster phase. People are in need of help in this phase and if there is delay in arrival of aid the losses may be more catastrophic.

After a lapse of a short period of time from the occurrence of the disaster, people start attempting to bring back normalcy in life either on their own or with outside assistance. They try to overcome their woes and losses, set things right and start leading somewhat a normal life. This phase is usually called post disaster phase.

This is true for every kind of disaster. A study of the specific features of a disaster in its above three phases is very much essential to ultimately carve out a fool-proof strategy for disaster management. This will be dealt with in detail subsequently in this course.

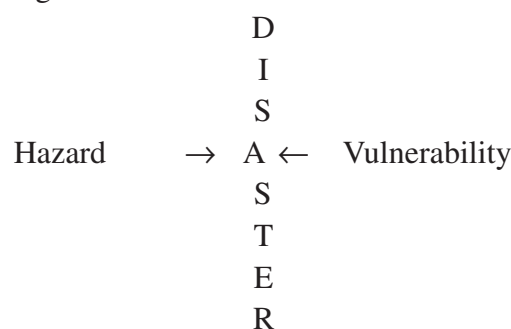
1.6 Concept and definition of Hazards

As discussed in the previous section, a disaster is the product of a hazard such as earthquake, flood or windstorm coinciding with a vulnerable situation, which might include communities, cities or villages. Without the occurrence of a hazardous event at a location having vulnerability of one or the other kind, there cannot be a disaster.

The extent of damage from the disaster depends on:

1. The impact, intensity and characteristics of the hazardous phenomenon, and
2. How people, environment and infrastructure are affected (due to their inherent vulnerability) by that phenomenon.

The relationship between hazard and vulnerability is best represented in the pressure and release, or “Crunch Diagram” :



Hazards are defined as "Phenomena that pose a threat to people, structures or economic assets and which may cause a disaster. They can be either man-made or naturally occurring in our environment" (Disaster Preparedness Training Manual, Philippine National Red Cross, 1994).

1.6.1 Types of Hazards

Hazards may be broadly classified into:

I. Natural hazards:

a) Flood, b) Cyclone, c) Earthquake, d) Hailstorm, e) Drought, f) Landslide, g) Erosion, h) Heat wave, i) Cold wave, j) Cloud-burst, k) Avalanche, l) Tornado, m) Tsunami.

II. Man-made hazards:

a) Transport (Road, Rail, Air and Sea) disasters, b) Fire accidents, c) Building Collapse, d) Industrial accidents, f) Explosions, g) Terrorism h) War and i) Epidemics.

However, based upon their sources there are four basic types of hazardous events that put societies at risk of disasters:

- a. Those based in nature: Earthquake, droughts, floods, avalanches etc.
- b. Those based in violence: War, armed conflict, physical assault, etc.
- c. Those based in deterioration: Declining health, education and other social services, environmental degradation etc.
- d. Those based in the failings of industrialized society: Technological failures, oil spillage, factory explosions, fires, gas leakage, transport collisions

For the present, we shall restrict our discussion to the natural hazards i.e. falling in category (a) above. A natural hazard pertains "to a natural phenomenon which occurs in proximity to a particular region and poses a threat to people, structures and economic assets caused by biological, geological, seismic, hydrological or meteorological conditions or processes in the natural environment." From the discussions in the previous section it is by now clear that there is hardly any region in the world which is not affected by any kind of natural disaster. So hazards are omnipresent. One or the other kind of hazard is present everywhere in this world. However, the situation is worse in case of India.

1.6.2 Hazard Profile of India

a) India is one of the ten worst disaster prone countries of the world. The country

is prone to disasters due to number of factors; both natural and human induced, including adverse geo climatic conditions, topographic features, environmental degradation, population growth, urbanisation, industrialization, non scientific development practices etc. The factors either in original or by accelerating the intensity and frequency of disasters are responsible for heavy toll of human lives and disrupting the life supporting system in the country.

- b) The basic reason for the high vulnerability of the country to natural disasters is its unique geographical and geological situations. As far as the vulnerability to disaster is concerned, the five distinctive regions of the country i.e. Himalayan region, the alluvial plains, the hilly part of the peninsula, and the coastal zone have their own specific problems. While on one hand the Himalayan region is prone to earthquakes and landslides, the plain is affected by floods almost every year. The desert part of the country is affected by droughts and famine while the coastal zone is susceptible to cyclones and storms.
- c) The natural geological setting of the country is the primary basic reason for its increased vulnerability. The geo-tectonic features of the Himalayan region and adjacent alluvial plains make the region susceptible to earthquakes, landslides, water erosion etc. Though peninsular India is considered to be the most stable portions, but occasional earthquakes in the region shows that geo-tectonic movements are still going on within its depth.
- d) The tectonic features, characteristics of the Himalaya are prevalent in the alluvial plains of Indus, Ganga and Brahmaputra too, as the rocks lying below the alluvial plains are just extension of the Himalayan ranges only. Thus this region is also quite prone to seismic activities. As a result of various major river systems flowing from Himalaya and huge quantity of sediment brought by them, the area is also suffering from river channel siltation, resulting into frequent floods, especially in the plains of Uttar Pradesh and Bihar.
- e) The western part of the country, including Rajasthan, Gujarat and some parts of Maharashtra are hit very frequently by drought situation. If Monsoon worsens the situation spreads in other parts of the country too. The disturbance in the pressure conditions over oceans, results into cyclones in coastal regions. The geo tectonic movements going on in the ocean floor make the coastal region prone to tsunami disaster too.

- f) The extreme weather conditions, huge quantity of ice and snow stored in the glaciers etc. are other natural factors which make the country prone to various forms of disasters.
- g) Along with the natural factors discussed in the preceding text, various human induced activities like increasing demographic pressure, deteriorating environmental conditions, deforestation, unscientific development, faulty agricultural practices and grazing, unplanned urbanization, construction of large dams on river channels etc. are also responsible for accelerated impact and increase in frequency of disasters in the country.

1.7 Definition of Vulnerability

Vulnerability is defined as "the extent to which a community, structure, service, or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster prone area."

Vulnerability can be understood as a set of prevailing and long-term factors, conditions and weaknesses, which adversely affect the ability of individuals, households, organizations and the community to protect themselves, cope with or recover from the damaging effects of disasters. Vulnerability may exist due to many reasons such as geographic location, physical state, social exclusion and marginalization, economic instability or environmental conditions.

From another view point, vulnerability to disasters may be said to be a function of human action and behaviour. It is determined by a combination of several factors, including awareness of hazards, the condition of human settlements and infrastructures, public policy and administration, the wealth of a given society and organized abilities in all fields of disaster and risk management. This argument gains importance from the fact that there is a close correlation between the trends of increased demographic pressure, escalated environmental degradation, increased human vulnerability and the intensity of impact of hazards. Poverty and vulnerability is integrally linked and mutually reinforcing.

Vulnerability incorporates considerations of both the intrinsic value of the elements concerned and their functional value in contributing to communal well being in general and to emergency response and post-disaster recovery in particular. The concept of vulnerability therefore implies a measure of risk combined with the level of social and economic ability

to cope with the resulting event in order to resist major disruption or loss. This susceptibility and vulnerability to each type of threat will depend on their respective differing characteristics. In the following sections we undertake a detail study of the vulnerability profile of India with respect to various kinds of hazards.

1.7.1 Types of Vulnerability

(i) Physical Vulnerability

Physical vulnerability relates to the physical location of people and elements at risk; buildings, infrastructure, etc., and their proximity to the hazard. For example people are only vulnerable to a flood because they live in a flood prone area. Physical vulnerability also relates to the technical capacity of buildings and structures to resist the forces acting upon them during a hazard event.

(ii) Socio-economic Vulnerability

The recent perceptions of vulnerability indicate that the degree to which a population is affected by a calamity will not purely lie in the physical components of vulnerability but also has a contextual realisation to the prevailing social and economic conditions. The impact of a disaster is determined by the event, its effects on people and their environment, as well as its consequential effect on human activities within a given society.

People who occupy comparatively weaker positions within the social fabric or have limited access to social services have a lessened capacity to absorb or avoid the impact of hazards. These differences in capacities are exemplified in risk analysis. Its effects are seen to be directly proportionate to the poverty-gap and poverty- intensity in the society/ location as it is this group who normally live in high concentration in marginal areas (unstable slopes, flood plains) with little infrastructure and fewer resources to cope with such disasters. Research in areas affected by earthquakes indicates that single parent families, women, handicapped people, children and the aged are particularly vulnerable social groups (M. Erdik, 1993).

iii) Psychological Vulnerability

This relates to hopelessness, helplessness, negative attitude towards change, unawareness, passivity, negative belief etc. of the disaster affected people.

1.7.2 Vulnerability Analysis

Vulnerability analysis is the process of estimating the susceptibility of 'element of risk' to various hazards. This is necessary to have an understanding of the level of exposure of

a particular region, community or structure to the various hazards identified above. It involves two main steps:

1. Identifying what elements are at risk according to the type of the hazard, and
2. Analyzing the root causes of why those elements are at risk.

This exercise provides us with information on the sectors that are at risk; the type of vulnerability i.e. whether physical, social, economical or psychological and the type of risk involved. Such information sets the stage for assessment of the disaster risk and lays the foundation for an effective planning process for disaster management.

Vulnerability: Choice and Recovery

Physical vulnerability is as much a function of location and exposure to a hazard as to the physical performance of buildings and structures. Yet because of socioeconomic factors some sections of society have more choices as to where they live and what assistance they receive in a disaster. Thus it is often the case that the poorest are more vulnerable. However whilst poverty is not always linked to vulnerability, the latter is often related to capacity. The capacity to recover will depend on income levels, savings, social support systems etc.

Poverty and risk to disasters are mutually reinforcing. The poor section of the society is worst affected in case of disaster. The situation further aggravates due to the compulsion of the poor to exploit environmental resources for their survival, increasing the risk and exposure of the society to disasters, in particular those triggered by flood, drought and landslides. Poverty also compels the poor to migrate and live at physically more vulnerable locations, often on unsafe land and in unsafe shelters. These inhabitations of the poor at such locations are either due to the fact that there is no other land available at reasonable cost or it is close to the employment opportunities. The inhabitations of the poor people on marginal land are prone to all types of disasters. The type of construction of these houses further deteriorates the condition. These dwellings made up of low cost material without giving much consideration to technical aspect are easy targets of various hazards.

While speaking of socio-economic vulnerability of a community towards a disaster it is necessary to give special importance to vulnerabilities related to gender and age. Again, the rural and urban sectors also need to be dealt with separately.

Gender related vulnerability: When disaster affects a particular area, both male and female are equally affected. However, the capacity of the females to overcome the effects of the disaster is generally much less than that of the males. This may be because of the physiological and psychological differences between them. Males are physically well built compared to females. Again, the females are child bearers and the physical movement of a pregnant woman gets restricted. The females are more attached to their family. So they take longer time to overcome from the psychological shocks of losses due to the disaster. All these makes a female more vulnerable than a male and this should be taken care of while planning for disaster management.

Age related vulnerability: Again, people of all ages do not have the same vulnerability. The aged and the child members of the family do not have the same mobility and physical strength. They cannot move with the same ease as a young person. Again, if they get stuck up somewhere due to a disaster the aged members and the children have little chance of setting themselves free without the help of others.

Some sectors of economy are more vulnerable to hazards than others. Most obviously, the agricultural sector is potentially vulnerable, implying that the countries which rely heavily on agriculture may be particularly threatened by hazards. However, even here, the types of crops cultivated and techniques for growing them play a role in determining the scale of vulnerability.

1.7.3 Hazard-Vulnerability Profile of West Bengal

West Bengal is prone to almost all kinds of disasters. Floods are the most common and widespread of all natural disasters and can occur nearly anywhere in the State. Flooding along rivers is a natural phenomenon. West Bengal is situated along the Bay of Bengal and thus it is exposed to cyclone-related hazards. Cyclones have inflicted substantial damages periodically. In addition, there have been other natural calamities, such as drought, earthquakes and landslides, etc.

Districts on the western part of the State, especially Purulia, Bankura, parts of Paschim Medinipur and Birbhum are drought-prone because of receipt of inadequate rainfall. This zone is generally known as red lateritic zone because red soil is the main soil form in this area. It has very low water holding capacity thereby making the zone susceptible to drought.

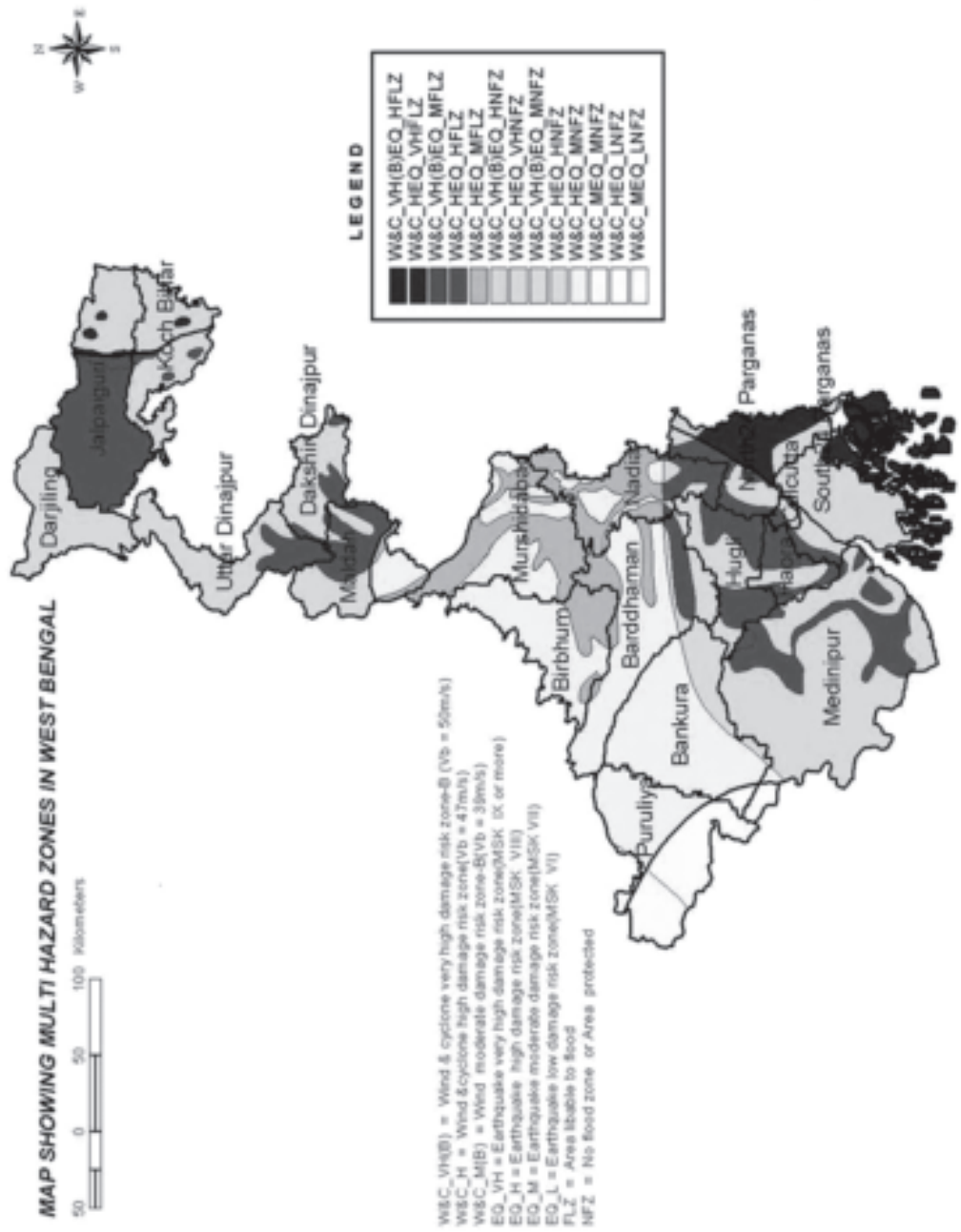
Landslides are common disaster phenomena in the district of Darjeeling. It is primarily the way of nature to adjust slope stability. But the process has been intensified by human interference mainly through rapid deforestation, incorrect land-use process, etc.

Earthquakes are not very common in the State. But most part of the State is quite vulnerable to earthquake because of the presence of a number of fault lines all over West Bengal. There have been instances of quite a few earthquakes in West Bengal, but frequencies had been relatively low. However, earthquakes occurring in the adjoining regions affect the State. The northern districts of the State are affected by massive earthquakes occurring in the Sikkim and Nepal region. Earthquakes in Bangladesh and the Ganga delta in North Bihar have also shaken the State.

The district-wise vulnerability status is given in the following table and Figure-4 gives the hazard-vulnerability picture of West Bengal.

Districts vulnerable to Flood			
Flood	North Bengal	South Bengal	
Highly vulnerable Districts	Cooch Behar, Jalpaiguri, Uttar Dinajpur, Dakshin Dinajpur, Malda;	Nadia, Howrah, Murshidabad, North 24 Parganas, South 24 Parganas, Hooghly, Burdwan, Birbhum, Paschim Medinipur, Purba Medinipur	
Less vulnerable Districts	Darjeeling	Puruliya & Bankura	
Districts vulnerable to Cyclone			
V = 50 m/s Paschim Medinipur, Purba Medinipur, South 24 Pgs. North 24 Pgs. Howrah, Hooghly, part of Nadia, Burdwan and Bankura	V = 47 m/s Major part of Nadia, Burdwan, Bankura, Murshidabad, Malda, Uttar and Dakshin Dinajpur, Jalpaiguri, Cooch Behar, Darjeeling and part of Purulia	V = 29 m/s Major portion of Purulia	
Districts vulnerable to Earthquake (seismic zone-wise)			
V	IV	III	II
Major part of Cooch Behar and some parts of Jalpaiguri	Remaining parts of Cooch Behar and Jalpaiguri, entire Darjeeling, Uttar and Dakshin Dinajpur, major part of Malda, North 24 Parganas and South 24 Parganas	Malda, North and South 24 Parganas, Nadia, Murshidabad, Howrah, Hooghly, Burdwan, Bankura, Birbhum, Paschim and Purba Medinipur.	Purulia

Figure 4: Multi - Hazard Maps of West Bengal



Source: BMTPC, India

Unit 2 □ Disaster Risk

Structure

- 2.1 Definition
- 2.2 Factors of Disaster Risk
- 2.3 Disaster Risk Analysis
- 2.4 Definition of Disaster Management
- 2.5 Interventions for Disaster Management
- 2.6 Crisis Management & Risk Management
- 2.7 The Disaster Management Cycle
- 2.8 Impact of Disaster on Development
- 2.9 Components of Disaster Management
- 2.10 Hyogo Framework of Action
- 2.11 Response of India to changes in international policy on Disaster Management
- 2.12 India's engagement with external agencies on Disaster Risk Reduction

2.1 Definition

Disaster Risk is a measure of the expected losses (e.g. injuries, death, loss of assets, disruption of economic activities etc) due to a hazard event of a particular magnitude occurring in a given area over a specific time period. Risk is a function of the probability of occurrence of different types of hazards and the losses each would cause.

2.2 Factors of Disaster Risk

The level of Disaster Risk depends upon the following factors:

- 1) Nature of the hazard
- 2) Vulnerability of elements which affected
- 3) Economic value of those elements

It is obvious that for a disaster to happen there should be some probability of occurrence of a hazardous event in a particular region and the presence of a vulnerable community, structure or other vulnerable elements is a pre-condition. In absence of either of the two