

## **Unit 2- Disasters**

### **Introduction**

A disaster is a consequence of a sudden disastrous event which seriously disrupts the normal function of the society or the community to the extent that it cannot subsist without outside help. A disaster is not just the occurrence of an event such as an earthquake, flood, conflict, health epidemic or an industrial accident; a disaster occurs if that event/process negatively impacts human populations. Disasters combine two elements: hazard, and the vulnerability of affected people. "A disaster occurs when a hazard exposes the vulnerability of individuals and communities in such a way that their lives are directly threatened or sufficient harm have been done to their community's economic and social structure to undermine their ability to survive. A disaster can be defined as any tragic event stemming from events such as earthquakes, floods, catastrophic accidents, fires, or explosions.

### **Definition**

The World Health Organization (WHO) defines Disaster as "any occurrence that causes damage, ecological disruption, loss of human life, deterioration of health and health services, on a scale sufficient to warrant an extraordinary response from outside the affected community or area."

### **Types of Disasters**

Natural and human-caused disasters affect thousands of people each year. Major adverse events such as these have the potential to cause catastrophic loss of life and physical destruction. They are often unexpected and can leave whole communities in shock.

People who live through a disaster can experience emotional distress. Feelings of anxiety, constant worrying, trouble sleeping, and other depression-like symptoms are common responses to disasters before, during, and after the event. Many people are able to "bounce back" from disasters with help from family and the community, but others may need additional support to cope and move forward on the path of recovery. Anyone can be at risk, including survivors living in the impacted areas and first responders and recovery workers.

### **Natural Disasters**

Natural disasters are large-scale geological or meteorological events that have the potential to cause loss of life or property. These types of disasters include:

- Tornadoes and Severe Storms
- Hurricanes and Tropical Storms
- Floods

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- Wildfires
- Earthquakes
- Drought

Severe storms and floods are the most common types of natural disasters reported in the United States. These meteorological events are occasionally preceded by presidential “emergency declarations” requiring state and local planning prior to the event, such as evacuations and protection of public assets. Disaster Distress Helpline staff are available to speak to those who call or text before, during, and after a natural disaster.

### Human-Caused Disasters

Examples include industrial accidents, shootings, acts of terrorism, and incidents of mass violence. As with natural disasters, these types of traumatic events may also cause loss of life and property. They may also prompt evacuations from certain areas and overwhelm behavioral health resources in the affected communities.

In the aftermath of the tragic loss of life that occurred on September 11, 2001, the feelings of loss of security and well-being—arguably the most crucial ingredients for leading a happy, healthy life—dramatically affected the citizens of the United States. Disaster Distress Helpline staff are also trained to respond to calls or texts related to these types of disasters.

- Incidents of Mass Violence

### Hazards, Disasters and Catastrophe

A hazard, or natural hazard, is any natural process that poses a threat to human life or property. The event itself is not a hazard; rather, a process becomes a hazard when it threatens human interests.

A disaster, or natural disaster, is the effect of a hazard on society, usually as an event that occurs over a limited time span in a defined geographic area. The term disaster is used when the interaction between humans and a natural process results in significant property damage, injuries, or loss of life.

A catastrophe is a massive disaster requiring significant expenditure of time and money for recovery.

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## 2.3 TYPES OF DISASTERS

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A disaster as mentioned earlier is natural because any disaster event by definition requires interaction either with man, his built environment, or both. It is possible, and is often the case, that human actions exacerbate the effect of these natural processes, such as increased flooding after the destruction of wetlands, or landslides

on slopes where anchor vegetation has been removed. This section identifies the most common of these. **Types of Hazards**

- **Natural Hazards** – Natural processes or phenomena occurring in the biosphere that may constitute a damaging event. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing. Natural hazards can be classified into Geological hazards, Hydro-meteorological hazards and Biological hazards
- **Technological Hazards** – Danger originating from technological or industrial accidents, dangerous procedures, infrastructure failures or certain human activities, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

**Some examples:** industrial pollution, nuclear activities and radioactivity, toxic wastes, dam failures; transport, industrial or technological accidents (explosions, fires, spills).

According to the High Powered Committee, appointed by Government of India in 1999 at the behest of the Prime Minister to look into the issue of Disaster Management Planning at National, State and District levels, various types of hazards prevailing in India can be classified into the following groups:

- **Water and Climate Related Disasters** – Floods, Droughts, Cyclones, Tornadoes, Hurricanes, Cloud burst, Snow Avalanches, Heat & Cold Waves
- **Geological Disasters** – Earthquakes, Landslides, Mudflows, Sea Erosion, Dam Bursts & Dam Failures.
- **Biological Disasters** – Biological Disasters, Epidemics, Cattle Epidemics
- **Chemical/Industrial/ Nuclear Disasters** – Chemical and Industrial Disasters, Forest Fires, Oil Spill Fires, Mine Fires and Mine Flooding, Nuclear Disasters
- **Accident Related Disasters** – Road, Rail and other Transportation accidents including Waterways (Boat Capsizing), Major Building Collapse, Serial Bomb Blasts, Festival related Disasters

The natural hazards/disaster can be further classified as:

- **Hydro-meteorological Hazards** – Natural processes or phenomena of atmospheric, hydrological or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hydro meteorological hazards include: floods, debris and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; drought, desertification, wild land fires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches.
- **Geological Hazards** – Geological hazard includes internal earth processes or tectonic origin, such as earthquakes, geological fault activity, tsunamis, volcanic activity and emissions as well as external processes such as mass movements, landslides, rockslides, rock falls or avalanches, surfaces collapses, expansive soils and debris or mud flows.

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(*Source:* Annual Disaster Statistical Review 2008 The Numbers and Trends, Centre for Research on Epidemiology of Disasters).

Natural Disasters			
Geophysical	Hydrological Hydro-meteorological	Meteorological	Biological
Earthquake*	Avalanches*	Storm	Epidemic
Landslides* Debris Flow*	Floods* Desertification* Tsunamis*	<ul style="list-style-type: none"> <li>• Tropical*</li> <li>• Cyclone</li> <li>• Local Storm</li> <li>• Tornadoes*</li> <li>• Hailstorms*</li> <li>• Ice storms*</li> <li>• Monsoons*</li> </ul>	<ul style="list-style-type: none"> <li>• Viral infections</li> <li>• Bacterial infections etc.</li> </ul>
			<b>Climatologically</b>
			<b>Extreme</b> <b>Temperature</b> • Heat wave • Cold wave <ul style="list-style-type: none"> <li>• Extreme winter condition</li> <li>• Drought*</li> <li>• Wildfire</li> <li>• Forest fire</li> <li>• Land fire</li> </ul>
* Disasters used in this publication			

**Tsunamis**

A series of waves generated by an undersea disturbance such as an earthquake, pronounced as 'soo-nah-mee', the word is Japanese in origin represented by two characters 'tsu' meaning harbor and 'nami' meaning waves. Tsunamis are often incorrectly referred to as tidal waves. There are many events that result in the generation of a tsunami, but earthquakes are the most usual. Other forces that generate the great waves include landslides, volcanic eruptions, explosions etc. Tsunamis are generated when a large area of water is displaced, either by a shift in the sea floor following an earthquake, or by the introduction of mass from other events. Waves are formed and the displaced water mass attempts to regain its equilibrium. It is important to note that not all earthquakes generate tsunamis; to do so, earthquakes must occur underneath or near the ocean, be large in magnitude, and create movements in the sea floor. While all oceanic regions of the world can experience tsunamis, the countries lying in the Pacific Rim region face a much greater frequency of large, destructive tsunamis because of the presence of numerous large earthquakes in the seismically active 'ring of fire'.

The waves that are generated travel outward in all directions from the area of the disturbance. The time between wave crests can range from as little as 5 minutes to as much as 90 minutes, and the wave speed in the open ocean averages a staggering 450 miles per hour. Wave heights of more than 100 feet have been recorded. In the open ocean, tsunamis are virtually undetectable to most ships in their path. As the waves approach the shallow coastal waters, they appear normal but their speed decreases significantly. The compression of the resulting from the decrease in ocean depth causes the wave to grow higher and crash onto land -often resulting in great destruction, injuries and death.

Strange phenomenon that precede a tsunami, such as the ocean receding for hundreds of feet, exposing the ocean floor, have resulted in death of those who ventured out to explore, only to be drowned by the water's sudden return. Most deaths, during a tsunami result from drowning. Other risks associated with the tsunami hazard include flooding, polluted water supplies, destruction of crops, business interruption, loss of infrastructure (roads, electrical lines etc) tend to be the most dangerous, because they can reach a nearby shore in less than 10 minutes. Even with the advent of tsunami warning systems, that is too short a time for local authorities to issue a warning.

### Earthquakes

An earthquake is a violent shaking of the earth's crust due to breaking and shifting of rocks beneath its surface. Earthquakes are considered to be one of the most dangerous and destructive natural hazards. It is difficult to make a prediction about the exact location and time of occurrence as well as its magnitude. A very large number of earthquakes occur every year but only a limited number of them are centered near populated areas or are having sufficient strength to cause damage to built environment.

About 60% of total land area of India is prone to seismic activity of varying intensities. Most of the vulnerable areas are generally located in Himalayan and sub-Himalayan regions, and in Andaman and Nicobar Islands. India has a long history of earthquakes occurrence. Several great earthquakes having magnitude more than 8.0 on Richter scale have taken place here.

An earthquake hazard zoning map has been standardized by the special committee of experts constituted by the Bureau of Indian Standards. According to this map entire country has been divided into four seismic zones based on seismic intensity, V, IV, III, and II. Zone V have an area of 12% and this area can face an earthquake of intensity IX or more. Similarly, Zone IV, III and II have an area of 18%, 29% and 41%; these areas can face an earthquake of Intensity of VIII, VII and VI respectively.

Earthquakes cause a variety of impact on the crust of earth. Various hazards associated with an earthquake are:

- i) **Ground shaking** - caused due to the arrival of different types of waves at a location.
- ii) **Fault rupture** - differential movement of a fracture results in heavy damage of the structures located over it.
- iii) **Soil liquefaction** - a process by which water saturated sediments temporarily losses strength and start acting like a liquid. Under certain geological/soil

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conditions liquefaction may take place during an earthquake causing damage to structures in that area. iv) **Landslides**

v) **Post earthquake fires** vi)

### **Tsunamis**

Due to various hazards associated with an earthquake, number of impacts observed include building collapse, rupture of pipelines and other utilities, and, floods from dam failure. However, the nature of damage during an earthquake depends on various factors:

- Earthquakes parameters like magnitude, intensity, duration and ground acceleration. Higher value of these parameters results in higher resultant damage.
- Local site conditions play a critical role in determining the damage pattern due to an earthquake. For example, the hilly terrains are more at risk due to topography which may lead to after-effect like landslides, road blockage, damming of rivers flows and damage to dams etc.
- Construction Practices followed in an area are very important parameter in determining the level of risk due to an earthquake.
- Other factors like density of population, time of occurrences, community preparedness play very important role in reducing the resultant damages due to an earthquake.

### **Earthquake Risk Mitigation Strategy**

It is well established that it is poorly built structures, not earthquakes that kill people. It is also a well known fact that most earthquake related deaths and most of the financial losses, are due to the structural collapse of houses and other buildings. The impact of earthquake on a structure is greatly influenced by the building material used, shape of the building and techniques employed for construction. In general houses built with mud, adobe, burnt brick and stone are poor against seismic forces.

The proactive measures for earthquake risk reduction may be earthquake safe construction, proper land use planning and community preparedness through awareness generation. The only way is through earthquake resistant design and construction of buildings as per the guidelines/codes available for this purpose. Bureau of Indian Standards has formulated nine standards for designing quake resistant buildings. Standards have also been laid for repairing, strengthening and improving old buildings of low strength masonry. These codes must be used for constructed all new buildings/structures, while existing ones should be retrofitted to acquire appropriate strength to resist the seismic forces.

High-risk areas like soft soils or land fills sites must be avoided to reduce the impact of an earthquake. Such sites attract more seismic forces in comparison to a site on hilly terrain to overcome this problem microzonation of cities must be made available to all concerned.

Community is the first responder to any emergency situation in wake of any disaster like earthquake. Community involvement in preparedness programmes is the key to mitigating the impact of an earthquake. A properly trained society performs better

during situations arising due to severe earthquake. For achieving the desired results community action plans must be prepared to mitigate the problems associated with earthquake hazards.

### **Landslides**

India has a vast hilly terrain spread in north, north east and southern parts of the country. Majority of Indian mountain systems are relatively young, in geological sense, making their rock structure highly fragile. Combined with other natural phenomenon like rainfall, earthquakes etc., these terrains are highly prone to landslides, posing a great challenge to environment, human lives, settlements and infrastructure in the hilly terrains of the country. Landslide is defined as a process involving the downward and outward movement of a part of the slope forming material, composed of mainly natural rock, soil, artificial fill or combination of these, due to the action of gravity. The term landslide defines many other types of similar processes and phenomenon like rock falls, mud or debris flows etc. under the influence of gravity.

Landslides affect at least 15 per cent of the land area of India. In all, 23 States and the Union Territories of India are affected by landslides hazard, mostly during the monsoon season. The regional variation in the incidences of landslides at national level can be seen in the following table. A landslide hazard map has been standardized, which indicates the hazard prone areas of the country. (Figure 3.1).

<b>Region</b>	<b>Incidences of Landslides</b>
Himalayas	High to very High
North eastern Region	High
Western Ghats and Nilgiris	Moderate to High
Kerala, Eastern Ghats and Vindhyachal	Low

Various causes of landslide occurrence can be classified into the following categories: ● Natural physical processes like earthquakes, volcanoes, heavy rainfall etc.

- Poor ground conditions like deposition of weak material, presence of geological features like joints, fissures etc.
- Morphological causes like weakening of rock due to weathering, removal of vegetative cover due to deforestation, forest fire etc., loading on the crest of the slope. Some of these causes are aggravated due to human action over the slopes like mining, excavation, irrigation, etc. for developmental gains.

### **Landslide Risk Mitigation Strategy:**

- The landslides are causing considerable damage to human settlements throughout the world. The impact not only results in damage to housing but also wipe out infrastructure like roads, highways and railways, electricity transmission lines, water supply, hydro power plants, water supplies source, forests, dams etc. Temporary damming due to landslides results in the flooding

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of large upstream areas and in case of dam failure; it causes flash flooding leading to huge devastation in downstream areas. The major impact of the landslides in terms of degradation due to loss of trees, fertile covers etc.

- To carryout the risk mitigation work, a team of cross-sectoral and interdisciplinary professionals which include geologists, engineers, architects, physical planners, public/community, disaster managers, policy and decision makers have to play a proactive role. ***The mitigation and management strategy must have a combination of features like:***

Early Warning for Landslides needs to develop on most disaster prone areas. Early warning systems elsewhere in the world have been developed by the real-time monitoring of landslides. This includes the continuous real time monitoring of various parameters including mass movements. The data so collected is transmitted through a telemetric system at regular time intervals. At the initiation of an event, radio signals are transmitted and alarm signals are sent to the relevant authority regarding the impending danger and probable time of occurrence of a landslide.

Based on the forecasts, early warning messages to evacuate the community may be initiated.

Structural measures are those measures which include physical construction to reduce or avoid possible impact of hazards. These measures include engineering solutions, such as

- Drainage control measures through provisions of surface and sub-surface drains.
- Retaining and reinforcement structures.
- Deflection spurs at the toe to avoid erosion from the rivers.

- Landslide treatment methods like shotcreting, grouting, netting, wire-meshes and sealing of cracks / fissures on the hills.
- Adopt remedial techniques like buttresses, shear keys, sub-drains, soil reinforcement, retaining walls, etc.
- Construction of retaining walls.

Non-Structural Measures are all such measures where efforts are made to mitigate the impact of landslides without construction of disaster resistant features. Methods may include:

- Hazard mapping and proper land use planning - landslide hazard maps will identify the critical areas ultimately leading to avoidance of critical zones where settlements could not be developed. Such areas preferably used for permanent vegetation only.
- Surface drainage control works will lead to minimizing the seepage of water during heavy rains, which will ultimately lead to restrict the movement of landslide.
- Reforestation of the areas will help in restricting landslides through binding the top soil and restricting erosion and run-off.
- Monitoring of landslide prone areas for impending disasters and forewarning the people of possible landslide problems.
- Construction of engineering structures like retaining walls, piling, bolting of rocks, putting nets arrest the landslides etc.



- Community participation and creation of public awareness about the sustainable development and landslide mitigation techniques etc. through the involvement of the local administration and non-government organizations.
- Forestation of landslide prone areas using appropriate species of plants can help in solving the problem up to certain extent.
- Education and awareness generation among the masses residing in areas prone to landslides

### Drought

Drought is temporary reduction in water or moisture availability significantly below the normal or expected amount for a specific period. This condition occurs either due to inadequacy of rainfall or lack of irrigation facilities. Droughts are faced by most of countries. In India, about 68 percent of total sown area of the country is drought prone. Western and southern parts are highly prone to droughts with small impact in the northern and central parts. Drought like situations keep on occurring in the states of Bihar, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Jharkhand and Chhattisgarh. Figure 2.1 shows the drought prone areas of the country.

### Types of Droughts

Drought can be classified into following three major categories:

- **Meteorological Drought** - It is a situation where there is reduction in rainfall for a specific period (days, months, season or year) below a specific amount (long term average for a specific time). It is the least severe form and occurs as a result of any relatively unexpected shortfall of precipitation.
- **Hydrological Drought** - It is a situation which reflects a reduction in water resources (stream flow, lake level, ground water, underground aquifers) below a specified level for a given period of time. It occurs as a result of marked reduction in natural stream flow or groundwater levels, plus the depletion of water stored in surface reservoirs and lakes for water supply purposes.
- **Agricultural Drought** - An agricultural drought occurs when soil moisture is insufficient to maintain average crop growth and yields. Agricultural droughts result due to the imbalance between soil moisture and evapotranspiration needs of a crop for a fairly long period, causing damage to the standing crops and reduction in crop yield.

### Causes for Drought:

Three drought types discussed above are completely different from one another. There are several causes due to which drought can occur. Some of the main causes are, :

- *Monsoon variations* - failure or erratic behaviour of monsoon can cause considerable amount of pressure; such situations may create drought like situations.

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- *Overexploitation of surface and ground water* - inadequate water conservation measures may result in situations where water availability reduced considerably during summers, which may lead to drought like situations
- *Changing agricultural practices* may also lead to drought like situations. When cropping patterns change from low to moderate water demand crops to high demand crops, water consumption increases to grow the crops exerting pressure on existing meager irrigation facilities and other available resources of water supply.
- *Over exploitation and mismanagement or poor management of water resources* for residential and irrigational purpose may lead to such situations.

### Impacts of Drought:

Drought cause considerable amount of problem in the affected regions. The impacts of droughts can be classified into following categories:

- **Environmental Impact:** Under this category problems associated due to scarcity of water supply for drinking, irrigations and other uses pose tremendous discomfort not only to the society but also on the forest and aqua-culture habitat.
- **Economic Impact** - Drought pose tremendous economic impact on the affected society in terms of loss of livelihoods / employment opportunities, Increased prices of Food / Fodder, falling of current agricultural and non-agricultural wages and loss from diary / fishery / other livestock production
- **Social Impact** - drought put tremendous pressure on the social fabric of the society in terms of Migration of people in search of alternative livelihood results in break up of communities and families, Loss of Human Life (heat stress / suicides / starvation deaths / unhygienic conditions in the working areas), Distress sale of assets (movable and non-movable), increased inequity among social groups, Increased conflicts - water user's conflicts, political conflicts and other social conflicts. It creates Negative impacts on nutritional status, Increased mental and physical stress (e.g. anxiety, depression, loss of security, domestic violence etc.) and morbidity. It increases crime rate.
- Inability of certain group within the population to afford increased food prices results in switch to cheaper and sometimes less preferred foods / reduction in overall food intake etc.
- Loss of education due to reduction in school attendance by children lacking energy and / or money for fees, and increase in child labour.

### Drought Management Practices

Conditions like drought are not new in the country. The concerted efforts to mitigate and manage the recurring drought situations, can be dated back to 1878 A.D, when the first Famine Commission was appointed and on the basis of its suggestions Famine Codes were formulated in 1883. These famine codes provide the guidelines for managing the droughts.

Effective disaster management entails an in-depth analysis of the vulnerability in all its ramifications. Vulnerability to a particular hazard should be seen as a measure of risk combined with the level of social and economic ability to cope with the disaster to resist major disruption or loss. Thus greater attention needs to be given to the

marginal segment of society like the poor, women and senior citizens. Thus vulnerability to any hazard should be considered in tandem with the existing social and economic conditions of the people for a clearer direction to future policy and planning.

The strategy for this management is three fold as follows:

- Close monitoring of emerging drought scenario so as to develop an advance warning system.
- Relief measures required for providing immediate succour to affected population and the upkeep of cattle wealth. If possible, to integrate it with long term objectives.
- Coming with an alternative crop strategy for maximum possible retrieval of Kharif crop and a better ensuing Rabi crop.

**Warning and Dissemination** - Weather-Watch-Group in Ministry of Agriculture meets every week to take stock of the rainfall progress, its effect on the crops from sowing to harvesting during Kharif season. Weekly inputs from Indian Metrological Department (IMD) give an early warning about the impending drought. States are accordingly informed as and when symptoms of drought are known.

#### **Improved water management Practices**

Various different measures for combating drought include:

- Judicious use of water for irrigation and other purposes.
- Adopting rain water harvesting methods utilizing traditional and conventional techniques.
- Recharging water table through the use of infiltration tanks, check dams, injection wells etc.

**Adopting Alternative Crop Strategy** - The water availability in 47 major reservoirs in the country is checked at the commencement of most critical period in January/February. If the IMD also predicts less rainfall, alternative crop strategy is implemented in different states by providing extra power, getting seeds for alternative crops and fertilizers. The farmers are informed before hand and advised for alternative crop. Seeds and fertilizers are given on subsidized rates. This helps in possible retrieval of Kharif crop and a better ensuing Rabi crop, if rains came in later half.

**Employment Generation Programmes** - Generation of additional employment through labour intensive works, like desilting dried ponds, and constructing tanks for rain water harvesting. The projects, which can be taken up on short notice, should be kept ready by District Administration before the monsoons each year. Various Central and State government schemes targeting development work are used for getting useful employment to the affected community. A paradigm of relief-cum-development would be more appropriate.

**Health and Public Health Measures** - People should be accustomed to live on rational water. This should be taught in schools. However nutritional requirement of all children, expectant nursing mothers should be taken care of. Disinfect drinking

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water sources to prevent spread of water borne diseases and plans to cope up with likely epidemic. Immunization and surveillance of public health measures be taken.

**Cattle Care** - Cattle are most affected during droughts. It may not be possible to supply fodder or take medical care of cattle, however cattle camps on village basis can be opened to take complete care of cattle population. Some other measures are:

- Assessment of fodder requirement on district basis in affected area and import fodder from outside.
- Monitor prices of fodder in selected market places.
- State Forest Department to arrange for cutting and bailing of grasses in the forest.
- Fodder cultivation to be encouraged. ● Ensure supply for molasses to cattle feed plants.

With modern methods of cultivation and continued good monsoons, the droughts are now becoming rare. However, we must be prepared to face them and hence the need to understand them.

### **Desertification**

It is a creeping hazard that can be caused by natural processes, human or animal pressures or as a secondary hazard associated with drought. The world's great deserts came into being long before man and have grown and shrunk according to natural long-term climatic changes affecting rainfall and groundwater patterns. However, since the appearance of man, desert growth has changed significantly, and has become a major concern for many of the world's governments and nongovernmental organizations focused upon environmental health and development.

Poor land management is the primary cause of anthropomorphic desertification. Increased population and livestock pressure on marginal lands accelerate the process. In some affected areas, nomads trying to escape the desertified land from less arid regions exacerbate the problem by placing excessive pressures on land that cannot handle it. The process of desertification is not one that is easily predictable, nor can it be mapped along expected patterns or boundaries. Areas of desert land can grow and advance in erratic spurts and can occur great distances from natural, known deserts. Often, a geographic area suffering from desertification is widely recognized only after significant damage has occurred. It is still unknown if global-change patterns associated with desertification are permanent, nor are the processes required to stop or reverse desertification well understood.

Droughts are a cause of desertification, but not all droughts automatically result in the creation of desert conditions. In fact, well-managed lands can recover from drought with little effort when rains return.

### **Debris flows**

These hazards also referred to as mudflows or mudslides, are less common than landslides but often much more destructive. Debris flows are dependent upon the introduction of great amounts of water from prolonged rainfall, flash flooding, or very rapid snowmelt. The lubrication provided by the liquid content of the debris

allows for much faster descent down the affected slope and, likewise, greater overall distances traveled from the source of the flow.

### **Avalanches**

Avalanches, or snow slides, are movements of debris composed of snow, ice earth, rock and any other material that is picked up as they progress down the affected slopes. An avalanche occurs when the gravitational stress pulling downward on the snow exceeds the ability of the snow cover to resist it. Four factors are required for an avalanche to occur:

- A steep slope
- Snow cover
- A weak layer in the snow cover
- A trigger

Common triggers are heavy alternating periods of snowfall, rain, and melting or an external increase in pressure (such as skiers, animals or explosions). About 90% of all avalanches start on slopes of 30-45 degrees. Failures on slopes of less than 20 degrees rarely occur; on slopes above 60 degrees, the snow rarely accumulates to critical mass. It is estimated that over 1 million avalanches occur each year worldwide. They typically follow the same paths year after year, leaving scarring along their course. Trained experts thus can easily identify, with a high degree of accuracy, areas that are prone to this hazard. However unusual weather conditions can produce new paths or cause avalanches to extend beyond their normal paths, and identifying these risk areas takes greater expertise and speculation.

### **Meteorological Hazards**

Meteorological Hazards are related to atmospheric weather patterns or conditions. These hazards are generally caused by factors related to precipitation, temperature, wind speed, humidity, or other more complex factors. As all the world's people are subject to the erratic nature of weather, there exists no place on Earth that is truly safe from the effects of at least one or more forms of meteorological hazard. The greatest range of natural hazard types falls under this general category.

### **Monsoons**

These are seasonal winds that exist throughout the world, and reverse in direction at predictable intervals each year. They are often associated with heavy rainfall when they cross over warm ocean waters before heading to cooler landmasses. As the wind blows over the warm water, the upward convection of air draws moisture from the ocean surface. When it passes over the cooler landmass, the moisture condenses and is deposited in heavy rainfalls that can last for weeks or months.

Monsoons are most marked and most intimately associated with the Indian subcontinent, which truly depends upon the annual cycle of winds for relief from the long, dry winter months. Without the monsoons, the agriculture and much other basic life process would be impossible. The monsoons in this region have two distinct seasons: a dry season that runs from September to March, blowing from the north-east, and a wet season that runs from June to September, blowing from the south-

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west. During the wet summer monsoon in India receives 50-90% of its annual rainfall, depending upon the location.

Disasters related to monsoons are associated with secondary effects from either monsoon failure or excessive monsoon rainfall. During years of monsoon failure, severe drought can ensue, leading to famine in the lesser-developed countries. Crops struggle or fail and without implementation of a pre-established emergency plan, food shortages may follow. In years of excessive monsoon rainfall, severe flooding may result, leading to drowning, homelessness, and the destruction of infrastructure, property and agriculture.

### **Tornadoes**

Also called funnel clouds, are rapidly spinning columns of air (vortexes) extending downward from a cumulonimbus cloud (clouds that cause rainfall). Thousands of tornadoes are formed throughout the world each year but, thankfully, most don't touch ground and therefore remain harmless. The United States is the country most susceptible to these atmospheric hazards, with approximately 1000 occurring each year.

Tornadoes form when warm, moist air meets cold, dry air, though the presence of these factors in one way guarantees that a tornado will form. Disasters caused by tornadoes are caused by the damaging winds they generate. Most of the deaths associated with tornadoes are caused by secondary hazards, such as debris missiles and large hail.

### **Ice Storm**

They are the precipitation events involving freezing rain that accumulates on exposed surfaces to a thickness greater than one-quarter of an inch. These storms can extend for hundreds of square miles, and are highly destructive due to the damage caused by the weight of the accumulated ice. The damage associated with ice storms results from the weight of the ice accumulation, which causes tree limbs to break, power lines to fall, and roofs to collapse. Icy roads lead to transportation accidents. Power outages can lead to people being exposed to extremely cold temperatures, and can have economic impacts, as business is interrupted and agriculture damaged.

### **Hailstorms**

Meteorological events characterized by the precipitation of balls or lumps of clear ice and compact snow. Cold ground temperatures are not necessary for hailstorms to occur, and these events commonly occur throughout the world, including in the tropics. The process by which hailstones form and grow is not entirely understood, but it is believed that ice crystals form within a cloud and then are covered in layer upon layer of frozen water and suspended in strong updrafts until the holding capacity of the cloud is exceeded. Hailstorms are generally spherical or irregularly spherical and generally vary in diameter from pellet size to half inch. On rare occasions, giant hailstones have formed, some up to 5 inches in diameter.

The primary negative consequence of hail is damage and injury to crops. Livestock also are at risk due to injuries and fatalities they sustain during the storms. Humans usually escape death but can be injured by hail falling. Property (buildings and cars) often sustains severe damage, and roof collapses are common when the heavy

hailstones accumulate quickly. Airplanes have also been reported damaged by storms containing hail.

When the focus of the earthquake is along a fault under a large body of water and the movement causes a major deformation of Earth's surface, the water's resulting movement can result in a tsunami thousands of miles away. A single high magnitude earthquake off the coast of Indonesia caused the 2004 tsunami events throughout Asia.

### Check Your Progress I

**Note:** Use the space provided for your answer.

1) Define Disasters.

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2) Highlight different perspectives on Disasters.

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### Cyclones

Cyclonic storms are among the most destructive natural disaster, more pronounced in the coastal states. India as a whole is highly prone to cyclones. The Indian Ocean region is one of the six highest cyclone prone regions of the world. Here, cyclones usually occur between May-June and between October-November.

A number of hazards are associated with the cyclones, which are responsible for large damages to life, property and agriculture are:

- i) *Gales and Strong winds:* Uproot large number of trees and cause serious damages to the engineered and not- engineered structures such as houses, lifeline infrastructure such as power and communication towers, hospitals, food storage facilities, roads, bridges, culverts, crops, etc.
- ii) *Torrential Rains:* Sewerage and drainage systems may block, severe flooding may devastate the crops and roads and railway lines may be washed away.
- iii) *Storm surges or tidal waves:* Storm surge is the most devastating feature associated with the cyclones. Storm surge inundates low-lying areas in the

## Introduction to Disaster Management

coastal areas resulting in loss of life and destruction of property, besides eroding beaches and embankments, destroying vegetation and reducing soil fertility.

Besides the loss of lives and livestock, cyclones have high destructive potential due to the strong winds that damage structures, and heavy rainfall which causes floods and storm surge that inundates low-lying coastal areas.

The public health aspects come under stress during and after the storm. The casualties due to storm surges are quite high in comparison to strong winds where more injuries due to flying debris take place. Water borne diseases and epidemics like Malaria etc. are very common due to water contamination and water logging in a cyclone hit area. Transportation and communication networks also get severe to very severely damages in the aftermath of a cyclone.

### Cyclone Risk Mitigation Strategy

It is not possible to completely avoid natural disasters like cyclones; however, their effects can be minimized by taking some known long- and short- term structural and non-structural mitigation measures. Few of very common measures prevalent and adopted for cyclone risk mitigation include: • Establishing proper early warning systems, • creating awareness among all stakeholders at all levels, • coastal afforestation, • construction of shelters, embankments, dykes, coastal roads, bridges, canals, etc.,

- through better preparedness, mitigation measures and improved response mechanisms.

### Cyclone Warning Network in India

Cyclone warning is the responsibility of India Meteorology Department (IMD). The warning system in India is based on a network of Area Cyclone Warning Centres (ACWC) of IMD. During the cyclone situations, the ACWC generate special warning bulletins and transmit them every hour in the local languages. There is a network of 252 stations involved on East and West Coast of India. The state-wise distribution of such stations is as West Bengal (31), Orissa (35), Andhra Pradesh (81), Tamil Nadu (60), Kerala (5), Karnataka (including one at Hassan) (6), Goa (1), Maharashtra (8), Gujarat (19), Daman and Diu (3), Puducherry (3).

A *four-stage cyclone warning system* is in place for issuing cyclone warning, which is based on:

- At the first stage, *Pre-Cyclone Watch* is issued containing early potential indications about the development of a cyclonic disturbance, its possible development into a cyclone and adverse weather that specific areas of the coastal belt are likely to experience.
- At the second stage, a *Cyclone Alert message* is issued 48 hours prior to the expected time of commencement of adverse weather over the specific coastal areas.
- A Cyclone Warning is issued 24 hours in advance of the cyclone's landfall in order to cover the devastating impact of cyclones over inland areas.



- iv) Finally, a *Post Landfall Outlook* is issued 12 hours before the landfall and continues till such time as cyclone force gusty winds are expected to prevail over the interior areas.

### Non-Structural Measures

Land use planning in the coastal areas is an important and effective tool for the loss reduction due to cyclones. The land use planning emphasizes the placement of least critical activities like parks and parking etc. in the most vulnerable areas. The improvement in the vegetation cover for the cyclone mitigation is an attractive option. The shelter protection plantation belt of *casuria trees* which are fast growing and recyclable have substantially helped to protect the human settlement built on the leeward side. The improved vegetation may also help in improving the water infiltration capacity of the soil, keeping the soil intact preventing erosion. The use of trees planted in rows also act as wind break near houses and compounds or may be planted around towns. Other than this regulatory control for keeping new settlements at a certain distance away from the coast line is also considered as a precautionary measure.

The community preparedness may result in a very positive public response to warnings and other preparedness measures like evacuation etc. The community should be aware about various hazards associated with the cyclone, the impact of these hazards and the vulnerability of the people to the hazards. The people must be aware about the specific actions required after receiving the warning. The community preparedness needs to be done at various levels and through different means. The various methods for promoting community preparedness are as:

- *Public dissemination of information* through mass media, posters in local languages and leaf lets etc. The people must be aware regarding the do's and don'ts for cyclone and specific preparedness measures.
- *Educational programmes* designed for different age groups with formal education system.
- *Training* for the government officials in charge of cyclone management. The training should be on the cyclone mitigation, preparedness and post-cyclone management aspects.

### Structural Measures

A majority of losses during a cyclonic storm are caused by damages to the built environment. The cyclone resistant design can play a crucial role in reducing the associated damages. Building codes, standards and guidelines are available for designing and construction of cyclones safe structures. The National Building Code and Indian Road Congress (IRC) specifications have detailed out the requirements for the design and construction of structures, taking into account the different hazards associated with the cyclonic storm like wind load etc.

One of the successful measures being adopted in the country is to evacuate and shelter the people likely to be affected by cyclones. These evacuees are kept into the specially designed and constructed multi-purpose cyclone resistant community relief shelters, for providing safe and secure accommodation during the cyclone. This is done through construction in a phased manner, of a network of such cyclone relief shelters along the coast line, so as to be within reachable distances from the affected

## **Introduction to Disaster Management**

settlements. New initiatives have been taken to develop a low cost, anticyclone core unit for each family to provide secure deposit of personal belongings during cyclones in the existing villages. When the families, evacuate, the personal belongings can be stored in the anti-cyclone core unit located in the base villages. This would help them to resume economic activity and livelihood soon, on return from the relief shelters.



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## **TYPES OF DISASTER-II**

### **(OTHER INCLUDING HUMAN MADE)**

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#### **Structure**

- 3.0 Objectives
- 3.1 Introduction
- 3.2 Nuclear Disasters
- 3.3 Forest Fires
- 3.4 Stampede
- 3.5 Epidemics
- 3.6 Accidents
- 3.7 Terrorism
- 3.8 Biological Disasters
- 3.9 Chemical Disasters
- 3.10 Short Case Studies



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UNIVERSITY**

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### **3.0 OBJECTIVES**

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After reading this unit, you should be able to:

- explain the salient features of man-made disasters;
- describe the implications of Chemical, Biological, Nuclear and other human induced disasters;
- explain the general threat perceptions of man-made disasters;
- list various preparedness and mitigation measures for combating such manmade disasters;
- chalk out response strategy for such disasters; and ● list down Do's and Don'ts for man-made disaster emergencies.

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### **3.1 INTRODUCTION**

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## Introduction to Disaster Management

In the decade 1990-2000, an average of about 4344 people lost their lives and about 30 million people were affected by disasters every year. A Hazard is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation (DM Act, 2005) and these hazards can include conditions that may lead to future threats and can have different origins:

- Natural (geological, hydro-meteorological)
- Induced by human process or man-made (environmental degradation and technological hazards)

A Disaster is an event of nature (hazard) or man-made cause that leads to sudden disruption of normal life of society, causing damage to life and property, to such an extent that normal social and economic mechanisms available are inadequate to restore normalcy (DM Act, 2005). Floods, droughts, cyclones, earthquakes, landslides and avalanches are some of the major natural disasters that repeatedly and increasingly affect globally. On the other hand, the fast pace of growth and expansion without preparedness has brought forth a range of different kinds of issues which seek urgent attention at all levels. In the absence of such preparedness measures, the growing numbers in our population are at a risk of prospective hazards such as air, rail or road accidents, boat capsizing, building collapse, electric fires, festival related disasters, forest fires, mine flooding, oil spills and serial bomb blasts besides nuclear, chemical and biological threats which are apparent in the present scenario. Considering the above, In India, a High Power Committee (HPC) was constituted at the behest of the Prime Minister by the Ministry of Agriculture in August 1999 under the Chairmanship of Shri J.C. Pant and had members from various Ministries, States, NGOs and experts from relevant fields. It was the first attempt in India towards evolving a systematic, comprehensive and holistic approach towards all disasters. Classifications of disasters identified by this HPC (HPC Report 2001) are as follows:

*a) Water and Climate related disasters:*

Floods and Drainage Management, Cyclones, Tornadoes and Hurricanes, Hailstorm, Cloud Burst, Heat Wave and Cold Wave, Snow Avalanches, Droughts, Sea Erosion and Thunder and Lightning.

*b) Geologically related disasters:*

Landslides and Mudflows, Earthquakes, Dam Failures/ Dam Bursts, Mine Fires. c)

*Chemical, Industrial and Nuclear related disasters:*

Chemical, Industrial and Nuclear Disasters. d)

*Accident related disasters:*

Forest and Urban Fires, Mine Flooding, Oil Spill, Major Building Collapse, Serial Bomb Blasts, Festival related disasters, Electrical Fires, Air, Road and Rail Accidents, Boat Capsizing and Village Fire. e) *Biologically related disasters:*

Biological Disasters and Epidemics, Pest Attacks, Cattle Epidemics, Food Poisoning.

### Types of Man-made disasters and concerned Nodal Ministry

Man-made Disaster	Nodal Ministry
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Air Accidents	Ministry of Civil Aviation
Civil Strife	Ministry of Home Affairs
Railway Accidents	Ministry of Railways
Chemical Disasters	Ministry of Environment and Forests
Biological Disasters	Ministry of Health
Nuclear Accident	Dept. of Atomic Energy
<b>Natural Disasters</b>	<b>Ministry of Agriculture</b>

(Source: HPC Report; GoI, 2001)

## 3.2 NUCLEAR DISASTERS

The occurrence of nuclear or radiological disaster is of the great concern. It is accompanied with sudden release of huge amount of harmful radiations or radioactive materials (Isotopes of Cesium, Cobalt, Iridium, Iodine, Strontium, Uranium, Plutonium etc.) or both together in environment in a small area. It is described as a disaster caused due to an extraordinary emission of radioactive material or radiation either through explosion of a nuclear bomb or in the operation of nuclear reactors and other nuclear related activities (Simone, 2006).

### Causes

**Intentional Use of Nuclear Weapons in the event of war:** With the advancement of scientific research, several countries have acquired the technology to produce Nuclear Arms, which are more destructive and harmful than the atom bomb used more than half a century ago. Nuclear bombs have openly been used twice, both times by the United State against Japan during World War II (1939-1945). On August 6, 1945, the city of Hiroshima was almost completely destroyed, and three days later the city of Nagasaki was bombed.

**Accidental Explosion of Nuclear Weapons:** Nuclear weapons are designed with great care to explode only when deliberately armed and fired. Nevertheless, there is always a possibility that, as a result of accidental circumstances, an explosion will take place inadvertently and such accidents might occur in areas where weapons are assembled and stored, during the course of loading and transportation on the ground, or when actually in the delivery vehicle, e.g., an airplane or a missile.

**Accidents in Nuclear Power Project:** There is also a risk of accidental exposure to harmful radiation from the several nuclear reactors used for generation of power. The potential threat from an accident at a nuclear power plant is exposure to radiation which would occur from the release of radioactive material into the environment and the area affected would depend on the amount of the release, wind direction and speed and weather conditions.

***Terrorist Attacks or Dirty Bombs:*** Through use of 'Radiological Dispersion Device' (ROD), an expedient weapon, wherein radioactive material is disseminated by using conventional explosives and debris is subsequently scattered across the targeted area. Also through other modes like attack of the nuclear power plant or facility using or processing radioactive material via air craft strike or bombardment with heavy munitions or sabotage (Source: India Disaster Knowledge Network Portal, 2008 <http://192.168.0.118/idknnew/>).

### **Response**

The emergency response actions will focus on reducing the effects of immediate effect that shall comprise- fire, destruction, damaged vegetation, dead, wounded human beings and animals, psychological phobia. This demands judicious planning, and multi-faceted preparations that shall include store management, training, communication and command, etc surmount the nuclear emergency.

#### **Do's and Don'ts**

##### ***Do's:***

- Plug ears, save skin from heat, put on head gear, know the explosion site and go away from ground zero, breath normally, stay calm.
- Lie down on ground with face down - head away from ground zero, cover face with handkerchief. It will avoid internal contamination
- If in shelter, close doors/windows, switch off AC and remain inside, evacuate, relocate, fallout may continue for more than 24 hours depending upon weather.
- Go underground to reduce external radiation and avoid external contamination. (Wet sand and 30 cm earth give 20 P.F.).
- If contaminated, remove clothes and put them in poly bags, take showers, stay in tunnels, trenches, foxholes, tents vehicles decontaminate food or areas. (Covered items like bread, butter, jam can be consumed after removing wrapper.
- Put on mask to avoid inhaling contaminated air. ● Put on protective suits, if available help injured. Become part of rescue team.
- Consume Bio-protectors like KI, KIO<sub>3</sub>, Beer, Tulsi, Arnica, Caffein, Diltiazem, Vitamin C/E, podophylum.
- Get treatment for burn, cut and other injuries. ● Keep monitoring radiation

##### ***Don'ts:***

- Do not look at blinding flash, don't go in to cloud/rain/fog. ● Do not run or get panicky. ● Do not spread rumours. ● Do not crowd the site: Keep away.
- Do not crowd hospitals/road/areas. ● Know the explosion site and do not go in downwind direction.

- Do not go to radioactive contaminated area. ● Do not remain in open air. Water is a good neutron shield. ● Do not spread radioactive contamination (External and Internal).

### 3.3 FOREST FIRES

The word “wildfire” originated as a synonym for Greek fire, a napalm-like substance used in medieval Europe as a naval weapon. Forests face many hazards but the most common hazard is fire. They pose a threat not only to the forest wealth but also to the entire regime of fauna and flora seriously disturbing the bio-diversity, the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twigs, which would burst into flames ignited by the slightest spark. The Himalayan forests particularly Garhwal Himalayas of Uttaranchal State have been burning regularly during the last few summers, with colossal loss of vegetation cover of that region. Forest fires can be either natural or controlled and caused by heat generated in the litter and other biomes in summer through carelessness of people (human neglect). Sometimes, forest fires are intentionally or purposely caused by local inhabitants for their selfish motives.

**Vulnerable Himalayan States of India towards Forest Fire (\*ha- Hectares)**

S.No.	State	Total land Area (ha*)	Forest area Recorded (ha*) %	Total cropped area (ha*)
1	Manipur	2211000	602000 (27.23)	186000
2	Arunchal Pradesh	8374300	5154000 (61.55)	167359
3	Himanchal Pradesh	3367600	1046900 (31.09)	974800
4	Assam (Hill Distt)	1522200	296200 (19.46)	169300
5	Sikkim	710000	257000 (58.95)	152000
6	Meghalaya	2243000	940000 (41.91)	241000
7	Mizoram	2102000	1303000 (61.99)	65000
8	Tripura	1049169	606168 (57.78)	456000
9	Nagaland	1513774	862532 (56.98)	200500
10	Uttaranchal	5358595	3424857 (63.91)	1099306
11	Jammu & Kashmir	4505000	2747000 60.98)	1066000

\* **Source:** Manual on Natural Disaster Management in India, NDM Division, IIPA, GoI, 2005

### Causes

Forest Fires are, not an unusual phenomenon, they occur regularly, especially in summers, throughout the world. Forest fires can broadly be classified into three categories: ● Natural or controlled forest fires.

- Forest fires caused by heat generated in the litter and other biomes in summer through carelessness of people (human neglect) and
- Forest fires purposely caused by local inhabitants.

Many forest fires start from natural causes such as “Lightning” which set trees on fire. Periodic lightning induced fires have been recorded throughout history from India, South eastern and Central United States, Australia, Finland and Eastern and Southern Africa. Most forest fires are the result of human neglect caused by casual throwing away of a smoldering bidi, cigarette butt or a spark from a picnicker's open hearth in a desiccated forest can often be sufficient to start a fire in summer. Such fires usually start on the ground as the dry litter (senescent leaves and twigs) catches fire easily. Then, flamed by strong winds, the flames soon engulf vast tract forest turning them to ashes and, therefore, cause extensive damage unless controlled in time (Luna, 2007).

### Types of Forest Fire

Forest fires differ depending upon its nature, size, spreading speed, behavior etc. basically this can be sub-grouped into four types depending upon their nature and size as follows (Source: Manual on Natural Disaster Management in India, NDM Division, IIPA, GoI, 2005):

- 1) **Underground Fire:** Underground fire is the fire of low intensity consuming the organic matter beneath and the surface litter of forest floor is sub-grouped as underground fire. In most of the dense forests occurring in the wetter parts of Himalayas, a thick mantle of organic matter is found on top of the mineral soil. This fire spreads in by consuming such materials. These fires usually spread entirely underground and burn for some meters below the surface and spreads very slowly and in most cases it becomes very hard to detect and control such type of fires. They may continue to burn for months and destroy vegetative cover of the soil. The other terminology for this type of fire is **Muck fires** while in some countries; it is referred to as **Ground fires**.
- 2) **Surface Fires:** Surface fire is the most common forest fires that burn undergrowth and dead material along the floor of the forest. In general it is very useful for the forest growth and regeneration. If grow in size this fire not only burns ground flora but also results to engulf the undergrowth and the middle story of the forest. Surface fires spread by flaming combustion through fuels at or near the surface- grass, dead and down limbs, forest needle and leaf litter, or debris from harvesting or land clearing. Thus a surface fire is “A fire that burns surface litter, other loose debris of the forest floor and small vegetation. This is the most common type of fire in timber stand of all species. It may be a mild, low-energy fire in sparse grass and pine needle litter, or it may be a very hot, fast moving fire where slash, flammable under story shrubs or other abundant fuel prevails. A surface fire if spreads, may burn up to the taller vegetation and tree crowns as it progresses”.



- 3) **Ground Fires:** There is no clear distinction between underground and ground fires. The smoldering for sometime under ground fires changes into Ground fire. This fire burns root and other material on or beneath the surface i.e. burns the herbaceous growth on forest floor together with the layer of organic matter in various stages of decay. They are more damaging than surface fires and they can destroy vegetation completely. These fires are fires in the subsurface organic fuels, such as duff layers under forest stands, Arctic tundra or taiga, and organic soils of swamps or bogs. Ground fires burn underneath the surface by smoldering combustion and are most often ignited by surface fires. Thus a Ground Fire consumes the organic material beneath the surface litter of the forest floor and fighting such fires is very difficult and tedious job.
- 4) **Crown Fires:** Crown fire is the most unpredictable fire, which burns the top of trees and spread rapidly by wind. In most of the cases surface fires invariably ignite these fires. Thus a Crown Fire is a fire that advances from top to top of trees or shrubs more or less Independently of the surface fire. In dense conifer stands on steep slopes or on level ground, with a brisk wind, the crown fire may race ahead of the supporting surface fire. This is most spectacular kind of forest fire. Since it is over the heads of ground force it is uncontrollable until it again drops to the ground, and since it is usually fast moving it poses grave danger to the fire fighters becoming trapped and burned.
- 5) **Firestorms:** Among the forest fire, the fires spreading most rapidly are the firestorm, which is an intense fire over a large area. As the fire burns, heat rises and air rushes in, causing the fire to grow. More air makes the fire spin violently like a storm. Flames fly out from the base and burning ember spew out the top of the fiery twister, starting smaller fires around it. Temperatures inside these storms can reach around 2,000 degrees Fahrenheit.

#### **Do's and Don'ts:**

##### **What to do BEFORE and DURING Fire:**

- Try to maintain FOREST BLOCKS to prevent dry litter from forests during summer season.
- Try to put the fire out by digging or circle around it by water, if not possible to call a Fire brigade.
- Move farm animals and movable goods to safer places.
- During fire listen regularly to Radio for advance information and obey the instructions cum advice.
- Forests Officials, Local people and Tribals living in Forests should play a constructive role before, during and after the fire of the Forest.
- Follow the effective monitoring and warning systems (including remote sensing for curing or drying out of vegetation).
- Teach the causes and harm of fire to your family and others.
- Do not be scared when a sudden fire occurred in the Forest, be calm, encourage others and community to overcome the problem patiently. ● Do apply seasonal mitigation measures i.e. Fuel reduction.

***What one should not do:***

- One should not throw smoldering cigarette butt or bidi in the forests. ● Do not leave the burning wood sticks. ● Don't enter the forest during the fire. ● Do not leave the dry litter during summer season. ● Tribals should not use Slash and Burn method indiscriminately on large scale.

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### **3.4 STAMPEDE**

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A stampede is an act of mass impulse among a crowd of people in which the crowd collectively begins running with no clear direction or purpose. Stampedes are believed to originate from biological responses in the brains and endocrine systems of the crowd and this large stampede will frequently destroy anything in its way. By an analogy, the term human stampede is applied to a sudden rush of a crowd of people, usually resulting in many injuries and death from suffocation and trampling. In stampede the term mob or crowd is used to refer to a congregated, active, polarized aggregate of people, which is basically heterogeneous and complex. Its most salient features include homogeneity of thought and action among its participants and impulsive and irrational actions by its participants. The two major behavioral reasons of any stampede are anxiety and panic. They are manifestation of our inborn "flight or fight" system, which is essential to our survival. Just as physical pain alerts us to diseases, so anxiety, panic and alarm alerts us to any sign of danger. Panic can appear to come from nowhere at all, but all that stampede needs is a small trigger caused by panic, such as feeling loneliness and helpless in a crowd, or trapped in an auditorium, staircase etc resulting in a truly horrible feeling which has an immediate effect on bodily functions. Nervousness can act as an addendum for such acts whereby people act baselessly seeing others rather than thinking for themselves.

#### **Types of Stampede**

Incidents of stampedes can occur in numerous socio-cultural situations. The causes and gravity of these situations vary from each other. The following list provides a fair idea about various types of situations where stampedes can occur:

- Air raid shelter ● Entertainment events
- Escalator and moving walkways ● Food distribution
- Funeral procession ● Natural disasters
- Power failure ● Religious events
- Fire incidents in religious/other events
- Riots
- Sports events ● Weather related

#### **Causes**

Causes of stampedes can be better understood through the FIST MODEL, which describes the primary elements involved in crowd disasters. In other words, the

elements provide a model for understanding the causes of crowd disasters, means of prevention, and possible mitigation of an ongoing crowd incident. The acronym “FIST” is defined as follows: FORCE (F) of the crowd, or crowd pressure; INFORMATION (I) upon which the crowd acts or reacts, real or perceived, true or false; SPACE (S) involved in the crowd incident, standing area, physical facilities - stairs, corridors, escalators; TIME (T) duration of incident, event scheduling, facility processing rates.

#### **Dos’ and Don’ts:**

- One must be very alert to the fact that some pilgrims of certain nationalities come in bunches and batches and push their way through. Pilgrims should not get into their way or try to stop them as one could get harmed in the process. It will be more sensible to avoid their path and wait till they get out.
- It is advisable to move in groups from the camps with the assistance of the controlling authority or group leader or police person.
- Do not try to go against the direction of the crowd. Move with the crowd.
- Do not lose temper and do not fight with others. If required, pilgrims can retrace steps after the rush has passed.
- Understand the evacuation routes, emergency exits and layout of the place of event.
- Keep calm. Don’t panic. ● In case of emergency do not run. ● Think before you do. Do not just blindly follow others. ● Open area is safer. On exit try to get away in diverse directions. ● Follow instructions given by the authorities, public address system etc. ● Do not spread rumors.
- Assist and collaborate with the organizers, authorities, the services. Police etc.
- Try to help others in your best capable way.

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### **3.5 EPIDEMICS**

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The prevalence of a disease is the number of diseased individuals at any one time (point prevalence) or over a given period (period prevalence). Individual cases of disease in widely separated geographic areas or otherwise independent cases are said to be sporadic. The term epidemic has been derived from two Greek words, “Epi” means “upon” and “Demos” means “people”. Thus, an epidemic of an infectious disease is the occurrence of a number of cases of a disease, known or suspected to be of infectious origin, that is unusually large or unexpected for the given place or time. An epidemic often evolves rapidly and requires a susceptible human population, the presence of a disease agent, and the presence of a mechanism or mode of large-scale transmission (e.g. contaminated water supply, poor sanitation and vector population). This definition covers the usual epidemic diseases such as, measles, chickenpox, and cholera, which are compressed in time, but also the modern “slow” epidemics of non-communicable diseases like diabetic, heart attacks, and depression. Common cold is endemic in northern latitudes. Cholera and malaria are

## Introduction to Disaster Management

endemic diseases in some parts of India. Infectious diseases are major causes of morbidity and mortality in many parts of our country.

### Types of Epidemics

There are two major types of infectious diseases which can develop into epidemics: “*common source*” and “*host-to-host*”. Common source epidemics arise from a contaminated source, such as water or food, while host-to-host infections are transmitted from one infected individual to another via various, perhaps indirect routes. Common source epidemics usually produce more new cases earlier and faster than host-to-host epidemics. Host-to-host epidemics are slower to grow and slower to diminish. Anything causing disease is called a *pathogen*. A vector is an organism that serves as an intermediary in the transmission of a host-to-host disease. For instance, many infections are transmitted by mosquitoes, fleas, ticks, etc. to people. A fomite is any inanimate object that adheres to or transmits infectious material, e.g., bedding, clothing, surgical instruments, etc.

#### Check Your Progress I

**Note:** Use the space provided for your answer.

- 1) List two or three different communicable diseases and categorize them based on source or point-to-point epidemics

### Impact

Epidemics and outbreaks of different communicable diseases have plagued mankind since time immemorial. According to estimates made by World Health Organization, worldwide 17 million deaths were attributed to infectious diseases during 1997; hundreds of million were disabled and incapacitated with economic loss that defies any precise calculations. Advances in public health and medicine, sanitation and vector control have led to considerable prevention and control of these diseases in some countries, but have had minimal impact in the majority of developing countries of the world due to lack of funds. Moreover, within a country, there continues to be enormous disparities in mortality, disability and exposure to infection among social classes with the poor, socially backwards and children suffering extremes of ill-health in all societies.

Increased rates of morbidity and mortality due to communicable diseases occur more frequently in association with complex emergencies than other disasters. In many of these settings, especially those occurring in developing countries, between 60% and

90% of deaths have been attributed to one of four major infectious causes: measles, diarrhoea, acute respiratory infections and malaria. Acute malnutrition is often associated with increased case fatality rates of these diseases, especially among young children. There have also been outbreaks of other communicable diseases, such as meningococcal meningitis, yellow fever, viral hepatitis and typhoid, in certain settings. **Mitigation Measures**

Significant improvements have taken place in health services in India during the past 58 years.

***Current system of surveillance and mechanism to control the outbreak of endemic diseases:*** For diseases with significant mortality and morbidity, the federal government has launched national Programmes which include malaria, tuberculosis, leprosy etc. Though the funding, technical designing as well as monitoring is done by the Central Government, the responsibility of implementation of these programmes rests with the respective state governments.

***National Programme for Surveillance of Communicable Diseases (NPSCD):*** Efforts have already been made by the Government of India to strengthen the health machinery for early detection of epidemic-prone diseases under its National Programme for Surveillance of Communicable Diseases. The Government of India has launched National Surveillance Programme for Communicable Diseases (NSPCD) during 1997-98 as Central Scheme. The main objective of this programme is capacity building at the state and district levels for early identification of outbreaks of communicable diseases and appropriate and timely response to these outbreaks. The programme is being implemented by the state governments through their existing infrastructure. Under the programme, the surveillance system is strengthened through training of medical and paramedical personnel, dissemination of technical information and guidelines, up-gradation of laboratories, modernization of communication and data processing systems.

A strong public health and surveillance system is required for quick detection and control of communicable diseases. At present the public health infrastructure in India is inadequately prepared to sense early warning signals of outbreak of an epidemic and to respond in time.

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## 3.6 ACCIDENTS

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### **Air Accidents**

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

### **Boat Accidents**

With the increase in volume of inland boats and sea fishing, boat capsizing is a distinct possibility. The factors, which contribute to this disaster have been identified as partly due to natural hazards such as cyclones or floods and greater part has been the due to man made causes such as over loading of the boat, poor quality of equipment in the boat, poor maintenance and consequent breakdown and of course human error of judgment. Boat accidents are found to occur mainly during the flood season, more so during bad weather and also under conditions of impaired visibility. Boats are more vulnerable during large gatherings such as melas, festivals etc. especially during their opening time when people want to reach early before its start or at closing time when there is a rush of people wanting to return home before night fall. Poor visibility at the time has also contributed to boat accidents especially those cases that take place due to collision. In many cases large number of boats gather during festivals, resulting in inadequate space for maneuvering the boat. Sometimes it may not be possible for authorities concerned to exercise full control on the river boat traffic due to non-availability of adequate security staff, logistic and other problems.

### **Oil Spills**

Today the sea is being a key source of food, fresh water, and minerals including oil and natural gas and renewable energy. The rapid industrial growth in recent years and the tremendous increase in human population are generating huge quantities of waste materials to be disposed off from land. Thus, the use of marine environment as a dumping ground of waste material has been constantly on the increase and this has caused pollution of the marine environment. In addition to industrialization and increase in population, urbanization, deforestation, increase in number and size of ships, demand for oil, oily wastes arising from ships, tankers and offshore installation, chemicals and dangerous goods, dumping of nuclear waste and leakage of under water pipelines is a long list being one of the causes of marine pollution in our coastal waters. Areas having off shore oil installations, under sea pipelines, sea routes traversed by oil tankers, refineries and under ground pipelines for oil transportation are vulnerable to oil spills.

### **Rail Accidents**

The Indian railways, is the largest railway system in Asia and the first largest railway system under a single management in the world. Railways is the principal mode of transport for both passengers and goods in the country. Railway is the life line of the nation particularly amongst the developing countries like India where infrastructure developments are accorded high priority to boost the nations wealth. The success of any transport organization is gauged by the parameters such as punctuality, reliability, safety, frequency and adaptability. In the course of the working, the railways are confronted with disasters arising out of cyclone, floods, fires, bomb blasts and accidents etc., involving trains. While a railway accident can occur at any stretch of railway track, experience has shown that portion of railway track having double line sections are particularly vulnerable to serious rail accidents.

## Road Accidents

Both National and State Highways are particularly vulnerable to serious road accidents since it is on these stretches that high speed accidents occur. Apart from these, roads in hilly sections and ghat areas are also vulnerable to road accidents due to road vehicles falling into pits. The problem of road traffic accident has assumed alarming proportion with ever increasing number of motor vehicles competing for the limited paved space. The resultant congestion in traffic is inevitable and the consequences of congestion are road accidents. It is observed that loss of life and injuries in road accidents are high in developing countries as compared to the developed countries. It is interesting to note that while there is a reduction of deaths due to road accidents in the developed countries the picture emerging from the developing countries shows an abnormal increase. Road safety, as a problem, has been analyzed in many different ways. Prominent amongst them are the four basic elements; **1) Machine Factor, 2) Human Factor, 3) Engineering Factor and 4) Environment Factor.**

### Causes

**Air Accidents:** Causes of air accidents are either human failure of pilots, air traffic controllers or technical failures of on board, landing instruments. In rare cases it may also be the result of terrorist activities.

**Boat Accidents:** Boat accidents occur mainly due to overloading, overcrowding, unruly behavior, panic amongst passengers and capsizing. Overloading of the boat results in very low freeboard allowing water to enter the boat easily. Flash-floods and strong currents in the river also result in boat accidents, especially in cases where there are no proper communication available with boat operators regarding the weather. A major cause for boat accidents is lack of safety consciousness on the part of crew, which leads to unsafe situations such as overloading, overcrowding, sailing in adverse weather and collision.

**Oil Spills:** Causes of oil spills are invariably leakage somewhere in the pipeline. Leakage in the pipeline in turn can be due to a variety of reasons such as substandard pipes, corrosion of metal, pipes having outlived their life, poor maintenance etc. Factors that contribute to oil spills are: **(a) Collision at sea:** Due to transit of number of tankers in the area to transport oil from oil extraction platforms, the eventuality of tanker collision off the coast resulting in spill and turning into major oil spill catastrophe cannot be ruled out, **(b) Oil extraction activities:** Defect/ malfunctioning of oil extension pipe line/oil spill in the vicinity of oil extraction platform is ever present. The chances of these oil rigs coming under the attack of our enemies during the hostility further enhances the chances of oil spill disaster scenario. **(c) Grounding:** There have been number of instances where due to Navigational errors number of ships have run aground, **(d) Tanker routes pumping out of bilges:** Due to various oil tankers transiting, accidental discharge on the oil route can not be ruled out. Number of ships also find it convenient to pump out from bilges in Open Ocean and the bilges mostly contains the oil and **(e) Danger of spillage while transferring oil from ship to shore facilities:** Danger of oil spillage always looms large when the oil is being transferred from the offshore terminal to the ship and from the ship to shore facilities in various ports.

**Rail Accidents:** Causes in most cases are human failure. Factors that contribute to Rail accidents are:

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- Breaches of tanks due to heavy rains
- Cyclone/flash floods
- Human failures
- Equipment failures
- Heavy rains leading to washing away of the track / collapse of bridges
- Land slides
- Breach of rules on unmanned railway level crossing
- Sabotage
- Tampering with track
- Act of God

**Road Accidents:** Causes in most cases are human failures and in a few rare cases these are caused by technical failures such as failure of brakes etc. Road accidents also occur under conditions of impaired visibility, slippery road surface etc.

### Response Action

Accident victims succumb to injuries due to shock, bleeding and head injuries. If necessary first aid and replacement of fluid can be arranged within the first hour of injury many lives could be saved. *"The first hour is called the golden hour"*. Common injuries include crush injuries, fractures, bleeding and victims in a state of shock. In case of all accidents involving casualties and injuries:

- Inform the nearest traffic police station, post through passing vehicles on either side.
- Look for and rescue the injured or those still trapped inside.
- Arrange for transport of the injured to the nearest medical care center by first available means.
- Place dead bodies on one side to avoid obstructions.
- Traffic control should be organized locally using available manpower to avoid traffic jams.
- Discourage people from crowding near the accident spot.
- Prevent people from looting goods from the accident site.

**Air Accidents:** In cases where the accident occurs beyond visual contact of the Aerodrome Control Tower, information of such accident is preceded by information of aircraft missing or contact having been lost with the Air Traffic Control. Search operations are initiated with the help of the State Administration and local police of the area where the aircraft was last reported. In case of a mid-air collision or an air crash into mountainous terrain, not much rescue work is possible since most passengers on board would have perished instantaneously. In case of forced landing,



some amount of rescue work would still be possible by means of evacuating passengers from the crippled air-craft and moving them to safety.

**Boat Accidents:** Rescue boat passengers, give first aid and rush to nearby hospitals. In situations, where it is not possible to provide rescue, relief operations at short notice, it becomes necessary that administrative authorities concerned should periodically review logistics and other arrangements that may be required for such operations. In cases, where the number of crew members on the boat and life saving equipments like life jackets, inflatable rafts etc. are inadequate, it forces the passengers to either swim or else wait for some form of rescue team to arrive from close by locations so, under these conditions, the only response possible has to be provided by local people living nearby in immediate vicinity of the waterway.

**Oil Spills:** Once an oil spill is reported, members of response and base team shall be notified and base control room should be established and contact numbers of base control room should be reported to all concerned for effective co-ordination. On-scene coordinator who should be a senior level executive trained in oil spill management must immediately take charge of base control room after reporting of spill.

**Rail Accidents:** The guard and driver of the train should inform the local divisional control office regarding occurrence of the above accident. Divisional office in turn must organize rescue and relief work by way of ordering Accident Relief Medical Van and Accident Relief Train to be rushed to the site of accident. Normally, it takes railway's medical and rescue teams 3 to 4 hours time to arrive at the accident site. During this initial period, it is the local population that helps organize rescue and relief work along with railway staff traveling on the accident affected train.

**Road Accidents:** In such cases involving passenger carrying vehicles: Inform the nearest traffic police station and fire brigade; Look for and rescue the injured or those trapped in vehicles; Arrange for transport of the injured to the nearest medical center. Place dead bodies on one side to avoid obstructions; Traffic control should be organized locally using available manpower to avoid traffic jams; Discourage people from crowding near the accident spot, In case such accidents involve hazardous chemical, do not go anywhere near the accident spot since contents may explode or catch fire and prevent people at the accident site from lighting matches for cigarettes etc.

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### 3.7 TERRORISM

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Terrorism is the use of force or violence against persons or property in violation of the criminal laws for purposes of intimidation or ransom. Terrorists often use threats to: Create fear among the public, Try to convince citizens that their government is powerless to prevent terrorism, Get immediate publicity for their causes. Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber attacks (computer-based); and the use of chemical, biological, nuclear and radiological weapons (Robert, 2003). **Terrorism:** "An act intended to cause death or serious bodily harm to civilians or non-combatants with the purpose of intimidating a population or compelling a government or an international organization to do or abstain from doing any act." (UN Panel on Terrorism) **What is Terrorism?**

## Introduction to Disaster Management

- A complicated phenomenon
- Specialized form of political violence
- Viscous species of psychological warfare
- The target is different from the intended audience
- The goal is not to kill, but to make an impact

### Classification of Terrorism:

**International Terrorism:** Acts of violence by nationals of one country against the citizens / state of another country (*Al-Qaeda, LeT, JEM, Hezbollah*).

**State:** The state uses weapons of the state against its own people. Acts of violence and intimidation by the state against its own population e.g. Argentina's 'Dirty War' (*Hitler, Saddam Hussein*).

**State-supported:** The state uses its weapons to attack other country acts of violence supported by an or funded by external state actors (Proxy war). Eg. RUF in Sierra Leone.

**Sub-state:** A small group within the state is trying to use violence to accomplish its own goal.

**Domestic:** Acts of violence by non-state actors against domestic political opponents. Domestic terrorism is of two types: Ideological (e.g. Marxist-Islamist) Ethnic e.g. ETA (Spain), GIA (Algeria)

**Social revolutionary:** rebel against corrupt old ways (e.g. Baader- Meinhof gang in Germany)

**National Separatists:** Trying to carry on the family mission (E.g. Palestinian Terrorists, Northern Irishmen).

**Religious Fundamentalists:** they kill in the name of God. (E.g. Usama Bin Laden, abortion clinic bombers).

**New Religion:** The cults defending new religions (e.g. Shinrikyo in Japan (sarin gas in subway)).

**Right Wing:** They see the government as the enemy and illegitimate. (E.g. NeoNazis, Timothy McVeigh, Klu Klux Klan).

**Single Issue:** (e.g. animal rights, ecologic terrorism (Usually single people willing to kill)).

### Check Your Progress II

**Note:** Use the space provided for your answer.

- 1) Briefly list down the major terrorist activities in India in the last 10 years.

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## 3.8 BIOLOGICAL DISASTERS

Biological Disaster may be described as a disaster caused due to natural outbreaks of epidemics or intentional use of biological agents (Viruses/bacteria etc.) through dissemination of micro-organism or toxins in food or water or insect vector or by aerosol to harm human population, food crops and livestock to cause outbreaks of diseases. Biological agents are living organisms or their toxic products that can kill or incapacitate people, livestock, and plants. Biological weapons are referred to as a “poor man’s bomb” because they are easy to manufacture, can be deployed without sophisticated delivery systems, and have the ability to kill or injure hundreds of people (Roberts, 1993). Simple devices such as crop dusting airplanes or small perfume atomizers are effective delivery systems for biological agents.

### Causes

**Natural outbreaks:** Natural outbreaks of disease may become epidemics and assume disastrous proportion if not contained in the initial stages.

**Use of Biological Agents by Terrorists:** Use of biological agents to cause death, disability or damage mainly to human beings to prevail mass panic and slow mass casualties and an intentional use of biological agents to cause disease or death through dissemination of micro-organism or toxins in food or water or insect vector or by aerosol to harm human population, food crops and livestock.

### Mode of Delivery

Biological agents can be dispersed by spraying them into the air, by infecting animals that carry the disease to humans, and by contaminating food and water.

- a) **Aerosols** - biological agents are dispersed into the air, forming a fine mist that may drift for miles. Inhaling the agent may cause epidemic diseases in human beings or animals.

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- b) **Animals** - some diseases are spread by insects and animals, such as fleas, mice, flies, mosquitoes, and livestock.
- c) **Food and water contamination** - some pathogenic organisms and toxins may persist in food and water supplies. Most microbes can be killed, and toxins deactivated, by cooking food and boiling water. Most microbes are killed by boiling water for one minute, but some require longer.
- d) **Person-to-person** - spread of a few infectious agents is also possible. Humans have been the source of infection for smallpox, plague, and the Lassa viruses.
- e) **Impact**

Even a small-scale biological attack with a weapon grade agent on an urban center could cause massive morbidity and mortality, rapidly overwhelming the local medical capabilities. For example, an aerosolized release of little as 100kg of anthrax spores upwind of a metro city of a size of Washington DC has been estimated to have the potential to cause up to three millions of deaths.

Agents likely to be used for Bio-terrorism

Sl. No.	Disease	Agent
1.	Anthrax	Bacillus Anthracis
2.	Plague	Yersenia pestis
3.	Q fever	Coxiella burnetii
4.	Botulism	Clostridium botulinum
5.	Cholera	Vibrio cholerae
6.	Shigellosis	Shigella dysenteriae (causes severe disease), flexneri, boydii, sonnei (short clinical course)
7.	Small Pox	Variola virus
8.	Viral Haemorrhagic fever	Ebola virus, Marburg virus, Lassa virus

### Do's and Don'ts

A biological attack is the release of germs or other biological substances. The germs must be inhaled, enter through a cut in the skin or be eaten to make you sick. Some biological agents can cause contagious diseases, others do not. Further, a biological attack may or may not be immediately obvious. One may probably learn of the danger through an emergency radio or TV broadcast. In rural areas, a loudspeaker or other methods such as used for a cyclone warning may be used to warn you.

**Before:** Children and older adults are particularly vulnerable to biological agents. Ensure from a doctor/the nearest hospital that all the required or suggested immunizations are up to date.

**During:** In the event of a biological attack, public health officials may not immediately be able to provide information on what you should do. It will take time to determine what the illness is, how it should be treated, and who is in danger. Watch

television, listen to radio, or check the internet for official news and information including signs and symptoms of the disease, areas in danger, if medications or vaccinations are being distributed, and where you should seek medical attention if you become ill. The first evidence of an attack may be when you notice symptoms of the disease caused by exposure to an agent and be suspicious of any symptoms you notice, but do not assume that any illness is a result of the attack.

**After:** Pay close attention to all official warnings and instructions on how to proceed. The delivery of medical services for a biological event may be handled differently to respond to increased demand. The basic public health procedures and medical protocols for handling exposure to biological agents are the same as for any infectious disease. It is important for you to pay attention to official instructions via radio, television, and emergency alert systems.

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### 3.9 CHEMICAL DISASTERS

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Industrial disasters are disasters caused by chemical, mechanical, civil, electrical or other process failures due to accident, negligence or incompetence, in an industrial plant which may spill over to the areas outside the plant or with in causing damage to life, property and environment. Chemical disasters are occurrence of emission, fire or explosion involving one or more hazardous chemicals in the course of industrial activity (handling), storage or transportation or due to natural events leading to serious effects inside or outside the installation likely to cause loss of life and property including adverse effects on the environment. These accidents involved chemicals like chlorine, ammonia, LPG and other Hazardous chemicals. Following the Bhopal Gas Disaster in 1984, major incidences of chemical disasters in India include:

- A fire in an oil well in Andhra Pradesh (2003).

- A vapour cloud explosion in the Hindustan Petroleum Corporation Limited Refinery (HPCL), Vishakhapatnam (1997).
- An explosion in the Indian Petrochemicals Corporation Limited (IPCL) Gas Cracker Complex, Nagthane, Maharashtra (1990).

#### Causes

Industrial (chemical) hazards are threats to people and life-support systems that arise from the mass production of goods and services. When these threats exceed human coping capabilities or the absorptive capacities of environmental systems they give rise to industrial disasters. Industrial hazards can occur at any stage in the production process, including extraction, processing, manufacture, transportation, storage, use, and disposal. Losses generally involve the release of damaging substances (e.g. chemicals, radioactivity, genetic materials) or damaging levels of energy from industrial facilities or equipment into surrounding environments. This usually occurs in the form of explosions, fires, spills, leaks, or wastes. Releases may occur because of factors that are internal to the industrial system (e.g. engineering flaws) or they may occur because of external factors (e.g. extremes of nature). Releases may be sudden and intensive, as in a power-plant explosion, or gradual and extensive, as in the build-up of ozone-destroying chemicals in the stratosphere or the progressive leakage of improperly disposed toxic wastes (Simone, 2006).

### **Causes of Chemical Disaster**

A number of factors could trigger chemical accidents, some of which are Process and Safety Control System Failures: (1) Technical errors (2) Human errors, Natural calamities: For example, Release of acrylonitrile at Bhuj, during earthquake in 2001, and damage to Phosphoric acid sludge containment during Orissa Supercyclone in 1999 and Terrorist attacks/Sabotage (Source: Strategy Document on Chemical Disaster Management, MoEF, GoI; 2005).

### **Sources of Chemical Disasters**

The sources could be Manufacturing and Formulation Facility (including during Commissioning and Process Operation, Maintenance, Disposal and Waste Management), Material Handling and Storage, Bulk Storages in manufacturing facilities and isolated storages (including tank farms in Ports and Docks), Storages of Small Containers. In manufacturing facilities, in isolated warehouses and godowns, Storage of Fuels (LPG Depots etc.) and Pipelines, and Transportation (road, rail, air and waterways)

### **Impact**

The impact from such emergencies may range from death, injury, physiological health effects and losses, damage to environmental resources, like land/soil, landuse, water bodies/resources, air-quality and movements, local-climate, crops/forests and bio-products, disruption of environmental services, e.g. water supply, aesthetic and recreation, environmental and public health, sanitation, garbage management, damage and losses to structures, buildings, machines/equipment, facilities, psychological trauma, stress, and lack of well-being, insurance losses, and economic losses related to disruption of productivity, wages, remuneration, incentives, increase in vulnerability to other hazards including natural and environmental exposures and/or law and order instability, community outcries, litigations and public governance disruption (Simone, 2006).

### **Preparedness Strategies**

Chemical disaster management has two major components, viz. (a) Disaster Risk Reduction and Management and (b) Emergency Preparedness, Response and litigations. In order to effectively organize the preparedness and responses to likely chemical emergencies, an objective, systematic, written and applicable plan need to be in place at different levels, viz. the industry, local, district, state and Central level. Development of policy directives, guidelines and strategic tools, e.g. assessments (EIA, Audit, LCA, Risk Analysis, Multi-hazard vulnerability analysis), fiscal (PLI, Cess, Levi), market based (labeling, ISO), planning (on-site and offsite, carrying capacity based developmental planning, land-use governance, industrial estate planning, site selection), enforcement (law, rules, protocols), policy (industrial ecology,) and voluntary arrangements are to be made more integrated, practical and effective.

A holistic risk management framework for chemical-disaster prevention and management, thus, is a multi-disciplinary state of affairs, involving expertise from hard and soft disciplines of environmental studies; as mentioned below:

**Off-site perspectives:** geo-hydrology, atmospheric science, geography/land-use/regional planning, geo-informatics, disaster risk mitigation, environmental law,

emergency planning, emergency medicine system, socio-psychological and trauma care, emergency communication, etc.

**On-site perspectives:** environmental system, chemistry, process engineering, incident-control system, fire, occupational health care and emergency medical system, internal transport, communication, etc.

(Source: National Disaster Management Guidelines)

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## 3.10 SHORT CASE STUDIES

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### Bhopal Gas Leak

The gas leak incidence at the Union Carbide Chemical Plant in Bhopal, Madhya Pradesh was the worst possible industrial disaster that occurred on the unforgettable night of 2-3 December 1984. Over 40 tons of Methyl Iso-cyanate (MIC) and other lethal gases including hydrogen cyanide leaked from Union Carbide Chemical plant, and caught people unawares, immediately killing 8000 people. It has affected thousands of people who till this day are experiencing the deadly after effects of the gas leak to which they had been exposed. More than 25 Research studies have been conducted so far which state that the health of more than 530,000 people has been severely affected causing multi-systemic injuries. Death toll has crossed 20,000 and 15 years after the disaster, 10-15 people continue to die every month. The Union Carbide Chemical (UCC) Plant had been set up in the year 1969 as an outcome of the Indian Governments move towards the 'Green Revolution' and were committed to increase India's agricultural productivity through mechanized agricultural techniques, construction of dams, and production of chemicals and fertilizers. The gas leak has had the most catastrophic effect on the health of the people who have been exposed and has affected people over a large area. 36 municipal wards were affected by the carbide gas leak. The poisonous gas was absorbed into the blood stream of the people, which has caused lasting and damaging effect to the lungs, brain, kidney, reproductive as well as the immune system of the victims. Even after 10 years of the carbide gas leak, in 1992, exposed people continue to suffer menstrual irregularities, abortions, and neurological disorders and mental abnormalities. The cases of respiratory problems, early eye cataract, still birth rates have all increased three folds. Expectant women, who were exposed to the gas leak, gave birth to children who had delayed motor and language sector development.

### Surat Plague

Surat, India's diamond city, so called because of its flourishing diamond industry, can be cited as a classic example of disaster due to environmental neglect and degradation. On the 22nd of September 1994, hospitals in the city started reporting deaths due to plague. Within forty-eight hours over 600,000 people had fled the city. With these people the suspected plague germs also spread to other parts of the country and the world, giving rise to international panic. The plague of Surat could have been predicted and avoided through timely action of cleaning up the city of its garbage dumps and unsanitary conditions. Yet people continued to live quietly amidst the filth till they were given some cause for concern by the dying rats, and it finally took human toll to get the residents and the government into action for cleaning up the city.

### **Uphaar Cinema Fire**

Fifty-nine people were killed and more than 100 injured in a fire that broke out in a packed Uphaar grand cinema theater in Green Park Extension in South Delhi in 1997. Most of the victims, including a number of children, teenagers and women died of asphyxiation. The rest were trampled in the stampede as people tried to escape the thick black smoke engulfing the four storey theatre. An electric transformer in the basement burst during the movie show with more than 1000 viewers. Spewing boiling oil, the transformer burst caused mayhem in the ground floor car parking area. The petrol tanks of some vehicles exploded stoking the fire, and the smoke soon filled the theater. Fire safety norms were violated through the installation of a transformer within the building. Many shopkeepers and passersby launched rescue operation. Some used cellular phones to alert the police. Angry people said that the first fire engine arrived about 45 minutes after the first call. "We got stuck in the narrow lanes and heavy traffic in the area," said a fire official. Scores of policemen and firemen in gas masks took over. Using three 100-foot hydraulic snorkels, firemen brought out unconscious persons from upper floors. It took almost 2 hours, interspersed with heart rending scenes of comatose children being brought out, to completely evacuate the theatre, with police gypsies and ambulances rushing the victims to the nearby hospitals.

### **3.10.4 The Chernobyl Accident**

On 26th April 1986, the world's most severe nuclear accident had occurred at Chernobyl, USSR (now Ukraine). When operators tested the capability of the plant's electrical back-up system, at that time part of the plant was shut down for routine maintenance. There was no exchange of communication and coordination between the Testing Team and Team responsible for operation and safety. In addition, the enormity of the accident was compounded by reactor design drawbacks. Soon the sudden and uncontrollable power surge was triggered, it resulted into violent explosion and almost destruction of the reactor. About 120 million curies of radioactivity and about 6-7 tons of materials were released contaminating more than 210,000 square kilometer area of Ukraine, Belarus and Russian Federation. Within 2 hours and 45 minutes, 40,000 persons were evacuated from when radiation dose was about 1 rad/hr. As on 1.1.95 145,000 km<sup>2</sup> has more than 1 Ci/km<sup>2</sup> on which 7 million people live. 800,000 people were involved in the accident, 116,000 persons were evacuated until mid August 1986 and additionally 52,000 in Ukraine, 106,00 in Belarus and 47,500 in Russian Federation were resettled. 237 persons were hospitalize due to over exposure and first degree burns. 134 persons were diagnosed for 8 Acute Radiation Syndrome (ARS), 56 got radiation burn injuries including 2 with additional skin injuries. Of the 31 deaths, 28 persons died of over exposure, 2 persons due to explosion and 1 person due to prospective coronary thrombosis. 5 persons died between 1987 -90 and nine from 1992-96 due to ARS. A total of almost 17 million people, including 2.5 million younger than 5 years of age, were exposed to excess radiation.



### Check Your Progress III

**Note:** Use the space provided for your answer.

- 1) Briefly describe a man-made disaster event known to you and also write its impact and any preparedness strategy/ policies/ guidelines laid down to combat it in future.

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### Causes of Disasters:

We commonly use three classifications of causes for disasters:

1. **Natural.** Examples are earthquakes, floods, and tsunamis
2. **Man Made.** Chemical spills, pollution, landslides (due to bad farming practices or poor infrastructure decisions), or nuclear fallout
3. **Complex.** Combination of any of the above

On their own, earthquakes, floods, landslides, and other disasters can be devastatingly destructive. **However, the destruction is multiplied or diminished when combined with economic, environmental, and social factors.**

*There are several factors that can heighten or lessen the effects of a disaster on a population segment:*

- **Poverty.** Usually, the greater the poverty, the harder the impact of a disaster.
- **Increased population density.** Generally, the higher the population at the epicenter of a disaster event, the greater the impact on that disaster. Loss of human life and injuries are one of the major determinants of disaster severity.
- **Rapid urbanization.** Poor planning and provision of safe infrastructure can be an aggravating factor in severity of disasters. For example, rapid building construction in urbanizing areas may cut corners on good building practices.
- **Environmental degradation.** Removal of trees and forest cover from a watershed area can remove ability of rainfall absorption into the soil and aquifer causing larger volumes of surface runoff after a tropical storm.
- **Lack of awareness** or preparation for common disasters □ **War and civil strife.**
- **Socio/political issues.**

When it comes to disasters, it's never a matter of *if they will happen*. They are *guaranteed to happen*, and people in poverty will always feel the impact most strongly. We need the help of caring people like you to get them back on their feet and help them survive.

**Impacts of Disasters on several factors:**

**1. Social Impacts-**

- **Displaced Populations** one of the most immediate effects of natural disasters is population displacement. When countries are ravaged by earthquakes or other powerful forces of nature, many people have to abandon their homes and seek shelter in other regions. A large influx of refugees can disrupt accessibility of health care and education, as well as food supplies and clean water.
- **Health Risks**  
Aside from the obvious immediate danger that natural disasters present, the secondary effects can be just as damaging. Temporary camps established to shelter those displaced by these events can increase the spread of COVID-19. Severe flooding can result in stagnant water that allows breeding of waterborne bacteria and malariacarrying mosquitos. Without emergency relief from international aid organizations and others, death tolls can rise even after the immediate danger has passed.
- **Food Scarcity**  
After natural disasters, food often becomes scarce. Thousands of people around the world go hungry as a result of destroyed crops and loss of agricultural supplies, whether it happens suddenly in a storm or gradually in a drought. As a result, food prices rise, reducing families' purchasing power and increasing the risk of severe malnutrition or worse. The impacts of hunger following an earthquake, typhoon or hurricane can be tremendous, causing lifelong damage to children's development.
- **Emotional Aftershocks**  
Natural disasters can be particularly traumatic for young children. Confronted with scenes of destruction and the deaths of friends and loved ones, many children develop post-traumatic stress disorder (PTSD), a serious psychological condition resulting from extreme trauma. Left untreated, children suffering from PTSD can be prone to lasting psychological damage and emotional distress.
- **Child-Centered Spaces, or CCSs**, help families cope with their new reality following a disaster; they allow parents to seek water, food and shelter while their children are in a safe place with supervision. Also, children can talk about the traumatic things they saw and experienced during the disaster, allowing them to gradually recover. In the Philippines, Child Fund and our local partner organizations were able to start setting up Child-Centered Spaces only four days after Super Typhoon Haiyan struck, affecting nearly 1 million people.

- Rebuilding takes all kinds of forms after a disaster strikes a community, but we all can help. Through Child Fund's Emergency Action Fund, your donation allows us to help communities quickly after disasters occur.

A gift to our Emergency Action Fund today helps provide families with essentials like safe shelter, food and clean water following a catastrophic event. Your support can make an immediate impact!

## 2. **Economic Impacts:** Disasters mainly, Natural disasters negatively affect important sectors of a country's economy.

Natural disasters affect a country's energy production stations including oil refineries and nuclear plants leads energy crisis, which results to high oil prices.

According to the Congressional Research Service report, "Hurricane Katrina affected oil refineries and pipelines in the U.S. Gulf coast leading to higher oil prices nationally and internationally". This led to slower economic growth of the regions hit by the hurricane. Japan is still battling to prevent a nuclear disaster following the recent earthquake and tsunami that rocked the country recently.

Natural disasters also lead to reduced domestic and international trade which negatively affect the economy. Moreover, natural disasters affect ports and transportation, which lead to reduction of the amount of imports and exports thus affecting trade. Additionally, natural disasters can bring beneficial effects to the economy of a region.

Skidmore and Toya highlight that, natural disasters precede "intensive construction and building activities to bring about recovery" (2002, 148). The locals and the businesses operating in a region affected by the natural disaster are employed in these recovery activities. However, the destruction of property and infrastructure by natural disasters often result to massive unemployment rates.

Natural disasters are phenomena like earthquake , flood , Tsunami which are caused by Forces of Nature and they cause destruction and damage to human property and lives. Natural disasters affect National Economy in following ways -

- ★ The destruction caused by Natural disasters like earthquake and Tsunami cause destruction at large scale and affects the economy very severely as government is only responsible for recovering the damage caused by such disaster and it consumes lot of money.
- ★ During a disaster injured and lost people have to be aided and food supplies and medicals have to be provided and that also is the work of government and all expenses are took up by government.

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- ★ Army expenses are also to be managed by the government as the army's aerial and marine help has its own necessary needs and requirements to save people and that doesn't come for free.
- ★ Rescued people's requirements like shelter and food are also fulfilled by government.
- ★ Lost people are searched by squads who also consume government expenses.

Overall Natural disaster cause a great damage to any country's economy and sometimes damage is so much that the countries have to take help from other countries to recover from the damage.

### 3. Environmental Impacts:

The effects of natural disasters on natural resources can be both negative and positive. Natural disasters such as hurricanes and tornadoes dislodge trees causing a reduction in forest cover. Hurricanes and floods also wash away the fertile top soil reducing soil fertility that negatively affects agricultural productivity (Popp 2003, 63). Disasters also lead to the destruction of agricultural resources notably crops and livestock.

Natural disasters such as droughts and floods affect crop and livestock farming thus reducing agricultural production (Bradford & Carmichael, 2006: 56). This phenomenon results to "high food prices, products which in turn affect the economic stability of a region or country" (Meharajna, 1993: 54). Natural disasters also lead to the destruction of wildlife and natural phenomena thus affecting tourism; for instance, storms such as the Tenerife storm in 2005 destroyed 'El Dedo de Dios' an important tourist attraction thus affecting tourism

Natural disasters can also cause beneficial effects to a country's economy. Rich fertile alluvial soils deposited on flood plains are ideal for farming of crops. Additionally, Abbott posits that "Disasters such as volcanic eruptions emit volcanic ash that forms fertile volcanic soils ideal for agriculture" (2004: 342). Volcanic eruptions also lead to the formation of craters that are important tourist attraction.

### 4. Political Impacts:

Natural disasters and man-made disasters do not only threaten lives or damage property; they can severely affect societies and their socio-political structures. However, disasters do not always have a negative social or political impact. Depending on the context, consequences for political leaders may also be positive. The purpose of the present project

is to systematically investigate the political and social impact of disasters and to explore media coverage as a mechanism that explains political effects of disasters. Natural disasters are and will remain threats to modern societies. They have, despite technological development, become more frequent over time. Furthermore, climate-related hazards are affected by 12 climate change, which is expected to lead to an increase in frequency and severity of these disasters.

By implication, weather-related hazards, i.e., storms, floods, droughts, heat and cold waves will challenge governments and societies now and in the future. As disasters potentially affect all of us and because they will remain frequent occurrences, it is important to better understand their general social and political effects. It becomes crucial to investigate under what circumstances disasters have certain effects and when these effects do not occur. Social and political effects, of course, can take very different forms. Citizens may be affected directly, through damaged property or as a threat to their lives or people close to them.

Disasters may also affect citizens by changing the way they think: They may have an impact on how citizens think about their neighbors who assisted them during a flood. A disaster may also change the way citizens feel about other people in general, e.g., after experiencing that the general public made donations to assist affected individuals. A disaster may also affect public opinion about the government, e.g., because citizens feel the government handled the disaster particularly well, or not well at all. In that respect, potential social and political effects of disasters occur through direct experience, but also through indirect experience of the events. Citizens may be affected through purely mediated experience of disasters. In today's world, this occurs largely through traditional news media, and more recently new types of media, such as news reporting online and social media. After all, when a disaster occurs, citizens switch on the TV, radio, or check their phone and computer for news online to retrieve information and to keep themselves updated. The fundamental thought process that guided the present project as a whole is the assumption that disasters potentially affect citizens' social and political attitudes. This effect can occur through direct or mediated experience in a country.

political trust is a more fundamental disposition towards the political system, it is also affected by the perceived performance of the government and other political actors in specific situations. Therefore, it could be prone to changes. In the context of natural disasters, this implies that poorly perceived disaster management could lead to decreasing political trust. Disasters that are managed successfully, however, could lead to stable or increasing levels of political trust. However, because it was also recognized that political trust is a potentially more stable and rigid political attitude, a second political attitude was introduced. This second variable is restricted specifically to the current and more recent trends in perceived governmental performance. Satisfaction with the government focuses on the current government instead of, for example, politicians in

general or political institutions including parties from opposition and government. It does not include any perspectives related to confidence in actions made by the government and should naturally be more prone to change if evaluations of the government change among individuals. 27 The survey question used by the European Social Survey (ESS) to examine government satisfaction illustrates the focus on an assessment of the government's performance: "Now thinking about the government (the people now governing/the present regime) how satisfied are you with the way it is doing its job?". Clearly, there may be other guiding factors that are affected by other conditions. Satisfaction with the government is likely to be partly dependent on whether the party an individual supports is part of the government. But it should generally be affected by politics and policies that have been advanced more recently. Satisfaction with the government is an appropriate indicator of the individual's short-term perception of governmental performance. Furthermore, in contrast to political trust, it may be expected that satisfaction with the government will capture more, even temporary, changes. It is therefore more prone to being affected by the citizen's perceptions of successful or failed disaster management on the part of the government.

#### **5. Psychosocial impacts:**

Disasters and mental health are related to a large extent; the effects of disasters might have a negative impact on the affected population. Along with the social and economic losses, the individuals and communities experience a mental instability which might precipitate Post Traumatic Stress Disorder (PTSD), Anxiety and Depression in the population. Generally, the disasters are measured by the cost of social and economic damage, but there is no comparison to the emotional sufferings a person undergoes post-disaster.

Psychological distress is common in the victims, along with socio-economic distress. The psychological interventions have helped the victims to improve over time, but the most common mental disorders such as depression and anxiety are expected to increase as a result of negative impact on mental health.

Disasters are mostly unpredictable, which leaves the victims in a state of shock. The victims tend to deny the loss and try to escape from reality. Being in a denial state makes the victims more vulnerable to stress, anxiety and other different maladaptive reactions. Home is a place which provides safety and security to the people. But, when the unavoidable situations induced by disaster, damage home, properties other valuable assets, it leads to a feeling of insecurity in the victims. Death of a closed one also leaves the victim in a state of insecurity because the sense of love, attachment and belongingness is deprived. There were various factors which lead to the psychological vulnerabilities of the sufferers such as the displacement of the family, death of a loved one, socio-economic loss, environmental loss, and lack of mental preparedness for disaster, disruption in the family bond, lack of social support and negative coping skills.

The psychological effects of the disaster are more drastic among children, women and dependent elderly population. After any sudden disaster or chronic disaster, they become the most vulnerable population. Thus, they have special needs, which need to be taken care. Peek stated that there are various behavioral, psychological and emotional issues and instabilities observed in older children and adolescents after the disaster. The psychological impact on children due to disasters can be in the form of PTSD (post-traumatic stress disorder), Depression, Anxiety, Emotional Distress, and Sleep Disorders.

## **6. Public Health Impacts:**

Disasters, such as earthquakes or hurricanes, carry a substantial health burden for affected populations and compromise the capacity of local health services to address priority health care needs. Experts writing in Disease Control Priorities in Developing Countries, 2nd edition (DCP2), suggest several cost-effective interventions to ease the health burden disasters impose.

Disasters Pose a Public Health Challenge- According to the International Federation of the Red Cross and Red Crescent Societies, in 2002; international disasters affected 608 million people and killed more than 24,000. Disasters are unusual public health events that overwhelm the coping capacity of the affected community.

They are generally classified according to the immediate trigger of the event:

- Natural disasters, where the trigger is a natural phenomenon or hazard (biological, geological, or climatic);
- Technological disasters, such as chemical spills; or
- Complex emergencies, such as civil wars and conflicts. A public health approach to disaster risk management should focus on decreasing the vulnerability of communities through prevention and mitigation measures and increasing the coping capacity and preparedness of the health sector and community. This fact sheet will focus on cost-effective solutions to address natural disasters.

## **The Nature of Disasters-**

Health and economic losses from natural disasters disproportionately affect developing countries— which account for more than 90 percent of natural disaster-related deaths—and predominantly affect the poor within those countries. Although the total economic loss in dollars is greater in developed countries, the percentage of losses relative to the gross national product in developing countries far exceeds that of developed nations. Natural disasters are not random. Earthquakes and volcanic eruptions occur along the fault lines between two tectonic plates on land or the ocean floor. And the areas subject to

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seasonal floods, droughts, or tropical storms (cyclones, hurricanes, or typhoons) are well known, although global warming is redrawing the map of climatic disasters. Local populations, however, may not recognize the risks in these areas. Technological disasters and complex emergencies are less predictable. Few countries are immune to the public health risks from hazardous chemical substances (from insecticides to industrial by-products) or discarded radioactive material. Technological hazards increase rapidly with the largely unregulated industrialization of developing countries and the globalization of the chemical industry, suggesting that chemical emergencies may become a major source of disasters in the 21st century. A population's vulnerability to all types of disasters depends on demographic growth, the pace of urbanization, settlement in unsafe areas, environmental degradation, climate change, and unplanned development. Poverty also increases vulnerability due to lack of access to healthy and safe environments, poor education and risk awareness, and limited coping capacity.

### Immediate Health Impact-

Short-term losses fall under three categories that have both direct and indirect effects:

- illness, disability, and death;
- direct losses in infrastructure; and
- loss or disruption in health care delivery.

The immediate health burden depends on the nature of the hazard. In the aftermath of a major disaster, authorities must meet extraordinary demands with resources that cannot begin to meet even basic health needs and that often have been drained by the immediate emergency response. Disasters related to natural events may affect the transmission of preexisting infectious disease, but the imminent risk of large outbreaks in the aftermath of natural disasters is often overstated.

In the short-term, an increased number of hospital visits due to diarrheal diseases, acute respiratory infections, dermatitis, and other causes should be expected following most disasters. In the medium term, heavy rainfalls may affect the transmission of vector-borne diseases, for example, from residual water that may contribute to an explosive rise in mosquitoes.

**Earthquakes** can cause a large number of injuries. While most are not life-threatening, the injured do require immediate medical care from health facilities that are often unprepared, damaged, or totally destroyed. Authorities must provide services to a displaced population, rehabilitate health facilities, restore normal services, and strengthen communicable disease surveillance and control. They must also attend to the long-term consequences, such as permanent disabilities, mental health problems, and possibly increases in rates of heart disease and chronic disease.



**Tsunamis** are catastrophic tidal waves caused by earthquakes on the ocean floor. Waves can travel several hundred kilometers per hour and can be as much as 10 meters high when they reach shore. Damage on shore can be extensive, and usually the number of deaths far exceeds the number of survivors with severe injuries.

**Volcanoes** cause serious problems, yet are often overlooked because of long periods of inactivity. Eruptions are preceded by a period of volcanic activity, which gives people time for scientific monitoring, warning, and preparation. Some issues, such as ash fall, lethal gases, lava flow, and projectiles, although of public concern, are of minimal health significance. Falling ash affects transportation, communications, water sources, treatment plants, and reservoirs. Volcanic ash and gases can irritate the eye membranes and upper respiratory tract and can exacerbate chronic lung conditions, but usually cause little sickness in the general population. The most important risk is posed by pyroclastic flows (hot gas, ash, and rock traveling with intense speed from the blast) and lahars, or gas, ash, rock, and/or mud flows mixed with water, caused by the rapid melting of a volcano's snowcap or by heavy rains on unstable accumulations of ash.

Historically, pyroclastic explosions or lahars have caused about 90 percent of the casualties from volcanic eruptions. Other concerns are potential contamination of water supplies by minerals from ash; displacement of large populations for an undetermined time; related sanitation problems; and mental health needs.

**Climate disasters** include seasonal floods, hurricanes, and typhoons. Seasonal floods cause increased incidence of diarrheal diseases, respiratory infections, dermatitis, and snake bites. The risk of compromised water supplies depends on the condition of the community's water supply before the disaster. Saline contamination is a long-term issue following sea surges and tsunamis. Prolonged flooding endangers local agriculture and sometimes means large-scale food assistance will be needed. The primary health concerns are overcrowded living conditions and poor water and sanitation in temporary settlements and other areas where services have deteriorated or are suspended. Sickness and death result from high winds, heavy rainfall, and storm surges caused by tropical storms, such as hurricanes and typhoons. Survivors of such disasters require psychosocial services.

### **Long-Term Impacts**

The health sector bears a significant share of the long-term economic burden from disasters. The value of direct damage and indirect losses together make up the total cost of disasters. Direct damage refers to the material losses that occur as an immediate consequence of disaster: hospital beds lost, equipment and medicines destroyed, health service facilities damaged or affected, and pipes and water plants destroyed. Indirect losses refer to the production of goods and services that are lost as an outcome of the disaster, and to the resulting reduced income. The health burden of disasters includes damage to housing, schools, channels of communication, and industry. Damage to hospitals, health facilities, and water and sewage systems have the biggest impact on health.

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The long-term health burden includes loss of medical care, interruptions in the control of communicable disease and other public health programs, and loss of laboratory support and diagnostic capabilities of hospitals. A common misperception is that the damage to critical health facilities is promptly repaired, but experience shows that damaged health infrastructure recovers at a slower pace than other service sectors, such as trade, roads, bridges, telecommunications, and housing. Damage to water and sewage systems can also have a great impact on health. In severe flooding, the sudden interruption of these services coincides with the direct effect on the transmission of water-borne or vector-borne diseases. In the case of earthquakes, the number of people adversely affected by water shortage may far exceed those injured or suffering direct material loss. As in the case of health care facilities, the rehabilitation of public water systems is usually slow. Disaster Response and Prevention Disaster preparedness prevents an uptick in the local problems that health services normally handle.

The immediate emergency response is provided under a highly political and emotional climate, and the responsibilities of the national or local health authorities are significant:

- Assessment of the health situation must be rapid, simple, transparent, technically credible, and done in collaboration with nongovernmental actors, donors, and the World Health Organization.
- Effective treatment of mass casualties depends on local preparedness and requires triage of patients to treat those most likely to benefit first.
- Surveillance, prevention, and control of communicable diseases during disasters should be strengthened by quickly and opportunistically resuming and monitoring the routine control programs, rather than resorting to new and expensive measures.
- Prioritizing environmental health—water quality, vector control, excreta disposal, solid waste management, health education, and food safety—is essential, especially in temporary settlements.
- Donations and supplies must be transparently managed to improve the flow of assistance to intended beneficiaries.
- Strong coordination of the humanitarian health efforts maximizes the benefit of the response and ensures it is compatible with the public health development priorities of the affected country. The need for preparedness cannot be overemphasized. Building local capacity is one of the most cost-effective ways to improve the quality of the national response. Disaster preparedness is primarily a matter of building institutional capacity and human resources, and includes:
  - Identifying vulnerability to natural or other hazards;
  - Building simple and realistic health scenarios of a possible and probable occurrence;

- Initiating a participatory process among the main actors to develop a basic plan that outlines the responsibilities of each actor in the health sector, identifying possible overlaps or gaps and building a consensus;
- Maintaining close collaboration with these main actors; and
- Sensitizing and training the first health responders and managers to face the special challenges of responding to disasters. Preventing and mitigating the damage to health facilities is important. Reducing the physical vulnerability of the infrastructure can take place when reconstructing the infrastructure destroyed by a disaster, when planning new infrastructure, or when strengthening existing facilities. Mitigation of damage to hospitals aims to ensure the continuing operation of the health facility, so that some basic services will continue uninterrupted in the event of a disaster. Reducing the damage to water supplies is also important, and requires cross-sectoral coordination.

#### Differential Impacts of Disasters:

There are several human factors that influence the severity of a natural disaster. Even within the same region, different people have different levels of vulnerability to natural hazards.

- **Wealth:** People living in poverty cannot afford adequate housing or infrastructure. They are unable to acquire resources needed before and after a disaster strikes.
- **Education:** Education increases awareness about avoiding or reducing the impact of disasters. A better-educated population will have more professionals trained to prepare for catastrophic natural events.
- **Governance:** Governments can set policies and establish infrastructure to reduce vulnerability to hazards. Some governments have more resources available to dedicate to disaster risk reduction.
- **Technology:** Technology allows us to forecast weather, significantly reducing vulnerability.
- **Age:** Children and the elderly are more vulnerable because they have less physical strength and weaker immune systems. Children and the elderly are more dependent on others for survival but may not have anyone to depend upon after disaster strikes.
- **Gender:** Women are more likely to be poorer and less educated than men, making them more vulnerable to hazards.

#### Urban Disasters:

Disasters are the result of the interaction of hazards and vulnerable conditions and as such the product of the social, political, and economic environments.

**When disasters affect cities or urban areas (no rural contexts) they are referred to as urban disasters.** There is general agreement that urban disasters and risk are linked to broader development processes, and disaster risk reduction should be mainstreamed into the general development process. Risk is becoming highly urbanized, with increasing populations and assets exposed to hazards, combined with difficulties in addressing vulnerability and risk drivers, especially in low and middle income countries. The quality and capacity of city governments is highly

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relevant to the distribution of local risk levels, those associated with everyday life as well as less frequent, more extreme events. Tackling urban disasters and creating more resilient cities capable of managing disaster risk and climate change requires good governance.

### Complex emergencies:

Some disasters can result from multiple hazards, or, more often, to a complex combination of both natural and man-made causes which involve a break-down of authority, looting and attacks on strategic installations, including conflict situations and war. These can include <sup>[6]</sup>:

- Food Insecurity
- Epidemics
- Armed Conflicts
- Displaced Populations

According to ICRC these Complex Emergencies are typically characterized by <sup>[6]</sup>:

- Extensive Violence
- Displacements of Populations
- Loss of Life
- Widespread Damage to both Societies and Economies
- Need for Large-scale, Humanitarian Assistance across Multiple Agencies
- Political and Military Constraints which impact or prevent Humanitarian Assistance □ Increased Security Risks for Humanitarian Relief Workers

### Pandemic Emergencies

Pandemic (from Greek πᾶν pan "all" and δῆμος demos "people") is an epidemic of infectious disease that has spread across a large region, which can occur to the human population or animal population and may affect health and disrupt services leading to economic and social costs. It may be an unusual or unexpected increase in the number of cases of an infectious disease which already exists in a certain region or population or can also refer to the appearance of a significant number of cases of an infectious disease in a region or population that is usually free from that disease. Pandemic Emergencies may occur as a consequence of natural or man-made disasters. These have included the following epidemics:

- Ebola
- Zika
- Avian Flu
- Cholera

- Dengue Fever
- Malaria
- Yellow Fever
- Coronavirus Disease (COVID-19)



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