1

MEANING AND CONCEPT OF DISASTER AND HAZARDS

After going through this chapter you will be able to understand the following features:

Unit Structure :

1.1 OBJECTIVES

By the end of this unit you will be able to –

- Define disaster
- Know about the difference between hazards, calamity and disaster
- Understand vulnerability, capacity, risk
- Discuss disaster management cycle
- Understand disaster management in India –

- Learn financial arrangements in disaster management –
- Understand the role of NGOs,
- Know role of community-based organizations
- Know role of media and communication in disaster management
- Discuss role of geography and GIS in disaster management

1.2 INTRODUCTION

The main aim of learning about disaster management is to lessen the impact of disasters around the world. The United Nations defines a disaster as a serious disruption of the functioning of a community or a society. It essentially deals with management of resources and information on disastrous events. Disaster management tries to coordinate these resources effectively and seamlessly. The role of Indian government in prevention and control of disasters is noticeable.

1.3 SUBJECT-DISCUSSION

Disaster management is a relatively new identifiable profession, where the tasks of a disaster manager, is of a disaster relief assistant during and after a disaster emergency. It is not necessarily a full-time activity. Indeed, for most people in the field, their concerns for disaster issues form only a part of their total responsibilities. There has been a growing awareness in recent years that all of these disaster management activities, in fact, comprise the process of disaster management. But the role of people who are involved in the field of disasters must be coherent and cohesive. This includes the spectrum of activities from administration to project implementation. Also Disaster prevention to disaster mitigation to disaster preparedness to disaster response comes under this category. Disaster management would succeed only if there is elimination of the underlying causes of disasters. This would again contribute to minimizing the people's vulnerability to disaster. Positive responses to emergencies will make an enormous impact on the current deadly state of disaster events. Disaster managers will require several skills and technologies to achieve their goal and must have vigorous training.

The term "disaster management" includes the complete field of disaster-related activities. Generally people have an intention to think disaster management in terms of the post-disaster actions taken by relief and reconstruction officials. But it is observed that disaster management covers a much broader scope where many modern disaster managers find themselves far more involved in pre-disaster activities than in post-disaster response.

1.4 DEFINITION OF CONCEPT OF DISASTER

There are innumerable definitions of a disaster. Among relief organizations definitions vary according to each agency's roles, biases, and capabilities. In short a sudden accident or a natural catastrophe that causes great damage or loss of life is known as disaster. It is a situation resulting from an environmental phenomenon or armed conflict that produces stress, personal injury, physical damage, and economic disruption of great magnitude. Here one important point must be noted that even though disasters are referred to by the event that caused them; a disaster is not the event itself. Earthquake may be taken as an example to explain this. It is a natural phenomenon. But if it does not strike a populated area with weak buildings, it is not likely to be a disaster.

Which event will qualify as a disaster entirely depends upon who is defining it. For example to a government, an oil refinery explosion could be a major disaster, but it is unlikely to trigger a massive response from the United Nations or from voluntary agencies (VOLAGS) unless hundreds of low-income families are hurt in the same. On the contrary, disasters caused by long-term environmental degradation will often draw attention from VOLAGS long before governments mobilize their resources.

There lie differences between disasters and accidents. A disaster is separated from an accident, or incident, by its magnitude of need and of victims involved. When an airliner crash it is of course severe and costly, but the number of people affected is relatively small. We should also differentiate disasters from individual, non extreme or small-scale suffering. For example, a world-wide growing phenomenon is hunger. It is a major concern, and often being endemic, is addressed with different approaches. Only when hunger becomes widespread and acute, or turns out to be a famine, the situation qualifies as a Disaster. This distinction is important because it not only helps to define disasters as a separate set of events but also gives a starting point for studying and understanding their importance, their impact, and the proper responses they require.

1.4.1 Disasters are of three types:

1. Natural Disasters

Natural disasters refer to those disasters that are triggered by natural phenomena such as earthquakes, cyclones, floods, etc. These are again technically known as natural hazards. The term "natural disaster" can be misleading because it implies that the disasters are solely a result of natural hazards-when in fact, human endeavours are a major contributing factor in creating a disaster. For example, if settlements or farms were not located in flood plains, disasters would not result from floods. If housing were built to earthquake- and cyclone-resistant standards, these hazards would be of scientific interest only and not result in disasters.

Recently, environmental degradation has begun to occur more frequently as a novel disaster. It results typically from poor farming, grazing, or

settlement practices, or because of demands for fuel wood. Excessive exploitation of natural resources or improper use or maintenance of lands changes the ecological balance; the resulting effects of deforestation, desertification, erosion, siltation, or flooding often bring disaster.

Increased flooding due to overgrazing or poor farming practices in the upper portions of a watershed, and increased desertification resulting from overgrazing or improper use of water resources are a few examples. This type of disaster is a growing concern not only because of the environmental consequences but also because large numbers of people can be displaced. The resulting social disruption can cause massive problems.

Man-made Disasters

The term "man-made disasters" usually refers to disasters resulting from man-made hazards. Man-made disasters can be divided into three categories: armed conflict, technological disasters, and disasters that are not caused by natural hazards but that occur in human settlements.

2. Technological Disasters

Technological disasters are usually a result of accidents or incidents occurring in the manufacture, transport, or distribution of hazardous substances such as fuel, chemicals, explosives, or nuclear materials. The catastrophic gas leak at the pesticide plant in Bhopal, India, in 1984 is an example.

Environmentalists opine that such disasters are common in industrializing and developing countries as these lack the trained workers and government regulators to detect and correct hazards in larger and complex plants. Moreover, the level of technical expertise among workers in developed countries is better than in developing countries. Often developing countries also believe that environmental safeguards are too costly and hence the working conditions in developing countries are unsafe. For example, in a plant in a country where the workers do not have shoes it is difficult to require the workers to wear steel-toed safety boots.

The type of accidents in both developed and developing countries is not much different from each other, but the likelihood of their occurring and the potential damage is much greater. The death tolls from the resulting accidents could be magnified because Third World industries often are encircled by shantytowns and slums filled with migrants from the surrounding countryside. In other cases, technological disasters are more economic than physical. For example, large refineries have exploded with minimal loss of life, yet the cost of restoring those facilities can be a major burden substantially affecting the entire economy of a small country.

1.5 DIFFERENCE BETWEEN HAZARDS, CALAMITY AND DISASTER

- **Difference between hazards and disaster**

A situation that poses a level of threat to life, health, property, or environment and is very dangerous for human and animal life is known as **hazard**. Most hazards are dormant or potential, with only a theoretical risk of harm. An active hazard creates an emergency. Hazard and possibility interact together to create risk

On the other hand, **disaster** is the result of a hazard that may be natural or manmade. Natural hazards are things that take place in nature that cause harm. The word "natural" is used to note that the disaster is caused by nature. Some examples of natural hazards are: earthquakes, hurricanes, sinkholes, hail storms, wildfires, and the like. It might also be helpful to keep in mind that one natural hazard can lead to another. For example, an earthquake can cause a tsunami. Natural disasters are slightly different. They are the effects of natural hazards on humanity. For example, the tsunami in Indonesia caused a great amount of loss of property and more importantly lives. The earthquake and tsunami in Japan also caused loss of property and lives, as well as nuclear fallout.

❖ **The differences between the two are as follows:**

- A **hazard** is a situation where there is a threat to life, health, environment or property where as, a **disaster** is an event that completely disrupts the normal ways of a community. It brings on human, economical, and environmental losses to the community which the community cannot bear on its own.

- **Hazards** are natural or manmade phenomenon that are a feature of our planet and cannot be prevented. In their dormant state, hazards just pose a threat to life and property while **disasters** are the result of a hazard that may be natural or manmade.

- These hazards are termed as disasters when they cause widespread destruction of property and human lives. Once a hazard becomes active and is no longer just a threat, it becomes a disaster.

- Both hazards and disasters are natural as well as manmade.

- We can prevent hazards becoming disasters if we learn to live in harmony with nature and take precautionary steps.

- **Difference between calamity and disaster**

Calamity is an event resulting in great loss while **disaster** is an unexpected natural or man-made catastrophe of substantial extent causing significant physical damage or destruction, loss of life or sometimes permanent change to the natural environment.

1.6 VULNERABILITY, CAPACITY, RISK

1.6.1 Vulnerabilityis a condition wherein human settlements, buildings, agriculture, or human health are exposed to a disaster by virtue of their construction or proximity to hazardous terrain.

1.6.2 Capacity

Capacity is the combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals. Capacity development is the process by which people, organizations and society systematically stimulate and develop their capacities over time to achieve social and economic goals, including through improvement of knowledge, skills, systems, and institutions.

According to UN/ISDR (2004), **capacity** is "a combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk or the effects of a **disaster**". This includes physical and human resources as well as leadership and **management**. UNDP (United Nations Development Programme) understands capacity development as a locally-driven, society-wide transformation, and recognizes that capable individuals, organizations and societies play an indispensable role in the successful reduction and management of disaster risks.

We can simplify the term and say that if capacity is the means to plan and achieve, then capacity development describes the way to those means. Capacity development commonly refers to a process that is driven from the inside and starts from existing capacity assets. Capacity building, however, refers to a process that supports only the initial stages of building or creating capacities, often by outsiders, and is based on an assumption that there are no existing capacities from which to start. It is therefore less comprehensive than capacity development.

For UNDP, developing sustainable DRR (Disaster risk reduction) capacities at national and local level is based on the following assumptions:

- Locally generated, owned and sustained capacity is essential to the success of any DRR enterprise.
- The development of DRR (Disaster risk reduction) capacity is the concern of an entire society, rather than of any single agency, professional discipline, or stakeholder group.
- The development of technical capacities associated with professional disciplines or functions—such as environmental management or land-use management—needs to be combined with other types of capacity development that include the promotion of leadership and other managerial capacities and performance-enhancing measures

- An enabling environment—i.e. strong political ownership and commitment at the highest levels of authority, extensive participation, transparency and clear public accountability— is essential for translating capacity into performance.

The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during crises or adverse conditions. Coping capacities contribute to the reduction of disaster risks.

1.6.3 Risk

Risk is the relative degree of probability that a hazardous event will occur. An active fault zone, for example, would be an area of high risk.

The combination of vulnerability and hazard gives us disaster risk or the possibility of a disaster in an area. Thus, risk is a potential to cause damage. Disaster risk is the product of hazard and vulnerability divided by capacity for convenience. Conventionally risk is expressed by the notation.

Risk = Hazards X Vulnerability/Capacity

Thus risk increases with increase in hazards and vulnerability and decreases with the increase in capacity.

Capacity is defined as the community to intervene and manage a hazard in order reduce potential impact.

1.7 TYPOLOGY OF DISASTERSNATURAL DISASTER

Natural disasters refer to those disasters that are triggered by natural phenomena such as earthquakes, cyclones, floods, etc. These are again technically known as natural hazards. The term "natural disaster" can be misleading because it implies that the disasters are solely a result of natural hazards when in fact, human endeavours are a major contributing factor in creating a disaster. For example, if settlements or farms were not located in flood plains, disasters would not result from floods. If housing were built to earthquake- and cyclone-resistant standards, these hazards would be of scientific interest only and not result in disasters.

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environmental consequences but also because large numbers of people can be displaced. The resulting social disruption can cause massive problems.

TYPES OF NATURAL DISASTERS

Several natural disasters in India happened due to climatic conditions of India. These have caused massive losses of Indian life and property. **Droughts, floods, flash floods, cyclones, avalanches, landslides** brought on by torrential rains, and snowstorms pose the greatest threats. In order to be classified as a disaster these phenomena must have profound environmental effect and /or human loss. These frequently incur financial loss too.

Excessive down pour during monsoons caused landslides in hilly areas which disturb the life to a huge extent in those areas and even in the nearby ones. Other dangers include frequent summer dust storms, which usually track from north to south; they cause extensive property damage in North India and deposit large amounts of dust from arid regions. Hail is also common in parts of India, causing severe damage to standing crops such as rice and wheat.

Some of the natural disasters in India are as follows:

I. Landslides in India

In India, the landslides keep happening frequently in lower Himalayas because these hills are not old enough and are still into formation. One more reason behind the occurrence of landslides in these regions is deforestation as the trees that hold the soil tight have been cut in huge number. Apart from lower Himalayas some areas of Western Ghats also experience landslides, though not such heavy ones. In major parts of Himachal Pradesh, Kashmir and Sikkim, avalanches are quite common.

II. Floods in India

Flood is the most widely occurring natural calamity that takes place in almost all the regions of India. The heavy rainfall causes the water-levels of major rivers like Brahmaputra to rise up resulting into destruction everywhere in that region. Crops are affected widely. Another cause that contributes majorly to this disaster is global warming. The huge ice deposits, melting at a fast pace, increase the water levels further. For past few decades, floods have been occurring in Central India mostly. The imbalance in environmental cycle has led to all sorts of environmental issues, floods being most common of them.

Some of the heaviest recorded floods in India have been the Gujarat flood of 2005, the Ladakh floods of 2010, the Brahmaputra floods and Himalayan Flash floods of 2012, the Assam floods of 2013, One of the most recent natural disasters to have affected India is the massive flood which affected Jammu &Kashmir in September, 2014 which claimed thousands of lives.

III. Flash Floods

Another catastrophic natural disaster to have hit the country was the flash floods in River Ganga in 2013. Heavy and sudden rains in the region caused destructive landslides in Uttarakhand, which took toll of thousands of lives, most of them being pilgrims of Badrinath and Kedarnath, while thousands were reported missing.

IV. Drought in India

Drought in India has caused tens of millions of deaths over the course of the 18th, 19th, and 20th centuries. Indian agriculture is heavily dependent on the southwest summer monsoon. In some parts of India, the failure of the monsoons result in water shortages, resulting in below-average crop yields.

V. Cyclones that Devastated India

Cyclones play the most devastating role as natural disaster. The coastal regions that come under Inter tropical Convergence Zone including the Bay of Bengal are hit by cyclones which are characterized by storming rains that lead to complete blackout and cutoff from all sorts of connectivity even for important supplies.

India's western coast, bordering Arabian Sea, experiences mild cyclones only rarely; these mainly strike Gujarat and, less frequently, Kerala. The powerful cyclones are majorly experienced in the coastal states such as Andhra Pradesh, Orissa, Tamil Nadu, and West Bengal in the Bay of Bengal region.

Among many other cyclones the Odisha Cyclone 05B that struck Orissa on 29 October 1999, was the most devastating one that had cost thousands of lives and left millions of people homeless. It was the worst in more than a quarter-century. With peak winds of 160 miles per hour (257 km/h), it was the equivalent of a Category 5 hurricane.

VI. Earthquakes in India

India has a history of havoc created by earthquakes which happen due to sliding of various layers of the earth. The Indian sub-continent is moving towards rest of Asia at a considerable rate. This has created various zones that are prone to earthquakes. Till date, the areas in India that have been affected by earthquakes are Kangra in Himachal Pradesh, Andaman & Nicobar, Jammu & Kashmir, West Bengal, New Delhi, Gangtok in Sikkim, Ratnagiri in Maharashtra, parts of Gujarat, Latur in Maharashtra, Uttarkashi in Uttarakhand, parts of Himachal Pradesh, Arunachal Pradesh and Kolkata in West Bengal. Almost all of India has suffered from the fury of earthquake.

Latur earthquake is one of the most devastating natural disasters in India of all time which hit Latur in Maharashtra on September 30, 1993. The earthquake which killed nearly 20000 and left 30000 injured, measured

6.4 on the Richter scale. It also caused huge damage to property, reducing thousands of buildings to rubble.

Apart from these major natural issues, there are many more like drought, heat waves and wildfires that have been bothering life in India to a great extent. Several measures have been taken to avoid the extent of damage, yet a lot needs to be done in this regard.

MAN-MADE DISASTER

Events which are caused by man either intentionally or by accident are know**n as Man-made Disasters.** Some of the examples are wars, civil wars, terrorism, errors in designing, nuclear disasters, industrial disasters etc. As their occurrence is unpredictable, man-made disasters pose a challenging and severe threat to public health and /or well-being which must be dealt with thorough vigilance and proper preparedness and response. Information on the major sources of man-made disasters helps to educate the public about their cause and effects so that emergency planning relating to these disasters become easier. With the advent of time as mankind has developed and become technologically advanced, frequency and magnitude of man-made disasters has increased in the same proportion. Man-made disasters are the results of industrial and material progress. Accidents happen due to negligence on the part of man. The Bhopal Gas tragedy is a result of an accident which played havoc on the local residence.

TYPES OF MAN-MADE DISASTERS

Man-made disasters are mainly of two types:

a. **Local disasters** which are small-scale disasters such as train accidents, plane crashes and shipwrecks.

b. The other one is **Industrial and technological disasters**. These are much larger in scale and are the result of technology failures or industrial accidents. Such disasters affect both local population and may even cover a much larger area. Industrial disasters result due to accidental leakage of water or air pollutants. Many of the chemicals are extremely toxic and carcinogenic which affect the human population in an adverse way. Some people die instantly while others are crippled for whole life in the form of blindness, paralysis and many other chronic diseases.

Man-made disasters are those hazards caused directly or indirectly by human action or inaction.

❖ **They are as follows:**

1. Sociological hazards

a. Crime

b. Civil disorder

c. Terrorism

d. War

2. Technological hazards

a. Industrial hazards

b. Structural collapse

c. Power outage

d. Fire

e. Hazardous materials

f. Transportation

3. Costs hazards

1. Sociological hazards

a. Crime

Crime is an action or omission which constitutes an offence and is punishable by law. Punishments can range from the payment of a fine to incarceration in jail. Individual human societies may each define crime differently. While every crime violates the law, not every violation of the law counts as a crime; for example: breaches of contract and of other private law may rank as "offenses" or as "infractions". Modern societies generally regard crimes as offenses against the public or the state, distinguished from torts (offenses against private parties that can give rise to a civil cause of action). In context, not all crimes provide man-made hazards.

James Robert Scott, currently serving a sentence of 20 years to life in a Missouri prison, was convicted of causing a massive flood of the Mississippi River at West Quincy, Missouri as part of the Great Flood of 1993.This flood inundated 14,000 acres on the Missouri side of the river.

a. Civil disorder

Civil disorder is a broad term. It is also known as civil unrest. It is typically used by law enforcement to describe unrest that is caused by a

group of people. Although civil disorder does not necessarily escalate to a disaster in all cases, the event may escalate into general chaos. Rioting has many causes, from antipathy over low minimum wages to racial segregation. Examples of well-known civil disorders and riots are the Poll Tax Riots in the United Kingdom in 1990; the 1992 Los Angeles riots in which 53 people died; the 2008 Greek riots after a 15-year-old boy was fatally shot by police; and the 2010 Thai political protests in Bangkok during which 91 people died.

b. Terrorism

Terrorism is the unofficial or unauthorized use of violence and intimidation in the pursuit of political aims. This controversial term has varied definitions. One definition means a violent action targeting civilians exclusively. Another definition is the use or threatened use of violence for the purpose of creating fear in order to achieve a political, religious, or ideological goal.

The Federal Bureau of Investigation (FBI) defines terrorism as "the unlawful use of force against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in the furtherance of political or social objectives."

- **Terrorists use a variety of methods to achieve their ends:**

i. Biological - Biological weapons are of two types, one is replicating (infectious) agents, while the other is non-replicating (non-infecting or intoxicating) agents. Replicating agents are pathogenic bacteria, viruses or fungus. Non-replicating agents are produced from replicating agents, other living organisms and plants and are called "toxins".

ii. Nuclear-There are two fundamentally different threats in the area of nuclear terrorism. One is the use, threatened use or threatened detonation of a nuclear bomb. The other is the detonation, or threatened detonation, of a conventional explosive incorporating nuclear materials – radiological dispersal devices, also called RDD.

iii. Incendiary-An incendiary device is any mechanical, electrical or chemical device used intentionally to initiate combustion and start a fire.

iv. Chemical-Chemical weapons are defined as compounds that, through their chemicals properties, produce lethal or damaging effects in man, animal, plants or materials.

v. Explosive- The United States Department of Transportation (DOT) defines an explosive as a substance fitting into one of two categories: Any substance or article, including a device, designed to function by explosion (e.g., an extremely rapid release of gas and heat), or Any substance or article, including a device, which by chemical reaction within itself, can function in a similar manner even if not designed to function by explosion, unless the substance or article is otherwise classified.

c. War

War is conflict between relatively large groups of people, which involves physical force inflicted by the use of weapons. Warfare has destroyed entire cultures, countries, economies and inflicted great suffering on humanity. Other terms for war can include armed conflict, hostilities, and police action. Acts of war are normally excluded from insurance contracts and disaster planning.

2. Technological hazards

a. Industrial hazards

Industrial disasters occur in a commercial context, such as mining accidents. They often have an environmental impact. The Bhopal disaster is the world's worst industrial disaster to date, and the Chernobyl disaster is regarded the worst nuclear accident in history. Hazards may have longer-term and more dispersed effects, such as dioxin and DDT poisoning.

b. Structural collapse

Main cause of structural collapses is by engineering failures. Bridge failures may be caused in several ways, such as under-design (as in the Tay Bridge disaster), by corrosion attack (such as in the Silver Bridge collapse), or by aerodynamic flutter of the deck (as in Galloping Gertie, the original Tacoma Narrows Bridge). Failure of dams was not infrequent during the Victorian era, such as the Dale Dyke dam failure in Sheffield, England in the 1860s, causing the Great Sheffield Flood. Other failures include balcony collapses or building collapses such as that of the World Trade Center.

c. Power outage

A power outage is an interruption of normal sources of electrical power. Short-term power outages (up to a few hours) are common and have minor adverse effect, since most businesses and health facilities are prepared to deal with them. Extended power outages, however, can disrupt personal and business activities as well as medical and rescue services, leading to business losses and medical emergencies. Extended loss of power can lead to civil disorder, as in the New York City blackout of 1977. Recent notable power outages include the 2005 Java–Bali Blackout which affected 100 million people and the 2009 Brazil and Paraguay blackout which affected 60 million people.

d. Fire

Casualties resulting from fires, regardless of their source or initial cause, can be aggravated by inadequate emergency preparedness. Such hazards as a lack of accessible emergency exits, poorly marked escape routes, or improperly maintained fire extinguishers or sprinkler systems may result in many more deaths and injuries than might occur with such protections.

e. Hazardous materials

i. Radiation contamination

When nuclear weapons are detonated or nuclear containment systems are otherwise compromised, airborne radioactive particles can scatter and irradiate large areas. Not only is it deadly, but it also has a long-term effect on the next generation for those who are contaminated

During World War II, United States troops dropped atomic bombs on the Japanese cities of Hiroshima and Nagasaki. As a result, the radiation fallout contaminated the cities' water supplies, food sources, and half of the populations of each city were stricken with disease.

The Soviet republics of Ukraine and Belarus are part of a scenario like this after a reactor at the Chernobyl nuclear power plant suffered a meltdown in 1986.

ii. CBRNs

CBRN are weaponized or non-weaponized Chemical, Biological, Radiological and Nuclear materials that can cause great harm and pose significant threats in the hands of terrorists. The term is used to describe a non-conventional terror threat that, if used by a nation, would be considered use of a weapon of mass destruction.

Examples include Saddam Hussein's Halabja poison gas attack, and Lord Amherst giving smallpox laden blankets to Native Americans.

f. Transportation

i. Aviation

Air disasters are an incident rather than an accident. It is associated with the operation of an aircraft. An aircraft is a vehicle ranging from a helicopter, an airliner, or a space shuttle. The world's worst airliner disaster is the Tenerife crash of 1977, when miscommunications between air traffic control and an aircrew caused two fully-laden jets to collide on the runway, killing 583 people.

ii. Train

A train wreck or train crash is a type of disaster involving one or more trains. This often occurs as a result of miscommunication. When a moving train meets another train on the same track accident occurs. Again if a train wheel jumps off a track in a derailment or when a boiler explosion happens there will be train accidents causing disaster.

iii. Road

Traffic collisions are the leading cause of death, and road-based pollution creates a substantial health hazard, especially in major conurbations. The greenhouse effect of road transport is a significant fraction of the

anthropogenic warming effect, and the rapid consumption of fossil fuel accelerates the Hubbard peak.

iv. Space

Space travel presents significant hazards, mostly to the direct participants (astronauts or cosmonauts and ground support personnel), but also carry the potential of disaster to the public at large. Accidents related to space travel have killed 22 astronauts and cosmonauts, and a larger number of people on the ground.

An example is the Space Shuttle Columbia, which disintegrated during a landing attempt over Texas in 2003, with a loss of all seven astronauts on board. The debris field extended from New Mexico to Mississippi.

3. Costs

Some man-made disasters have been particularly notable for the high costs associated with responding to and recovering from them, including:

Chernobyl disaster, 1986: $15 billion estimated cost of direct loss. It is estimated that the damages could accumulate to €235 billion for Ukraine and €201 billion for Belarus in the thirty years following the accident;

Three Mile Island, 1979: $1 billion;

September 11 attacks, 2001: $20.7 billion;

Exxon Valdez oil spill, 1989: The clean-up of oil spill cost an estimated $2.5 billion; recovery for settlements, $1.1 billion; and the economical loss (fisheries, tourism, etc) suffered due to the damage to the Alaskan ecosystem was estimated at $2.8 billion;

The costs of disasters vary considerably depending on a range of factors, such as the geographical location where they occur. When a disaster occurs in a densely-populated area in a wealthy country, the financial damage might be huge, but when a comparable disaster occurs in a densely-populated area in a poorer country, the actual financial damage might relatively small, in part due to a lack of insurance. For example, the 2004 Indian Ocean earthquake and tsunami (although obviously not man-made) with a death toll of over 230,000 people, cost a 'mere' $15 billion, whereas the Deepwater Horizon oil spill, in which 11 people died, the damages were six-fold.

1.8 IMPACT OF DISASTERS – SOCIO-ECONOMIC AND POLITICAL.

India is among the world's most disaster-prone areas as a large part of the country is exposed to natural hazards. These have turned into disasters causing loss of life and property. The consequences of natural disasters caused by earthquakes, floods, volcanic eruptions on, landslides, and hurricanes are catastrophic. In recent years these hazards took toll of

thousands of lives and caused massive destruction of property. These have adversely affected the vital sectors of the country's development as agriculture, communication, irrigation, power projects and rural and urban settlements get affected. However, irrespective of the duration of a disaster, the damage in the form of deaths, injuries and losses of property is immense. The magnitude of the disasters can be judged by the fact that only during the past two decades; occurrences of floods, earthquakes, landslides, cyclones, etc. have killed several million people.

1.9 NEED OF DISASTER MANAGEMENT IN INDIA

India is the largest democracy and the second most populous country in the world with about 6 billion people. India is integrated, yet highly diversified country. India lies in South Asia, surrounded on three sides by the Arabian Sea, the Indian Ocean, and the Bay of Bengal. To the north there are the Himalayan mountain ranges. The geographical area of India is 3.4 million square kilometers, and the coastline is 7,500 kilometers long. India was economically the richest country in the world till Mughals invaded for looting. India knew mining and processing of diamonds, and all the great diamonds belonged to India. The per capita GDP in 2005 was only $ 736, and India stood at 128th among the countries in terms of the Human Development Index (UNDP 2007).Poverty is the main root cause of disasters in India.

Having some of the world's most severe droughts, famines, cyclones, earthquakes, chemical disasters, mid-air head-on air collisions, rail accidents, and road accidents, India stands out to be the most disaster prone countries of the world. India is also one of the most terrorist prone countries.

India was, until recently, reactive and only responded to disasters and provided relief from calamity. It was a relief driven disaster management system. India also has world's oldest famine relief codes. In recent times, there has been a paradigm shift and India has become or is becoming more proactive with emphasis on disaster prevention, mitigation and preparedness.

Traditionally India accepted international help in responding to disasters. Although, after the 2004 Indian Ocean tsunami, India refused to accept international response assistance from foreign governments, it deployed its defense personnel, medical teams, disaster experts, ships, helicopters, and other type of human, material, and equipment resources to help Sri Lanka, Mauritius, and Indonesia. It may be noted that India itself suffered from the tsunami and was internally responding at the same time.

Disasters do not recognize or respect national geographic boundaries. The tsunami experience illustrates it vividly. In the increasingly globalized world, more disasters will be spread over many countries and will be regional in nature. India has set up an example of responding internally and simultaneously in neighboring countries for the other countries to follow.

India took a pioneering step regarding disaster management. In the academic year 2003-2004, India planned of starting disaster management education as part of social sciences in class VIII. In the subsequent academic year 2004-2005 disaster management, was added to class IX. In the following academic years disaster management was progressively added to classes XI and XII. This was done by the Central Board of Secondary Education. India is also implementing community based disaster management program, along with disaster management education in schools, with the help of United Nations Development Program in all-hazard vulnerable districts.

Some changes have been brought in disaster policy and creation of new organizations on the basis of catastrophic disasters in recent times. Policy changes include the enactment of Disaster Management Act, 2005 and development of the national disaster management response framework. The National Disaster Management Authority was established to spearhead in creation of culture of disaster resilience. The National Institute of Disaster Management itself and along with Disaster Management Cells in the states is providing training opportunities in disaster management.

1.8.1 Disaster Policy

The mode of Indian disaster policy has been changed from response and calamity relief to disaster prevention, preparation and mitigation. Another significant change of disaster management is to move from government to public private partnership, and community disaster management. In this regard, significant changes have been made, but the authoritarian attitude of the government officials is the main stumbling block.

After the Great Famine of 1876-1878 the Famine Commission of 1880 was constituted and there was eventual adoption of Famine Relief Code. India probably has the world's oldest disaster relief code which started in1880. This relief code provides details of the relief to be given by the government to the affected people.

The India Disaster Report (Parsuraman and Unikrishnan 2000) provides the nature of disaster response by the government of India. It identifies key issues with respect to the availability of and access to disaster-related information and its quality, the absence of coherent disaster preparedness and response policy, and urgent actions and interventions needed. It shows that significant advances in health and social and economic development have been repeatedly interrupted and reversed by disasters.

Although India was following five year national plans, the earlier five year plans did not mention disaster management. The Tenth Five-Year Plan 2002-2007 for the first time had a detailed chapter entitled Disaster Management and The Development Perspective. The plan emphasized the fact that no development will be sustainable without mitigation being built into the development process. Disaster mitigation and prevention were adopted as essential component of the development strategy.

High priority was given to Disaster management in the country. The Eleventh Five Year Plan 2007-2012 (Planning Commission 20008) states, "The development process needs to be sensitive towards disaster prevention, preparedness and mitigation. Disaster management has therefore emerged as a high priority for the country. Going beyond the historical focus on relief and rehabilitation after the event, there is a need to look ahead and plan for disaster preparedness and mitigation in order to ensure that periodic shocks to our development efforts are minimized."

The Eleventh Five Year Plan aims at consolidating the process by giving impetus to projects and programs that develop and nurture the culture of safety and the integration of disaster prevention and mitigation into the development process.

The guidance and direction to achieve this paradigm shift will need to flow from National Disaster Management Authority (NDMA), and in the true spirit of the Disaster Management Act, 2005 to all stakeholders including State Governments and Union Territories, right up to the Panchyat Raj (local administration by five locally elected citizens) Institutions. Communities at large will need to be mobilized to achieve this common objective as they are the first responders (and not the usually thought fire, ambulance, and police). Even the best of isolated efforts will not bear fruit unless they are part of an overall, well-considered approach, and responsibilities of all stakeholders are clearly spelt out and accountability and sustainability factored in.

The impact of 2001 Gujarat Earthquake was huge. It had very serious effect on the government and policy makers, in addition to victims, their families, and general citizenry. The Government of Gujarat for the first time in India enacted the Gujarat Disaster Management Act, 2003. Before that, neither at the federal level nor at the state level there was any act to deal with the management of disasters of various kinds in a comprehensive manner. The state and federal governments were largely following the relief code and the rules and regulations, and the government orders issued over the years, which were not consolidated.

❖ **Every citizen's aid is demanded for the following purposes, namely**

(a) Prevention,

(b) Response,

(c) Warning,

(d) Emergency operation,

(e) Evacuation, and

(f) Recovery.

The recurrent occurrences of different types of disasters compelled Government of India to establish many different committee and

commissions to suggest dealing with the problem. Recently there is the establishment of High Power Committee on Disaster Management (HPC) in 1999 for making recommendations on the preparation of Disaster Management plans and suggestions for effective mitigation mechanisms.

The Government of India has long been thinking of a National Disaster Management Authority. The Gujarat earthquake gave extra impetus for having a national disaster management authority.

Finally on December 23, 2005 the Disaster Management Act, 2005 was enacted by the Government of India. The Disaster Management Act, 2005 mandated creation of National Disaster Management Authority, with Prime Minister as the Chairman, and State Disaster Management Authorities headed by the respective Chief Ministers, to spearhead and implement a holistic and integrated approach to disaster management in India. The act also provided for creation of National Institution of Disaster Management.

NDMA has prepared a disaster management policy framework. The themes underpinning this policy are:

- Community-based disaster management, including integration of the policy, plans and execution at the grass root level.
- Capacity development in all related areas.
- Consolidation of past initiatives and best practices.
- Cooperation with agencies at national, regional and international levels.
- Compliance and coordination to generate a multi-sectoral synergy.
- The objectives guiding the policy formulation have evolved to include:
- Promoting a culture of prevention and preparedness – by centre-staging disaster management (DM) as an overriding priority at all levels and at all times.
- Encouraging mitigation measures based on state-of-the-art technology and environmental sustainability.
- Mainstreaming DM concerns into the development planning process.
- Putting in place a streamlined institutional techno-legal framework in order to create and preserve the integrity of an enabling regulatory environment and a compliance regime.
- Developing contemporary forecasting and early warning systems backed by responsive and fail-safe communications and Information Technology (IT) support.

- Promoting a productive partnership with the Media, NGOs and the Corporate Sector in the areas of awareness generation and capacity development.
- Ensuring efficient response and relief with a caring humane approach towards the vulnerable sections of the society.
- Making reconstruction an opportunity to build back better and construct disaster-resilient structures and habitats (NDMA 2009).

Presently the Emergency Management and Research Institute (EMRI), a non-profit professional organization, operating in the Public Private Partnership mode, have brought out significant improvements in dealing with emergency medical services. This is a free service delivered through state-of-art emergency call response centres and has over 1,800 ambulances across Andhra Pradesh, Gujarat, Uttarakhand, Goa, Chennai, Rajasthan, Karnataka, Assam and Meghalaya. EMRI handles medical, police and disaster emergencies. More emphasis is put on medical help, through the "1-0-8 Emergency service".

Although India refused any foreign aid for response and relief after the tsunami it has welcomed foreign institutional support for rehabilitation, and reconstruction investment. India has reconstruction investment projects with World Bank and the Asian Development Bank.

It may be clarified that the Government of India refused to receive the financial assistance for response and relief from the foreign governments. However, the government did not prevent private organizations or individuals from providing assistance through private channels.

The government also passed a comprehensive new environmental law called the Environmental Protection Act of 1986. The new law vastly improved regulatory coverage of hazardous technologies and substances.

SUMMARY

After going through the chapter we may conclude that natural disasters are very much part of the natural cycles. It is somewhat obvious that public perception plays an important role in natural disaster management. Existing technologies are capable in providing important as well as new information to the disaster managers that could save lives, reduce damage to property, and lessen the environmental impacts of natural disasters. In spite of all these there are innumerable shortcomings that inhibit optimal decision-making for disaster management. Disasters are of three types, natural disasters, man-made disasters and technological disasters. Often the best response to natural or man-made disasters can be effective planning before tragedy strikes. Disaster management will be fruitful if the managers themselves know what to do in a disaster and how to prepare for one.

As a result of her unique geo-climatic conditions India has been traditionally vulnerable to natural disasters such as floods, droughts,

cyclones, earthquakes and landslides. The loss in terms of private, community and public assets has been astronomical. It is the poor and the under-privileged who are worst affected on account of disasters. Hence in India disaster management occupies an important place in this country's policy. Furthermore, identification of hazards and assessment of risks affecting the state is a vital step in the process of reducing the impacts of disasters.

1.10 CHECK YOUR PROGRESS/ EXERCISE

1. True false

a. A disaster is separated from an accident by its magnitude of need and victims involved.

b. Man made refer to those disasters that are triggered by natural phenomena such as earthquakes, cyclones, floods, etc.

c. Overgrazing or poor farming practices in the upper portions of a watershed has increased flooding.

d. The catastrophic gas leak at the pesticide plant in Bhopal, India, in 1984 is an example of man-made disaster

e. Communication plays a pivotal role in disaster reduction.

2. Fill in the blanks

a. A hazard is a situation where there is a threat to life, health, environment or property where as, a _____ is an event that completely disrupts the normal ways of a community.

b. Risk increases with increase in hazards and vulnerability and decreases with the increase in_____.

c. Minimizing the effects of disaster such as building codes and zoning, vulnerability analyses and public education is known as _____.

d. Disasters do not recognize or respect national geographic_____.

e. _____ disasters are more economic than physical.

3. Multiple choice question

a. Man-made disasters can be divided into the following categories

i. environmental degradation, increased desertification resulting from overgrazing, and disasters that are not caused by natural hazards but that occur in human settlements.

ii. armed conflict, technological disasters, and disasters that are not caused by natural hazards but that occur in human settlements.

iii. result of accidents or incidents occurring while distribution of hazardous substances, armed conflict, environmental degradation.

b. Hazards are termed as disasters

i. when they cause widespread destruction of property and human lives.

ii. when they cause great loss to agricultural field only.

iii. when they cause great loss human lives after epidemic.

c. In disaster management phasepreparedness means

i. planning how to respond

ii. returning the community to normal.

iii. minimizing the effects of disaster.

d. India has brought some changes in disaster policy that include

i. the enactment of Disaster Management Act, 2010 and development of the national disaster management response framework

ii. the enactment of Hazards Management Act, 2005 and development of the national disaster management response framework

iii. the enactment of Disaster Management Act, 2005 and development of the national disaster management response framework.

e. The two main windows presently open for meeting relief expenditure related to natural disasters are

i. Orissa State Disaster Management Authority (OSDMA) and the Calamity Relief Fund (CRF)

ii. National Disaster Response Force (NDRF) and National Disaster Mitigation Resource Centre (NDMRC)

iii. the Calamity Relief Fund (CRF) and National Calamity Contingency Fund (NCCF).

4. Answers the following Questions

1. Define disaster.
2. What are the differences between hazards, calamity and disaster-
3. What are the financial arrangements in Disaster management in India?
4. What is the Role of NGOs in disaster management in India?
5. How does community based organizations help in disaster management in India?
6. State the role of geography and GIS in disaster management.
7. What is disaster management cycle?

1.11 ANSWERS TO THE SELF LEARNING QUESTIONS

1.a. true

1.b.false, Natural disasters

1.c.true

1.d.false, Technological Disasters

1.e. true

2.a. disaster

2.b. capacity

2.c. mitigation

2.d. boundaries

2.e. Technological

3.a.ii.

3.b.i.

3.c.i.

3.d.iii.

3.e.iii.

1.12 TECHNICAL WORDS

1. **Disaster**-is an event that completely disrupts the normal ways of a community and brings human, economic and environmental losses upon the community.
2. **Hazard**-is a situation that poses a level of threat to life, health, property, or environment.
3. **Calamity**: a serious accident or bad event causing damage or suffering
4. **Vulnerability**-is the diminished capacity of an individual or group to anticipate, cope with, resist and recover from the impact of a natural or man-made hazard.
5. **Capacity-**is a combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster
6. **Emergency services**-The set of specialized agencies that have specific responsibilities and objectives in serving and protecting people and property in emergency situations.

7. **Environmental degradation**-The reduction of the capacity of the environment to meet social and ecological objectives and needs.
8. **Risk**: The combination of the probability of an event and its negative consequences.
9. **Mitigation**: The lessening or limitation of the adverse impacts of hazards and related disasters.
10. **Forecast**: Definite statement or statistical estimate of the likely occurrence of a future event or conditions for a specific area.

1.13 TASK

1. In a chart draw Disaster management cycle and describe how it functions
2. In a chart with the help of bullets write down the disaster management policy framework prepared by National Disaster Management Authority (NDMA).

1.14 REFERENCES FOR FURTHER STUDY

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2. Module 4 - Capacity Building in Asia using Information Technology Applications (CASITA)
3. Asian Disaster Preparedness Center (ADPC), Bangkok.
4. Encyclopedia of Disaster Management: Volume IV by Alfred Scott
5. Disaster Management: Future Challenges and Opportunities by Jagbir Singh
6. Disaster Management by Harsh K. Gupta
7. Oxford dictionary

2

ELEMENTS OF DISASTER MANAGEMENT

After going through this chapter you will be able to understand the following features:

Unit Structure :

2.1. OBJECTIVES

By the end of this unit, you will be able to –

- Understand the meaning and concept of disaster management.
- Role of the international organization for disaster management – UNISDR, INSARAG, RED CROSS
- Role of National organizations for Disaster management
- Role of NGOs, and community in Disaster management.

2.2 INTRODUCTION

The main aim of learning about disaster management is to lessen the impact of disasters around the world. The United Nations defines a disaster as a serious disruption of the functioning of a community or a society. It essentially deals with the management of resources and information on disastrous events. Disaster management tries to coordinate these resources effectively and seamlessly. The role of the Indian government in the prevention and control of disasters is noticeable.

2.3. SUBJECT-DISCUSSION

Disaster management is a relatively new identifiable profession, where the tasks of a disaster manager, is of a disaster relief assistant during and after a disaster emergency. It is not necessarily a full-time activity. Indeed, for most people in the field, their concerns for disaster issues form only a part of their total responsibilities. There has been a growing awareness in recent years that all of these disaster management activities, in fact, comprise the process of disaster management. But the role of people who are involved in the field of disasters must be coherent and cohesive. This includes the spectrum of activities from administration to project implementation. Also Disaster prevention to disaster mitigation to disaster preparedness to disaster response comes under this category. Disaster management would succeed only if there is elimination of the underlying causes of disasters. This would again contribute to minimizing the people's vulnerability to disaster. Positive responses to emergencies will make an enormous impact on the current deadly state of disaster events. Disaster managers will require several skills and technologies to achieve their goal and must have vigorous training.

The term "disaster management" includes the complete field of disaster-related activities. Generally, people have an intention to think of disaster management in terms of the post-disaster actions taken by relief and reconstruction officials. But it is observed that disaster management covers a much broader scope where many modern disaster managers find themselves far more involved in pre-disaster activities than in post-disaster response.

2.4 DISASTER MANAGEMENT - MEANING AND CONCEPT

Definition:

Disaster management is a process of effectively preparing for and responding to disasters. It involves strategically organizing resources to lessen the harm that disasters cause. It also involves a systematic approach to managing the responsibilities of disaster prevention, preparedness, response, and recovery.

Concept and Meaning

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 has

been done to their community 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, or fires, or It is a phenomenon that disasters can cause damage to lifdamagerty and destroy the economic, social and cultural life of people.Disaster is the exposure of a group of people to a hazard, leading to a serious disruption of the functioning of a society and causing human, material, economic environmental losses which exceed the ability of the affected community or society to cope. A disaster results from a combination of hazards and vulnerability that exceeds the capacity of society to reduce the potential negative consequences of risk. Hazard is an extreme event, natural or man-made , with a destructive potential to social, economic and human assets. These may include future threats, and may be"natural" (geological,hydro meteorological andbiological) or"manmad" (Conflict, environmental degradation and technological hazards).Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation. A disaster is a calamitous, distressing, or ruinous effect of a disastrous event which seriously affects or disrupts (or threatens to disrupt) the critical functions of a community, society or system, for a period long enough to significantly harm it or cause its failure. It is beyond the heapability of the local community to overcome it. The stricken community needs extraordinary efforts to cope with it, often with outside help or international aid. It is a situation resulting from an environmental phenomenon or armed conflict that produces stress, personal injury, physical damage, and economic disruption of great magnitude.

2.5 ROLE OF THE INTERNATIONAL ORGANIZATION FOR DISASTER MANAGEMENT – UNISDR, INSARAG, RED CROSS

UNISDR:United Nations Office for Disaster Risk Reduction 1989 International Decade for Natural Disaster Reduction

Given the increasing concern about the impact of disasters, the UN General Assembly declared 1990-1999 the International Decade for Natural Disaster Reduction (IDNDR). Initially, IDNDR was influenced largely by scientific and technical interest groups. However, the broader global awareness of the social and economic consequences of disasters caused by natural hazards developed as the decade progressed.

1994 First World Conference on Disaster Reduction and the Yokohama Strategy for a Safer World

The Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action was adopted at the World Conference on Natural Disaster Reduction, building on the mid-term review of the International Decade for Natural Disaster Reduction.

1999 International Strategy for Disaster Reduction (ISDR)

The International Strategy for Disaster Reduction (ISDR) was launched 3 by the Economic and Social Council and endorsed by the General Assembly as an international framework for responding to the challenge presented to the international community by the increasing incidence and scale of disasters. UNISDR was created as an inter-agency secretariat of ISDR together with the Inter-Agency Task Force on Disaster Reduction. The UNISDR mandate was then expanded to serve as a focal point within the United Nations System for the coordination of disaster reduction and to ensure synergies among the disaster reduction activities of the UN system and regional organizations and activities in socio-economic and humanitarian fields. Further mandates are to promote public awareness and commitment, to expand networks and partnerships, and to improve knowledge of disaster causes and options for risk reduction, building on the Yokohama Strategy and Plan of Action and as a follow-up to the International Decade for Natural Disaster Reduction.

2002 The Johannesburg Plan of Action

The World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, noted that "an integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, response and recovery, is an essential element of a safer world in the twenty- first century."4 The Johannesburg Plan of Implementation provided UNISDR and the Inter-Agency Task Force with a concrete set of objectives for integrating and mainstreaming risk reduction into development policies and processes.

2005 Second World Conference on Disaster Reduction and the Hyogo Framework for Action 2005-2015

The World Conference on Disaster Reduction was held in Kobe, Hyogo, Japan and adopted the "Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters", which is currently serving as the guiding document in strengthening and building international cooperation to ensure that disaster risk reduction is used as a foundation for sound national and international development agendas.

2007 First session of the Global Platform on Disaster Reduction

The UN General Assembly established a biennial Global Platform on disaster risk reduction to support the implementation of the Hyogo Framework for Action, allowing government representatives, NGOs,

scientists, practitioners, private sector, IFIs and UN organizations to share experiences, identify remaining gaps, formulate strategic guidance and advice for the implementation of the HFA. Six Regional Platforms and over 80 National Platforms have also been established as multi-stakeholder forums.5 Regional Platforms also assess progress but focus on the details of the regional plans of implementation and National Platforms act as the national coordinating body for disaster risk reduction.

2011 Programme of Action for the Least Developed Countries for the Decade 2011-2020

The Istanbul Programme of Action (IPoA) charts out the international community's vision and strategy for the sustainable development of LDCs for the next decade with a strong focus on developing their productive capacities. The Programme recognized that the scale and impact of natural disasters has increased over recent decades, threatening hard-won development gains of LDCs. It encourages LCDs to take action in implementing and integrating disaster risk reduction in their national and long-term planning and policies.

2012 United Nations Conference on Sustainable Development - Rio+20

The outcome Document - The Future We Want – of the United Nations Conference on Sustainable Development – Rio 20+ held in Rio de Janeiro, Brazil on 20–22 June 2012 contains a section (Chapter V-A) on disaster risk reduction that sets a firm foundation for discussions on a post-2015 framework to continue guiding nations after the Hyogo Framework expires in 2015.

2014 Third International Conference on Small Island Developing States and the SIDS ACCELERATED MODALITIES OF ACTION (S.A.M.O.A.) Pathway

The S.A.M.O.A. Pathway recognize that Small Island Developing States continue to grapple with the effects of disasters, some of which have increased in intensity and some of which have been exacerbated by climate change, which impede their progress towards sustainable development. It recognize that disasters can disproportionately affect small island developing States and that there is a critical need to build resilience, strengthen monitoring and prevention, reduce vulnerability, raise awareness and increase preparedness to respond to and recover from disasters.

2015 Third United Nations World Conference on Disaster Risk Reduction and the Sendai Framework for Disaster Risk Reduction 2015-2030

The Third United Nations World Conference on Disaster Risk Reduction was held in Sendai, Japan from 14 to 18 March 2015, drawing 6,500 delegates to the conference itself and 50,000 people to the associated Public Forum.[19] The Conference adopted the Sendai

Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) as the first major agreement of the Post-2015 Development Agenda, with seven global targets and four priorities for action.

The Sendai Framework for Disaster Risk Reduction 2015-2030 is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. The HFA was conceived to give further impetus to the global work under the International Framework for Action for the International Decade for Natural Disaster Reduction of 1989, and the Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action, adopted in 1994 and the International Strategy for Disaster Reduction of 1999.

It is a 15-year non-binding agreement which recognizes that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders. It aims for the following outcome:

"The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries."

2017 Fifth session of the Global Platform on Disaster Reduction

The 2017 Global Platform for Disaster Risk Reduction, held in Cancun, Mexico on 22-26 May drew in more than 5000 participants, among which were policy makers and disaster risk managers. Thousands of governments, international organizations and civil society representatives were in attendance. It was the first time the forum was organized outside Geneva and the global progress in the implementation of the Sendai Framework for Disaster Risk Reduction adopted in Japan in 2015 was reviewed.During the forum, Nigerian climate change activist, Olumide Idowu, who was a member of the organizing committee and represented youth and children, was assigned to lead the social media team.

Mandate:

UNDRR's mandate has been defined by a number of United Nations General Assembly Resolutions, the most notable of which is "to serve as the focal point in the United Nations system for the coordination of disaster reduction and to ensure synergies among the disaster reduction activities of the United Nations system and regional organizations and activities in socio-economic and humanitarian fields".

Its core areas of work include ensuring DRR is applied to climate change adaptation, increasing investments for DRR, building disaster-resilient cities, schools and hospitals, and strengthening the international system for DRR.

Management:

UNDRR is led by the Special Representative of the Secretary-General for Disaster Risk Reduction. Mami Mizutori took up office in this role on 1 March 2018, succeeding Robert Glasser of Australia. Prior to this, the organization was led by Margareta Wahlström of Sweden, who was the first Special Representative of the Secretary-General for Disaster Risk Reduction and had been appointed in November 2008.Robert Glasser took up his post in January 2016.From 1999 to 2008, UNDRR had been led by a UN Director-level official, under the auspices of the United Nations Office for the Coordination of Humanitarian Affairs.

The functions of the Special Representative of the Secretary-General for Disaster Risk Reduction include leading and overseeing UNDRR in the executions of its functions entrusted by the United Nations General Assembly, United Nations Economic and Social Council and the Hyogo Framework for Action (HFA) and its successor the Sendai Framework, as well as policy directions by the Secretary-General, overseeing the management of the Trust Fund for the International Strategy for Disaster Reduction, and carrying out high-level advocacy and resource mobilization activities for risk reduction and implementation. The Special Representative also ensures the strategic and operational coherence between disaster-reduction and humanitarian disaster preparedness and response activities, as well as socio-economic activities of the UN system and regional organizations.

INSARG : INTERNATIONAL SEARCH AND RESCUE ADVISORY GROUP

The International Search and Rescue Advisory Group (INSARAG) is a network of disaster-prone and disaster-responding countries and organizations dedicated to urban search and rescue (USAR) and operational field coordination. It aims to establish standards and classification for international USAR teams as well as a methodology for international response coordination in the aftermath of earthquakes and collapsed structure disasters. The INSARAG Secretariat is located in the United Nations Office for the Coordination of Humanitarian Affairs (OCHA)

Establishment:

INSARAG was established in 1991 following initiatives of international USAR teams that responded to the 1988 Armenia earthquake and the 1985 Mexico City earthquake.[1] The United Nations was chosen as the INSARAG Secretariat to facilitate international participation and coordination. INSARAG Secretariat is hosted in the Emergency Response Section (ERS) of the Response Support Branch (RSB) (which was called in the past "Field Coordination Support Section of the Emergency Services Branch") of OCHA in Geneva.

INSARAG activities are guided by UN General Assembly Resolution 57/150 of 16 December 2002 on "Strengthening the Effectiveness and

Coordination of International Urban Search and Rescue Assistance" and by the INSARAG Hyogo Declaration adopted at the first INSARAG Global Meeting in 2010 in Kobe, Japan.

The INSARAG Mandate entails the development of effective international USAR procedures and operational standards, implementation of UN General Assembly Resolution 57/150 of 22 December 2002 on "Strengthening the effectiveness and coordination of USAR assistance", improving cooperation and coordination amongst international USAR teams at disaster sites, promoting activities to improve USAR preparedness in disaster-prone countries, development of standardized guidelines and procedures, and sharing best practices amongst national and international USAR teams and defining standards for minimum requirements of international USAR teams.

Membership:

Any country or organization with a stake in urban search and rescue may join INSARAG. Countries that wish to join identify a national focal point that acts as an interface with the INSARAG Regional Group and the Secretariat. Organizations wishing to join apply to the Secretariat through their national focal point. Member countries with USAR teams deploying internationally are strongly encouraged to apply for an INSARAG External Classification (IEC), however, this is not a requirement to be a member of INSARAG.

INSARAG members are part of a worldwide knowledge-sharing network on collapsed structure rescue and operational field coordination. They are invited to annual meetings of the relevant INSARAG Regional Group and to participate in INSARAG working groups. The members are expected to have access to the Virtual OSOCC (Virtual On-Site Operations Coordination Centre) and the Global Disaster Alert and Coordination System (GDACS) on the internet, which provide alert notification in the event of a sudden-onset disaster and real-time information updates and coordination during ongoing disasters. The USAR Directory, managed by the INSARAG Secretariat, provides an overview of INSARAG member countries and their USAR teams.

RED CROSS:

The International Committee of the Red Cross (ICRC) is a humanitarian institution based in Geneva, Switzerland.

The mission of ICRC is to alleviate human suffering, uphold human dignity, protect life and health, especially during armed conflicts and other emergencies. ICRC is present in every country and is supported by millions of volunteers.

Latest context on International Committee of the Red Cross (ICRC) –

The Rastriya Raksha University (RRU) in Gujarat, an institution of national importance in India and the International Committee of the Red Cross (ICRC) Regional delegation in New Delhi on 10 December 2020

virtually signed a Memorandum of Understanding on academics, research, training, capacity building and extension activities.

The aim is to generate awareness, know-how and create a specialized human resource for security, strategy, capacity building and R&D expertise.

To leverage ICRC and RRU work together for addressing major issues concerning security, defense and international humanitarian law. With its mandate to protect the victims of International and Internal armed conflicts, ICRC has been three-time Nobel Prize Laureates.

ICRC is a part of the International Red Cross and Red Cresent Movement along with the International Federation of Red Cross and Red Cresent Society and 192 National Societies.

Overview of the International Committee of the Red Cross are as follows:

Formation	17 February 1863
Type	Private humanitarian organization
Purpose	Protecting victims of conflicts
Regions Served	Worldwide
President	Peter Maurer
Vice President	Gilles Carbonnier
Director-General	Robert Mardini
Staff	15,448 (average number of ICRC staff in 2016)

Origin and Development of International Committee of the Red Cross (ICRC)

1. The International Committee of the Red Cross came into being in 1864 by the work of Jean-Henri Dunant, a Swiss humanitarian, who organised emergency aid for the wounded soldiers of Austria and France in the Battle of Solferino in 1859.

2. In his book *UN Souvenir de Solferino* (1862; "A Memory of Solferino"), Dunant proposed voluntary relief societies in all countries.

3. The Geneva Convention of 1864 committed the signatory governments to care for the wounded of war, whether enemy or friend. This Convention was revised and new conventions to protect victims of

warfare at sea (1907), prisoners of war (1929), and civilians in times of war (1949) were adopted.

4. The Red Cross is the name used in the countries under Christian sponsorship while Red Crescent is used in the Muslim countries.

5. The ICRC is a private institution acting as a neutral and independent intermediary in humanitarian matters during international conflicts and other international disturbances. Its work is prompted by the desire to promote humane conduct and is guided by empathy for the victims. The ICRC remains detached from all political issues related to the conflict.

Objectives of ICRC

1. The ICRC acts to help all victims of war and internal violence, attempting to ensure implementation of humanitarian rules restricting armed violence.

2. Its mission arises from the basic human desire to lay down a rule governing the use of force in war and to safeguard the dignity of the weak.

3. With a mandate from the international community to help victims of war and internal violence and to promote compliance with International humanitarian law, the ICRC strives for protecting and assisting the victims of armed conflict and internal violence so as to preserve their physical integrity and their dignity and to enable them to regain their autonomy as quickly as possible.

Geneva Convention [1864, 1906, 1929, 1949]	Yemeni Civil War: Background and Humanitarian Crisis	People's Protection Units (YPG)
Armed Forces & Central Armed Police Forces	Armed Forces Special Powers Act (AFSPA)	Global Terror Convention – Protocols, Clauses
National Security Doctrine |	Internal Security and Disaster Management	Armed Forces Tribunal (AFT) India
Defence Communication Network	Nagorno-Karabakh Conflict	India-China Conflict – Galwan Valley Clash
Civil War in Syria	United Nations Peacekeeping	Conflicts in West Asia

Structure of ICRC

1. The Red Cross consists of the International Committee, the League of Red Cross and Red Crescent Societies and the National Red Cross and Red Crescent Societies.
2. The International Committee is an independent council of 25 Swiss citizens.
3. During a war, the Committee acts as an intermediary among belligerents and also among National Red Cross Societies.
4. It visits prisoners in war camps and provides relief supplies, mail and information for their relatives.
5. The League of Red Cross and Red Crescent societies help in providing relief to victims of national disaster and aid in the development of national societies.

Activities of International Committee of the Red Cross (ICRC)

1. Being a humanitarian agency, the Red Cross has national affiliates in almost every country in the world.
2. It was established primarily to care for the victims of war but now the organisation is also involved in the task of aiding in the prevention and relief of human suffering which includes first aid, accident prevention, water safety, training of nurses' aids and mothers' assistants and maintenance of maternal and child welfare centres and medical clinics, blood banks and many other services.
3. The ICRC acts in consultation with all other organizations involved in humanitarian work.
4. It systematically reminds all military and civilian authorities directly involved in armed conflict or internal violence of their obligations under international humanitarian law and the other humanitarian rules by which they are bound.
5. The Committee acts as an intermediary between the parties to armed conflict and promotes dialogue in situations of internal violence, with a view to finding solutions for matters of humanitarian concern.

2.6 ROLE OF NATIONAL ORGANIZATIONS FOR DISASTERMANAGEMENT

National Disaster Management Authority (NDMA): The NDMA which was initially established on 30 May 2005, was formally constituted on 27 September 2006, in accordance with Section 3(1) of the Disaster Management Act, 2005, under the Chairmanship of the Prime Minister. The NDMA is mandated to lay down policies and guidelines on effective and timely disaster management for different Ministries, Departments of

Government of India and State Governments for the integration of risk reduction measures into their development plans and projects. It also acts as a coordinating and enforcing body for the implementation of disaster management plans.

The National Disaster Management Authority (NDMA), headed by the Prime Minister of India, is the apex body for Disaster Management in India. Setting up of NDMA and the creation of an enabling environment for institutional mechanisms at the State and District levels is mandated by the Disaster Management Act, 2005. NDMA is mandated to lay down the policies, plans and guidelines for Disaster Management. India envisions the development of an ethos of Prevention, Mitigation, Preparedness and Response.

The Indian government strives to promote a national resolve to mitigate the damage and destruction caused by natural and man-made disasters, through sustained and collective efforts of all Government agencies, Non-Governmental Organizations and People's participation. This is planned to be accomplished by adopting a Technology-Driven, Pro-Active, Multi-Hazard and Multi-Sectoral strategy for building a Safer, Disaster Resilient and Dynamic India.

The NDMA Logo reflects the aspirations of this National Vision, of empowering all stakeholders to improve the effectiveness of Disaster Management in India. NDMA has 5 major divisions viz. Policy & Plans, Mitigation , Operations & Communications & Information & Technology, Administration and Finance.

National Institute of Disaster Management (NIDM): Under Section 42 of the Disaster Management Act, 2005, NIDM was constituted to be the premier institute for capacity building, training and development for disaster management in India. The institute believes in a "Culture of Prevention" outlook towards disaster risk reduction. Through a strategic, multi-stakeholder and multi-disciplinary approach, the institute develops training modules, organizes training programs, undertakes research and documentation and promotes courses, lectures and conferences on disaster management and risk reduction.During the financial years 2019-20 & 2020-21, Grant-in-Aid General of Rs. 12.00 Crore each was released to NIDM to meet their day to day expenditure on salary of staff, office expenses, training prrogrammes, travel, publicity, publication, payment of rent and other committed expenditure.

Directorate General of Fire Service, Civil Defence and Home Guards (DG FS, CD & HG): The Directorate General of Civil Defence was established under Ministry of Home Affairs in 1962 to handle all policy and planning matters related to Civil Defence, Fire Services and Home Guards, including the functioning of the National Fire Service College. An IPS officer in the rank of Director General of Police heads the organization.

National Disaster Response Force (NDRF): The NDRF was constituted under Section 44 of the Disaster Management Act, 2005 for a specialized

response to natural and man-made disasters. At present, NDRF comprise of 12 battalions, with each battalion consisting 1149 personnel. All the 12 battalions are located in Assam, West Bengal, Odisha, Tamil Nadu, Maharashtra, Gujarat, Uttar Pradesh, Punjab, Bihar, Andhra Pradesh and Arunachal Pradesh. These battalions have been trained and equipped to response to all man-made and natural disasters. It also looks after functioning of National College of Civil Defence.

National Fire Service College (NFSC): The National Fire Service College located in Nagpur, was established in 1956 with the aim of providing training to the Fire Officers of the country in advanced techniques of firefighting and rescue, and creating uniformity in the Fire Service organizations and their management across the country. It is a residential college. The college awards various courses such as B. E (Fire Engineering), Certificates, Diplomas and Advanced Diplomas , which are recognized by the Central and State Governments and public & private sectors. Infrastructure of the college is being upgraded to make it a world class Fire Training Institute. After upgradation, annual intake of the college will be more than 1400.

Coalition for Disaster Resilient Infrastructure Society (CDRIS) - Grantee Organisation:

The Government of India (on 28.08.2019) approved establishment of an international Coalition for Disaster Resilient Infrastructure (CDRI, as a Society, along with its supporting Secretariat office in New Delhi, at an outlay of Rs. 480 crore (approx. USD 70 million) for a corpus required to fund technical assistance and research projects on an ongoing basis over a period of 5 years from 2019-20 to 2023-24.

The rime Minister announced CDRI at the United Nations Climate Action Summit, in New York City on 23rd September 2019. Memorandum of Association (MoA) and Bye-laws for establishing the Secretariat of CDRI as 'CDRI Society' have been finalised. On 03.02.2020, CDRI Society has been registered.of India approved the fund provision through transfer of fund as Grants in Aid from MHA to the CDRI Society on a non-lapsable basis (for a period of five years from 201-20 to 2023-24). The Grants to CDRI Society is to execute CDRI Programmes through technical assistance and research projects on an ongoing basis and also towards covering recurring expenditure of Secretariat Operations and Management.So far, fund provision of CDRI activities are routed through NDMA. For this purpose, sanction order issued to NDMA from MHA's Budget Head 2245 "Relief on account of Natural Calamities". Till now, PAO NDMA is authorized to transfer following amount for CDRI:-

For FY 2018-19 - Rs. 12,1660 Crore

For FY 2019-20 - Rs. 20 Crore

For FY 2020-21 - Rs. 15 Crore

2.7 ROLE OF NGOs AND COMMUNITY IN DISASTER MANAGEMENT.

The Role of NGOs in Disaster management The key role which communities play in disaster management and disaster risk reduction is strongly acknowledged by the ISDR secretariat, whose vision is to "enable all communities to become resilient to the effects of natural hazards, technological and environmental disasters." Experiences show that community based approaches offer viable solutions for managing and reducing risks and ensuring sustainable development. Today, an increasingly predominant view is that for risk reduction strategies to be truly effective in protecting lives and livelihoods, they need to be people centered. They need to build on people's local knowledge and cultural practices, and apply tools and approaches that people can easily understand and integrate into their lives. Conversely, disaster reduction using top-down government and institutional interventions alone are often considered insufficient as they tend to have a lower understanding of community dynamics, perceptions and needs, and ignore the potential of local knowledge and capacities. On many occasions, local people and organizations are the main actors in disaster risk reduction and disaster response. When a disaster strikes, immediate response (i.e., search and rescue and care for those injured, traumatized and homeless) is often carried out by family members, friends and neighbours and grassroots organizations. In the case of the many small-scale events triggered by natural hazards, there may be little or no external support at all, especially in countries where government capacity is limited. Many members of local communities also represent the greatest potential source of local knowledge of hazardous conditions, and are the repositories of traditional coping mechanisms suited to their individual environment. Their awareness of historical risk scenarios is often stronger than that of other people. NGOs' involvement in DRR activities has proved beneficial for a number of reasons, including the following: NGOs can operate at grassroots level with communities and local organizations as partners, and take a participatory approach to development planning. This allows them to respond better to local people's priorities and build on local capacities. NGOs enjoy higher operational flexibility as they are relatively free from bureaucratic structures and systems, and better able to respond and adapt quickly and easily. NGOs often work with and on behalf of most needy groups: the poorest and the most vulnerable. 3 In spite of the encouraging trend observed over the past decade, it should be noted that NGOs have found it hard at times to gain acceptance, both at national and international levels. They have sometimes been regarded as minor players, especially in countries whose governments have been hesitant to concede authority and resources to the civil society. As a matter of fact, some governments do not always welcome the growth of civil society, and may sometimes resist the expansion of its role, especially where this involves criticism of government policies or practice. Finally, NGOs' participation in high-level decision-making processes so far has also been rather limited. This said, some NGOs are gaining growing recognition in the ongoing process of promoting DRR, and are becoming more actively involved in a number of

different activities. Over the past years, some NGOs have committed themselves to advocate for policy changes. Others have been active in mainstreaming DRR into rehabilitation and recovery programmes. Many others have engaged actively in capacity building, knowledge transfer and public awareness in communities at risk. All these efforts have contributed to reducing the vulnerability of those living in disaster-prone areas and increasing their resilience through educational activities and capacity building. Overall, the following broad areas of intervention have been identified as being the ones in which NGOs appear to be more actively involved: Policy and advocacy Knowledge and education Community-based risk and vulnerability assessment Community-based mitigation and preparedness Major Initiatives Taken & Progress Made by NGOs Policy & Advocacy A number of NGOs have been very active in advocating for better DRR policies and practices at the international level. Some played a key role in lobbying at the January 2005 World Conference on Disaster Reduction in Kobe, Japan, as well as in the follow-up of and implementation mechanisms for the Conference's outcomes. As a result of these efforts, there is certainly an increased recognition today of the need to mainstream DRR into development planning. Meanwhile, a lot of work still needs to be done to identify how such a mainstreaming can be achieved in practical terms. Some organizations have gone further, developing basic targets and indicators to help integrate and expand DRR initiatives into relief management and development planning (see case study below). Despite a general advancement in this area, it should be noted that the most active organizations working on the policy and advocacy fronts do not always seem to be involved in the implementation of the projects and initiatives they advocate. The general impression is that a significant number of the initiatives carried out at the community level are implemented by national NGOs and regional and sub-regional organizations. In spite of the added value they bring, such initiatives are less visible 4 and less documented than the ones promoted at the international level. Further investigation and more concerted action would be required to understand better the nature of this gap, and break the existing barriers. South-North cooperation also seems to be lacking in this, as in other areas.

ROLE OF COMMUNITY BASED ORGANIZATIONS:

Disaster Management means a planned and systematic approach towards understanding and solving problems in the wake of disasters involving the systematic observation and analysis of measures relating to disaster prevention, mitigation, preparedness, emergency response, rehabilitation and reconstruction. In other words, disaster management is a function of community preparedness. A natural hazard can transform into a natural disaster depending on its impact on society in terms of loss of life and property. To enhance community preparedness, a proper safety plan is very much is essential. The community preparedness plan involves all pre-disaster planning to reduce the loss as a result of natural disaster. It is basically a synthesis of various specific plans to solve a common purpose.

Community is the first responder in any disaster situation. So, there is a great need for community level initiatives in managing disasters. As a result initiatives taken by various agencies, including the state, need to be people-centric. Moreover, the level of community participation should be gauged through the role played by the community in the process of planning and decision-making.

The local economies must be strengthening, so that people become independent of external assistance. The voluntary sector has been in the forefront of mobilizing communities, enabling them to cope with disasters in the past decades. Their initiatives and experiences have been consolidated and demonstrated on a larger scale with the help of the state. Development organizations working in communities share a good rapport with the community. This has again helped the state in implementing its plans more effectively; village level plans prepared after the Super Cyclone in Orissa could be seen as an example of the same.

The global experience of the development community has demonstrated that Community-based Disaster Risk Reduction (CBDRR) efforts approached from a social and behaviour change perspective ensure that the poorest, most vulnerable and marginalised communities understand the simple and practical actions required to protect lives and personal assets in case of natural disasters. Perhaps the major lesson learnt is that CBDRR can change the mindset of both communities and other stakeholders.

Community Based Disaster Risk Management (CBDRM)

Community based disaster management, is the only proven method of disaster management; and it is hoped that India would be world leader in disaster management. It is a process where the risk communities, the first responders, are actively engaged in the identification, analysis, treatment, monitoring and evaluation of disaster risks in order to reduce their vulnerabilities and enhance their capacities. Due to the severity and widespread nature of natural disasters in India, the need for the institutionalization of CBDRM in government policy making and programmes has been considered as of significant value to the nation.

Best example of Community based disaster management was seen in Maharashtra when it was plagued by unprecedented floods causing havoc in Mumbai, Pune and other districts resulting in tremendous loss to human life, public and private property. The development sector responded to the needs of impacted through a process of relief, rehabilitation and livelihood restoration. There is a huge reservoir of knowledge and expertise in development sector in the world.

The most prominent disaster managers are the personnel in governmental disaster preparedness agencies, national emergency or relief agencies, national reconstruction agencies, and emergency service agencies, departments or ministries. All require disaster management specialists. Municipal or provincial governments often have disaster managers. A large city has a director of emergency services. It also has persons in public health departments, police departments, or public works

departments. They may be assigned additional responsibilities in emergency management.

Intergovernmental organizations often have specialized disaster or emergency management agencies. Such as, the United Nations Disaster Relief Office (UNDRO) provides a wide variety of emergency management services to member governments. The United Nations High Commissioner for Refugees (UNHCR) and the United Nations Relief and Works Agency (UNRWA) provide specialized assistance to refugees.

Even within the non disaster agencies of the United Nations, there are often special emergency management offices like UNICEF, which has an Emergency Unit; the World Health Organization, which has a Director of Emergency Relief Operations; and the Pan American Health Organization (a regional office of WHO), which has an Emergency Preparedness and Disaster Relief Coordination office that focuses specifically on the Americas. The World Food Program also has a special Office for Emergency Relief.

Many nongovernmental organizations, like National Red Cross and Red Crescent Societies, the League of Red Cross and Red Crescent Societies, and the International Committee of the Red Cross, are specifically organized to provide emergency services. They function both at the local level and at the international level. There are also millions of other private relief organizations throughout the world. These are organized to provide specialized assistance to disaster victims.

2.8 SUMMARY

After going through the chapter, we may conclude that natural disaster management is very important to human life. We have already learnt different international and national origination of disaster management. all those originations played important role in disaster management. Some of NGOs are also take initiatives to prevent to disaster in national and local are disaster also.

2.9 CHECK YOUR PROGRESS/ EXERCISE

1. Answers the following Questions

1. Define disaster.
2. What are the differences between hazards, calamity and disaster-?
3. What are the financial arrangements in Disaster management in India?
4. What is the Role of NGOs in disaster management in India?
5. How does community-based organizations help in disaster management in India?

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3

DISASTER MANAGEMENT: METHODS & APPROACHES

After going through this chapter you will be able to understand the following features:

Unit Structure :

3.1. OBJECTIVES

By the end of this unit, you will be able to –

- Understand the Disaster management: Historical Perspective
- Know the Pre-Disasterstage of management
- Know the Post Disaster stage of management

3.2 INTRODUCTION

The concept of Disaster Management (DM) has changed throughout history. Identifying changes and related factors can be effective in adopting logical, scientific and evidence-based approaches in the future. Therefore, this study was conducted with the aim of depicting the process of changes in the concept of DM and creating an original perspective. In this narrative literature review study, we used a historical approach. Literature, regardless of the time of publication, was searched using divergent keywords including "disaster, health, emergency, management, risk, disaster medicine, and hazard." DM evolution started with the emergence of civil defence during the last century. Although DRM was

initially focused on responses, currently, this concept includes disaster risk reduction (DRR) and disaster management. DRR includes prevention and mitigation, and disaster management includes response and recovery measures. DRR considering underlying risk factors such as social factors, and focusing on the participation of communities are important steps to be taken.

Disasters are not merely ornamental or interesting events that adorn our collective historical record— these disruptions have served to guide and shape it. Entire civilizations have been decimated in an instant. Time and time again, epidemics and pandemics have resulted in sizeable reductions of the world's population—as much as 50% across Europe during the14th-centuryy bubonic plague ("Black Plague") pandemic. Theorists have even ventured to suggest that many of history's great civilizations, including the Mayans, the Norse, the Minoans, and the Old Egyptian Empire, were ultimately brought to their knees not by their enemies but by the effects of floods, famines, earthquakes, tsunamis, El Niño events, and other widespread disasters (Fagan, 1999). From our modernperspective, the consequences of the December 2004 tsunami events that struck throughout Asia seem almost inconceivable—over 300,000 people killed in a moment by a devastating wall of water—but this is not close to record-breaking, or even unique, in the greater historical context.

3.4 DISASTER MANAGEMENT : HISTORICAL PERSPECTIVE

ANCIENT HISTORY

Hazard, and the disasters that often result have not always existed. To qualify as a hazard, an action, event, or object must maintain a positive likelihood of affecting man, or possibly have a consequence that may adversely affect man's existence. Until humans existed on the planet, neither the likelihood nor the consequence factors of hazards were calculable, and thus their presence is negated. With the appearance of man, however, followed the incidence of hazards and disasters. Archeological discovery has shown that our prehistoric ancestors faced many of the same risks that exist today: starvation, inhospitable elements, dangerous wildlife, violence at the hands of other humans, disease, accidental injuries, and more. These early inhabitants did not, however, sit idly by and let themselves become easy victims. Evidence indicates that they took measures to reduce, or mitigate, their risks. The mere fact that they chose to inhabit caves is testament to this theory. Various applications of disaster management appear throughout the historical record. The story of Noah's Ark from the Old Testament, for example, is a lesson in the importance of warning, preparedness, and mitigation. In this tale, believed to be based at least partly upon actual events, Noah is warned of an approaching flood. He and his family prepare for the impending disaster by constructing a floating ark. The protagonist in this story even attempts to mitigate the impact on the planet's biodiversity by collecting two of each species and placing them within the safety of the

ark. These individuals are rewarded for their actions in that they survive the disastrous flood. Those who did not perform similar actions, the story tells us, perish. Evidence of risk management practices can be found as early as 3200 BC. In what is now modernday Iraq lived a social group known as the Asipu. When community members faced a difficult decision, especially one involving risk or danger, they could appeal to the Asipu for advice. The Asipu, using a process similar to modern-day hazards risk management, would first analyze the problem at hand, then propose several alternatives, and finally give possible outcomes for each alternative (Covello and Mumpower, 1985). Today, this methodology is referred to as decision analysis, and it is key to any comprehensive risk management endeavor. Early history is also marked by incidents of organized emergency response. For example, when in AD 79 the volcano Vesuvius began erupting, two towns in its shadow—Herculaneum and Pompeii—faced an impending catastrophe. But although Herculaneum, which was at the foot of the volcano and therefore directly in the path of its lava flow, was buried almost immediately, the majority of Pompeii's population 2 Introduction to International Disaster ManagementSelected Notable Disasters throughout History Disaster Year Number killed Mediterranean earthquake (Egypt 1201 1,100,000 and Syria) Shaanzi earthquake (China) 1556 830,000 Calcutta typhoon (India) 1737 300,000 Caribbean hurricane (Martinique, 1780 22,000 St. Eustatius, Barbados) Tamboro volcano (Indonesia) 1815 80,000 Influenza epidemic (world) 1917 20,000,000 Yangtze River flood (China) 1931 3,000,000 Famine (Russia) 1932 5,000,000 Bangladesh cyclone (Bangladesh) 1970 300,000 Tangshan earthquake (China) 1976 655,000 Source: St. Louis University, 1997; NBC News, 2004. survived. This was because the citizens of Pompeii had several hours before the volcano covered their city in ash, and evidence suggests that the city's leaders organized a mass evacuation. The few who refused to leave suffered the ultimate consequence, and today lie as stone impressions in an Italian museum.

MODERN ROOTS

All-hazards disaster and emergency management, wherein a comprehensive approach is applied in order to address most or all of a community's hazard risks is relatively new. However, many of the concepts that guide today's practice can be traced to the achievements of past civilizations. While the management of disasters during the last few thousand years was limited to single acts or programs addressing individual hazards, many of these accomplishments were quite organized, comprehensive, and surprisingly effective at reducing both human suffering and damage to the built environment. Some examples follow. Floods have always confounded human settlements. Howeverarchaeologistsis have found evidence in several distinct and unrelated locations that early civilizations made attempts to formally address the flood hazard. One of the most celebrated of these attempts occurred in Egypt during the reign of Amenemhet III (1817–1722 BC). Amenemhet III created what has been described as history's first substantial river control project. Using a system of over 200 "water wheels," some of which remain to this day, the pharaoh effectively

diverted the annual floodwaters of the Nile River into Lake Moeris. In doing so, the Egyptians were able to reclaim over 153,000 acres of fertile land that otherwise would have been useless (Quarantelli, 1995; Egyptian State Information Service, n.d.) The roots of the modern fire department trace back 2000 years, to when the city of Rome was nearly destroyed by fire. Before this event, slaves had been tasked with fighting fires, and their poor training, lack of equipment, and understandable lack of motivation made them highly ineffective. Following the great fire, Emperor Augustus established a formal, citywide firefighting unit from within the Roman army, called the Corps of Vigiles. As a result, the firefighting profession became highly respected and, likewise, highly effective, and was emulated throughout the vast Roman Empire for 500 years. The structure of this organization was quite similar to many fire departments today, with members fulfilling job-specific roles. With the fall of Rome, however, came the disappearance of the Corps of Vigiles, and organized firefighting did not appear anywhere in the world for another thousand years. The Incas, who lived throughout the Andes mountains in South America during the 13th to 15th centuries, practised a form of urban planning that focused on their need to defend themselves from enemy attacks. Many of the Incan cities were located at the peaks of rugged, though easily defensible, mountains. The prime example of their architectural achievement is the fortress of Machu Picchu. However, in locating their cities upon mountaintops and other, similar areas, the Incas merely replaced one man-made hazard with a whole range of environmental hazards. To facilitate life on this extreme terrain, the Incas developed an innovative form of land terracing that not only conserved water in their unpredictable climate but also protected their crops—and thus their existence—from the landslides that occurred during periods of heavy precipitation.

THE INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION

On December 11, 1987, the United Nations General Assembly declared the 1990s as the "International Decade for Natural Disaster Reduction" (IDNDR). This action was taken to promote internationally coordinated efforts to reduce material losses and social and economic disruption caused by natural disasters, especially in developing countries. The stated mission of the IDNDR was to improve each United Nations (UN) member country's capacity to prevent or diminish adverse effects from natural disasters and to establish guidelines for applying existing science and technology to reduce the impact of natural disasters. On December 22, 1989, through UN Resolution 44/236, the General Assembly set forth the goals they wished to achieve during the IDNDR. In addition to establishing a special UN office in Geneva to coordinate the activities of the IDNDR, the resolution called upon the various UN agencies to:

1) Improve each country's capacity to mitigate the effects of natural disasters expeditiously and effectively, paying special attention to assisting developing countries in the assessment of disaster damage

potential and in the establishment of early warning systems and disaster-resistant structures when and where needed;

2) Devise appropriate guidelines and strategies for applying existing scientific and technical knowledge, taking into account the cultural and economic diversity among nations;

3) Foster scientific and engineerendeavoursvors aimed at closing critical gaps in knowledge in order to reduce loss of life and property;

4) Disseminate existing and new technical information related to measures for the assessment, prediction, and mitigation of natural disasters;

5) Develop measures for the assessment, prediction, prevention, and mitigation of natural disasters through programs of technical assistance and technology transfer, demonstration projects, and education and training, tailored. The Management of Disasters 5 disasters and locations, and to evaluate the effectiveness of those programs (United Nations, 1989). It was expected that all participating governments would, at the national level:

1) Formulate national disaster-mitigation programs, as well as economic, land use, and insurance policies for disaster prevention, and particularly in developing countries, integrate them fully into their national development programs;

2) Participate during the IDNDR in concerted international action for the reduction of natural disasters and, as appropriate, establish national committees in cooperation with the relevant scientific and technological communities and other concerned sectors with a view to attaining the objective and goals of the decade;

3) Encourage their local administrations to take appropriate steps to mobilize the necessary support from the public and private sectors and to contribute to achieving the purposes of the decade;

4) Keep the Secretary-General informed of their countries' plans and of assistance that could be provided so that the UN could become an international center for the exchange of information and the coordination of international efforts concerning activities in support of the objective and goals of the decade, thus enabling each state to benefit from other countries' experience;

5) Take measures, as appropriate, to increase public awareness of damage risk probabilities and the significance of preparedness, prevention, relief, and short-term recovery activities with respect to natural disasters and to enhance community preparedness through education, training, and other means, taking into account the specific role of the news media;

6) Pay due attention to the impact of natural disasters on healthcare, particularly to activities to mitigate the vulnerability of hospitals and

healthcare centers, as well as the impact on food storage facilities, human shelter, and other social and economic infrastructure;

7) Improve the early international availability of appropriate emergency supplies through the storage or earmarking of such supplies in disaster-prone areas (United Nations, 1989)

3.5. DISASTER MANAGEMENT : PRE-DISASTER STAGE OF MANAGEMENT

As per Disaster Management Act, 2005, "disaster management" means a continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient for:

(i) Prevention of danger or threat of any disaster;

(ii) Mitigation or reduction of risk of any disaster or its severity or consequences;

(iii) Capacity-building;

(iv) Preparedness to deal with any disaster;

(v) Prompt response to any threatening disaster situation or disaster;

(vi) Assessing the severity or magnitude of effects of any disaster; evacuation, rescue and relief;

(vii) Rehabilitation and reconstruction; Disaster Management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular r preparedness,response and recovery in order to lessen the impact of disasters.

(viii) Disaster management includes administrative decisions and operational activities that involve

- Prevention
- Mitigation
- Preparedness
- Response
- Recovery
- Rehabilitation Disaster management involves all levels of government. Nongovecommunity-based community-based organizations play a vital role in the process. Modern disaster management goes beyond post-disaster assistance. It now includes pre-disaster planning and preparedness activities, organizational planning, training, information management, public relations and many other fields. Crisis management is important but is only a part of the responsibility of a

disaster manager. The newer paradigm is the Total Risk Management (TRM) which takes a holistic approach to risk reduction.

DISASTER MANAGEMENT CYCLE

Disaster Risk Management includes each and every activities, programmes and measures which can be taken up before, during and after a disaster with the purpose to avoid a disaster, reduce its impact or recover from its losses. The three key stages of activities that are taken up within disaster risk management are as follows. (See Figure)

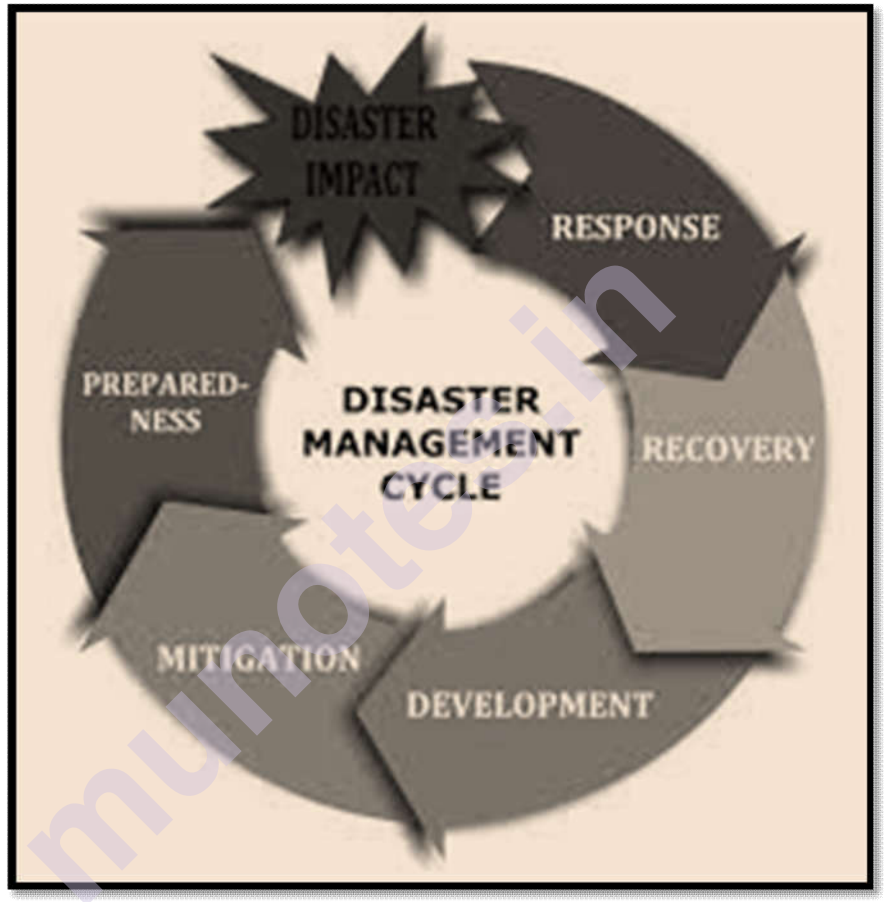

Fig: Disaster management cycle

1. Before a disaster (pre-disaster).

Pre-disaster activities are those which have been taken to reduce human and property losses caused by a potential hazard. Such as carrying out awareness campaigns, strengthening the existing weak structures, preparation of the disaster management plans at household and community level, etc. Such risk reduction measures taken under this stage are termed as mitigation and preparedness activities.

2. During a disaster (disaster occurrence).

These include initiatives taken to ensure that the needs and provisions of victims are met and suffering is minimized. Activities taken under this stage are called emergency response activities.

3. After a disaster (post-disaster).

There are initiatives taken in response to a disaster with a purpose to achieve early recovery and rehabilitation of affected communities, immediately after a disaster strikes. These are called as response and recovery activities.

The Disaster risk management cycle diagram (DRMC) enhances the range of initiatives which generally occur during the Emergency response as well as in the Recovery stages of a disaster. Some of these cut across both stages (such things as coordination and the provision of ongoing assistance); whilst other activities are unique to each stage (e.g. Early Warning and Evacuation during Emergency Response; and Reconstruction and Economic and 48 Social Recovery as part of Recovery). The DRMC also highlights the role of the media, where there is a strong relationship between this and funding opportunities. This diagram works best for relatively sudden-onset disasters, such as floods, earthquakes, bushfires, tsunamis, cyclones etc, but is less reflective of slow-onset disasters, such as drought, where there is no obviously recognizable single event which triggers the movement into the Emergency Response stage. According to Warfield (2008) disaster management aims to reduce, or avoid the potential losses from hazards, assure prompt and appropriate assistance to victims of disaster, and achieve rapid and effective recovery.

The disaster management cycle illustrates the ongoing process by which governments, businesses, and civil society plan for and reduce the impact of disasters, react during and immediately following a disaster, and take steps to recover after a disaster has occurred. Appropriate actions at all points in the cycle lead to greater preparedness, better warnings, reduced vulnerability or the prevention of disasters during the next iteration of the cycle. The complete disaster management cycle includes the shaping of public policies and plans that either modify the causes of disasters or mitigate their effects on people, property, and infrastructure. The mitigation and preparedness phases occur as disaster management improvements are made in anticipation of a disaster event. Developmental considerations play a key role in contributing to the mitigation and preparation of a community to effectively confront a disaster. As a disaster occurs, disaster management actors, in particular humanitarian organizations become involved in the immediate response and long-term recovery phases.

Pre – Disaster stage:

1. Prevention and Mitigation

Reducing the risk of disasters involves activities, which either reduce or modify the scale and intensity of the threat faced or by improving the conditions of elements at risk. Although the term „prevention is often used to embrace the wide diversity of measures to protect persons and property its use is not recommended since it is misleading in its implicit suggestion that natural disasters are preventable. The use of the term reduction to describe protective or preventive actions that lessen the scale

of impact is therefore preferred. Mitigation embraces all measures taken to reduce both the effects of the hazard itself and the vulnerable conditions to it in order to reduce the scale of a future disaster. In addition to these physical measures, mitigation should also be aimed at reducing the physical, economic and social vulnerability to threats and the underlying causes for this vulnerability. Therefore, mitigation may incorporate addressing issues such as land ownership, tenancy rights, wealth distribution, implementation of earthquake-resistant building codes, etc.

2. Preparedness

This brings us to the all-important issue of disaster preparedness. The process embraces measures that enables governments, communities and individuals to respond rapidly to disaster situations to cope with them effectively. Preparedness includes for example, the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories, public awareness and education and the training of personnel. It may also embrace search and rescue measures as well as evacuation plans for areas that may be „at risk from a recurring disaster. All preparedness planning needs to be supported by appropriate rules and regulations with clear allocation of responsibilities and budgetary provision.

3. Early Warning

This is the process of monitoring the situation in communities or areas known to be vulnerable to slow onset hazards, and passing the knowledge of the pending hazard to people in harm s way. To be effective, warnings must be related to mass education and training of the population who know what actions they must take when warned.

4. The Disaster Impact

This refers to the "real-time event of a hazard occurring and affecting elements at risk. The duration of the event will depend on the type of threat; ground shaking may only occur in a matter of seconds during an earthquake while flooding may take place over a longer sustained period.

3.6 THE POST-DISASTER STAGE

1. Recovery:

Recovery is used to describe the activities that encompass the three overlapping phases of emergency relief, rehabilitation and reconstruction.

2. Rehabilitation:

Rehabilitation includes the provision of temporary public utilities and housing as interim measures to assist long-term recovery.

3. **Reconstruction:** Reconstruction attempts to return communities to improved pre-disaster functioning. It includes such as the replacement of buildings; infrastructure and lifeline facilities so that long-term development prospects are enhanced rather than reproducing the same conditions, which made an area or population vulnerable in the first place.

4. **Development:**

   In an evolving economy, the development process is an ongoing activity. Long-term prevention/disaster reduction measures examples like construction of embankments against flooding, irrigation facilities draughtproofing measures, increasing plant cover to reduce the occurrences of landslides, land use planning, construction of houses capable of withstanding the onslaught of heavy rain/wind speed and shocks of earthquakes are some of the activities that can be taken up as part of the development plan.

3.7. SUMMARY

As you know we have learnt the term disaster management sodisaster management is important to avoid the maximum loss in a disaster. Humans can use Different approaches to the prevention of disaster. We use modern methods for habitation for affected areas by the disaster. We can take the help disaster management cycle too.

3.8. ANSWERS TO THE SELF-LEARNING QUESTIONS

1. Explain the terms of disaster management?
2. What is the disaster management cycle?
3. Briefly explain the pre-disaster management stage?
4. Briefly explain the post-disaster management stage?

3.9. TECHNICAL WORDS AND THEIR MEANING

1. **Risk**: The combination of the probability of an event and its negative consequences.
2. **Mitigation**: The lessening or limitation of the adverse impacts of hazards and related disasters.
3. **Forecast**: Definite statement or statistical estimate of the likely occurrence of a future event or conditions for a specific area.

4

NATURAL DISASTERS AND THEIR MANAGEMENT IN INDIA

After going through this chapter you will be able to understand the following features:

Unit Structure :

4.1 OBJECTIVES

By the end of this unit, you will be able to –

- Understand the Earthquake and Tsunami – cause, Effect, management
- Know the Flood – Distribution causes, Effect, Management
- Discuss the Cyclone - Distribution causes, Effect, Management
- Know the Famine - Distribution causes, effects, Management

4.2 INTRODUCTION

In the last two chapters, we have studied disaster management and how it tries to coordinate various resources effectively and seamlessly. Furthermore, two natural disasters, flood and drought, their causes and impact have also been studied. In this chapter, we are going to study natural disasters'lifecycles, earthquakes, landslides, the geographical distribution of natural disasters, causes and impact of natural disasters, forecasting, warning & monitoring of natural disasters, and preparedness and response of natural disasters.

4.3 SUBJECT-DISCUSSION

The term 'disaster' means 'bad star' in Latin. Disaster is a sudden disastrous event that brings great damage, loss, destruction and devastation to life and property, with no or very little prior knowledge. The damage caused by the disaster is incalculable and varies with the geographical location, climate and the type of the earth's surface. This influences the mental, socio-economic, political and cultural state of the affected area.

Disaster may be of two types natural and manmade. Floods, cyclones, drought, and earthquakes are natural disasters as they happen due to changes in the natural conditions whereasnuclear holocausts, Fire accidents are manmade disasters. A disaster completely disrupts normal daily life.

The word cyclone refers to many different types of storms. An earthquake is a trembling or a shaking movement of the ground and a landslide is the movement of rock, debris or earth down a slope. Now, all these natural disasters have a varied geographical distribution. If we know the cause and impact of natural disasters it would have been easier for us to reduce damage both in material terms and in terms of loss of human life.

NATURAL DISASTER

A natural disaster is a major adverse event that results from the natural processes of the Earth. Natural disaster includes floods, hurricanes, tornadoes, cyclones, volcanic eruptions, earthquakes, tsunamis, and other geologic processes. It results in large-scale loss of life or damage to property.

4.4 EARTHQUAKE AND TSUNAMI – CAUSE, EFFECT, MANAGEMENT

- **Earthquake**

An earthquake is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The seismicity, seismism or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time. Earthquakes are measured using observations from seismometers.

It is a sudden violent shaking of the ground, typically causing great destruction, as a result of movements within the earth's crust or volcanic action or sudden slip on a fault. The tectonic plates are always slowly moving, but they get stuck at their edges due to friction. When the stress on the edge overcomes the friction, there is an earthquake that releases energy suddenly in the form seismic waves that travel through the earth's crust and cause the shaking that we feel. The tectonic plates in the earth's crust which are almost hundred kilometres in thickness get dislocated because of seismic waves. An earthquake is a natural phenomenon. But sometimes activities like oil drilling, coal mining, and construction of big dams also add up to the seismic activity.

The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter scale. So, earthquake intensity is measured with the help of **seismometers** known as **Richter scale**. A magnitude of 3 on Richter scale is indiscernible whereas a magnitude higher than 7 usually causes damage and destruction. These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly almost imperceptible and magnitude 7 and over potentially causes serious damage over large areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. One of the worst earthquakes to hit was a magnitude of over 9 in Japan in 2011, it was the largest Japanese earthquake since records began. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal. At the Earth's surface, earthquakes manifest themselves by shaking and sometimes displacement of the ground.

An earthquake's point of initial rupture is called its focus or hypocenter. The **epicenter** is the point at ground level directly above the hypocenter.

The damage caused due to an earthquake depends on the location of the epicentre of the earthquake. Major destruction occurs near the epicentre of the earthquake because maximum intensity locates at the centre. Sometimes because of earthquakes there may be volcanic eruptions and landslides. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami.

- **Aftershocks**

An aftershock is an earthquake that occurs after a previous earthquake, the main shock. It occurs in the same region of the main shock but in a smaller magnitude. Aftershocks are formed as the crust around the displaced fault plane adjusts to the effects of the main shock. If an aftershock is larger than the main shock, the aftershock is re-designated as the main shock and the original main shock is re-designated as a foreshock.

- **Earthquake swarms**

Earthquake swarms are sequences of earthquakes striking in a specific area within a short period of time. They are different from earthquakes followed by a series of aftershocks by the fact that no single earthquake in the sequence is obviously the main shock; therefore none have notable higher magnitudes than the other. An example of an earthquake swarm is the 2004 activity at Yellowstone National Park.

- **Earthquake storms**

A series of earthquakes occur in a sort of earthquake storm, where the earthquakes strike a fault in clusters, each triggered by the shaking or stress redistribution of the previous earthquakes. Similar to aftershocks but on adjacent segments of fault, these storms occur over the course of years, and with some of the later earthquakes as damaging as the early ones. Such a pattern was observed in the sequence of about a dozen earthquakes that struck the North Anatolian Fault in Turkey in the 20th century and has been inferred for older anomalous clusters of large earthquakes in the Middle East.

- **Measuring and locating earthquakes**

Earthquakes can be recorded by seismometers up to great distances, because seismic waves travel through the whole Earth's interior. The absolute magnitude of a quake is conventionally reported by numbers on the Moment magnitude scale (formerly Richter scale, magnitude 7 causing serious damage over large areas), whereas the felt magnitude is reported using the modified Mercalli intensity scale (intensity II–XII).

Every tremor produces different types of seismic waves, which travel through rock with different velocities:

- Longitudinal P-waves (shock- or pressure waves)
- Transverse S-waves (both body waves)
- Surface waves — (Rayleigh and Love waves)

Propagation velocity of the seismic waves ranges from approx. 3 km/s up to 13 km/s, depending on the density and elasticity of the medium. In the Earth's interior the shock- or P waves travel much faster than the S waves (approx. relation 1.7 : 1). The differences in travel time from the epicentre to the observatory are a measure of the distance and can be used to image both sources of quakes and structures within the Earth. Also the depth of the hypocenter can be computed roughly. In solid rock P-waves travel at about 6 to 7 km per second; the velocity increases within the deep mantle to ~13 km/s. The velocity of S-waves ranges from 2–3 km/s in light sediments and 4–5 km/s in the Earth's crust up to 7 km/s in the deep mantle. As a consequence, the first waves of a distant earthquake arrive at an observatory via the Earth's mantle.

Rule of thumb: On the average, the kilometer distance to the earthquake is the number of seconds between the P and S wave times 8. Slight deviations are caused by in homogeneities of subsurface structure. By such analyses of seismograms the Earth's core was located in 1913 by Beno Gutenberg. Earthquakes are not only categorized by their magnitude but also by the place where they occur. The world is divided into 754 Flinn-Engdahl regions (F-E regions), which are based on political and geographical boundaries as well as seismic activity. More active zones are divided into smaller F-E regions whereas less active zones belong to larger F-E regions.

- **Size and frequency**

Almost 500,000 earthquakes occur each year that can be detected with the latest instruments. Among these, around 100,000 can be felt.

8.6.1 Geographical distribution of earthquakes

Minor earthquake prone areas on earth are Italy, Greece, New Zealand, Turkey, Portugal, Pakistan, Iran, Indonesia, Peru, Chile, Guatemala, Mexico, California and Alaska. Majority of earthquakes occur in the course of 40,000 km long circum-Pacific seismic belt which is in the shape of a horseshoe. Himalayan mountain plate is another zone where massive earthquakes may occur. With rapid rise in population in countries like Japan, Mexico and Tehran, because of their presence in seismic zones, major earthquakes may occur. If we list out the top 10 earthquake prone countries, it goes like:

1. Japan
2. Indonesia
3. United States of America
4. New Zealand
5. Fiji
6. Tonga
7. Chile
8. Papua New Guinea
9. Mexico
10. Solomon Islands

- **Causes and impact of earthquakes**

- **Causes**

Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests.

- **Naturally occurring earthquakes**

Earth's tectonic plates are marked by faults or fractures. **Earthquakes** are usually caused when underground rock suddenly breaks along a fault. When the tectonic plates slide past each other or have a collision with each other, an earthquake occurs. This sudden release of energy causes the seismic waves that make the ground shake. When two blocks of rock or two plates are rubbing against each other, they stick a little but don't just slide smoothly; the rocks catch on each other. The rocks still push against each other, but do not move. After a while, the rocks break because of all the pressure that's built up. When the rocks break, earthquake occurs. During and after the earthquake, the plates or blocks of rock start moving, and they continue to move until they get stuck again.

i. Tectonic earthquakes

Tectonic earthquakes occur anywhere in the earth where there is sufficient stored elastic strain energy to drive fracture propagation along a fault plane. The sides of a fault move past each other smoothly and aseismically only if there are no irregularities or asperities along the fault surface that increase the frictional resistance. Most fault surfaces do have such asperities and this leads to a form of stick-slip behaviour. Once the fault has locked, continued relative motion between the plates leads to increasing stress and therefore, stored strain energy in the volume around the fault surface. This continues until the stress has risen sufficiently to break through the asperity, suddenly allowing sliding over the locked portion of the fault, releasing the stored energy. This energy is released as a combination of radiated elastic strain seismic waves, frictional heating of the fault surface, and cracking of the rock, thus causing an earthquake. This process of gradual build-up of strain and stress punctuated by occasional sudden earthquake failure is referred to as the elastic-rebound theory. It is estimated that only 10 percent or less of an earthquake's total energy is radiated as seismic energy. Most of the earthquake's energy is used to power the earthquake fracture growth or is converted into heat generated by friction. Therefore, earthquakes lower the Earth's available elastic potential energy and raise its temperature, though these changes are negligible compared to the conductive and convective flow of heat out from the Earth's deep interior.

ii. Earthquake fault types

There are three main types of fault that may cause an earthquake: normal, reverse (thrust) and strike-slip.

Normal faults occur mainly in areas where the crust is being extended such as a divergent boundary. Earthquakes associated with normal faults are generally less than magnitude 7. This is so because the energy released in an earthquake, and thus its magnitude, is proportional to the area of the fault that ruptures and the stress drop.

Reverse faults occur in areas where the crust is being shortened such as at a convergent boundary. Reverse faults, particularly those along convergent plate boundaries are associated with the most powerful earthquakes, including almost all of those of magnitude 8 or more.

Strike-slip faults are steep structures where the two sides of the fault slip horizontally past each other. Many earthquakes are caused by movement on faults that have components of both dip-slip and strike-slip; this is known as oblique slip. Strike-slip faults, particularly continental transforms can produce major earthquakes up to about magnitude 8.

The most important parameter controlling the maximum earthquake magnitude on a fault is however not the maximum available length, but the available width because the latter varies by a factor of 20.

iii. Earthquakes away from plate boundaries

Where plate boundaries occur within continental lithosphere, deformation is spread out over a much larger area than the plate boundary itself. In the case of the San Andreas fault continental transform, many earthquakes occur away from the plate boundary and are related to strains developed within the broader zone of deformation caused by major irregularities in the fault trace (e.g., the "Big bend" region). Another example is the strongly oblique convergent plate boundary between the Arabian and Eurasian plates where it runs through the north-western part of the Zagros Mountains. This is demonstrated by earthquake focal mechanisms. All tectonic plates have internal stress fields caused by their interactions with neighbouring plates and sedimentary loading or unloading (e.g. deglaciation) these stresses may be sufficient to cause failure along existing fault planes, giving rise to intraplate earthquakes.

iv. Shallow-focus and deep-focus earthquakes

The majority of tectonic earthquakes originate at the ring of fire in depths not exceeding tens of kilometres. Earthquakes occurring at a depth of less than 70 km are classified as 'shallow-focus' earthquakes, while those with a focal-depth between 70 and 300 km are commonly termed 'mid-focus' or 'intermediate-depth' earthquakes. Deep-focus earthquakes occur at a depth where the subducted lithosphere should no longer be brittle, due to the high temperature and pressure.

v. Earthquakes and volcanic activity

Earthquakes often occur in volcanic regions. These are caused both by tectonic faults and the movement of magma in volcanoes. Such earthquakes can serve as an early warning of volcanic eruptions, as during the Mount St. Helens eruption of 1980. Earthquake swarms can serve as markers for the location of the flowing magma throughout the volcanoes. These swarms can be recorded by seismometers and tiltmeters (a device that measures ground slope) and used as sensors to predict imminent or upcoming eruptions.

vi. Rupture dynamics

A tectonic earthquake begins by an initial rupture at a point on the fault surface, a process known as nucleation. The scale of the nucleation zone is uncertain, with some evidence, such as the rupture dimensions of the smallest earthquakes, suggesting that it is smaller than 100 m while other evidence, such as a slow component revealed by low-frequency spectra of some earthquakes, suggests that it is larger. The possibility that the nucleation involves some sort of preparation process is supported by the observation that about 40% of earthquakes are preceded by foreshocks. Once the rupture has initiated it begins to propagate along the fault surface. The mechanics of this process are poorly understood, partly because it is difficult to recreate the high sliding velocities in a laboratory.

vii. Tidal forces

Research work has shown a robust correlation between small tidally induced forces and non-volcanic tremor activity.

viii. Earthquake clusters

Most earthquakes form part of a sequence, related to each other in terms of location and time. Most earthquake clusters consist of small tremors that cause little to no damage, but there is a theory that earthquakes can recur in a regular pattern.

ix. Human induced seismic activity

With the development and enhancement in technology, man has exploited the wealth of the nature. Human activities that lead to earthquakes are drilling for oil wells, coal mining, and collecting large volumes of water for construction of a dam. The underground explosions to break rock while making tunnels for roads, railroads, subways, or mines do not cause very strong seismic waves and we may not even feel them. Sometimes seismic waves occur when the roof or walls of a mine collapse and this can be felt by people near the mine. The largest underground explosions, from tests of nuclear warheads (bombs), can create seismic waves very much like large earthquakes. As an example, the 2008 Sichuan earthquake that occurred in China was because of the construction of a dam. In Australia also there was coal mining activity which resulted in an earthquake.

➢ Impact of earthquakes

❖ A number of natural changes occur due to an earthquake.

i. Ground rupture

The ground shakes and ruptures because of which building and other structures get damaged. The severity of destruction depends on how close

the area is to the epicenter. Ground rupture means the breakage and displacement of the earth's surface. It is a major threat to huge structures like bridges, dams and nuclear power plants.

ii. Landslides

Another major threat that occurs due to an earthquake is landslides. When the earthquake is accompanied by other major threats like wildfires, volcanic activity or storms, landslides may occur.

iii. Fire

Due to the damage of electrical power or gas lines chances of fire eruption are high due to an earthquake.

iv. Soil liquefaction

When water saturated granular material like sand loses its strength due to earthquake it gets modified into a liquid. This process may cause damage to bridges and buildings. There is a chance of these structures getting collapsed to the ground.

v. Tsunami

When earthquake occurs in the sea bed, the sea waves rise in the sea. It has long and sudden movements dispensing large volumes of water. Depending on the depth of the water these waves travel at a speed of 600-800 kilometers per hour. These waters are capable enough to drown the structures and building all along the sea coast. Usually tsunamis occur in the seal when the earthquake hit is above 7.5 on the Richter scale. After the tsunami in 2003 that devastated lakhs of people across Indian Ocean, countries all over the world are taking precautions and have invested in tsunami warning systems.

After effects

A major **earthquake causes** lot of destruction and damage to buildings and structures. Because of lack of basic amenities, diseases may spread. It will take lot of time for rehabilitation of people.

Man has been making a steady progress in all fields. There are several discoveries and innovations to his credit. Except for being ready to face any type of natural calamities, there is nothing that man can do in such circumstances. Time and again nature proves that it is mightier than human beings.

Forecasting, warning & monitoring earthquake

❖ **Forecasting**

Earthquake prediction is a branch of the science of seismology. It is concerned with the specification of the time, location, and magnitude of future earthquakes within stated confidence limits but with sufficient precision that a warning can be issued.

Seismologists feel compelled to provide earthquake predictions to society. Location, magnitude, and recurrence interval of earthquakes have large uncertainty. For example, the estimated magnitudes for earthquakes in the New Madrid Seismic Zone range from M 6.6 to M 8.0, and estimates of the recurrence interval range from 500 to 50,000 years. Uncertainties of this scale indicate that earthquakes cannot be predicted or forecasted reliably. One such example is Iben Browning's forecast: a 50% chance of a major earthquake with a magnitude of about 7 in the New Madrid Seismic Zone within a few days of 3 December 1990. Even though the 1975 Haicheng, China, earthquake has been claimed as a successful prediction, it was not predicted scientifically.

Generally, the location, magnitude, and recurrence interval of earthquakes and their respective uncertainties are quantified by a probability model (distribution), such as a Gaussian (normal) model with a mean and standard deviation or by a logic tree. A mean magnitude of M 7.5 and mean recurrence interval of 200 years were assumed for the characteristic fault. The prediction for this case may be that an M 7.5 earthquake "could occur" along the fault in the next month, next year, or in 50 years or that an M 7.5 earthquake "will probably occur" along the fault in the next month, next year, or in 50 years. To make a forecast, a probability model has to be introduced to describe earthquake occurrence in time (e.g., the Poisson, empirical, Brownian passage time, or time predictable). Although the Poisson model (i.e., time independent) contradicts the generally accepted physical model (i.e., Reid's elastic rebound theory), it is the most commonly used model for estimating earthquake probability. The Poisson model assumes the exceedance probability (PE) of the M 7.5 earthquake occurrence along the fault over a specified time period (t) can be estimated by Embedded Image1in which τ is the mean recurrence interval of the earthquake. For time periods of 1 month, 1 year, and 50 years, equation (1) yields PEs of about 0.042%, 0.5%, and 22.1%, respectively. Thus, the forecast that an M 7.5 earthquake will occur along the fault within the next month is 0.042%; the probability that an M 7.5 earthquake will occur within the next 50 years is 22.1%.

❖ **Warning earthquake**

Earthquakes and Buildings

Early alert capabilities in some cases will allow some systems to automatically shut down before the strong shaking starts so that the services and people using them will be safe. Such systems may include elevators, utilities such as water and gas, and factory assembly lines.

Small building are more affected, or shaken, by high frequency waves (short and frequent). For example, a small boat sailing in the ocean will not be greatly affected by a large swell. On the other hand several small waves in quick succession can overturn, or capsize, the boat. The same way, a small building experience more shakes by high frequency earthquake waves. Large structures or high rise buildings are more affected by long period, or slow shaking. For instance, an ocean liner will

experience little disturbance by short waves in quick succession. However, a large swell will significantly affect the ship. Similarly, a skyscraper will sustain greater shaking by long period earthquake waves, than by the shorter waves.

❖ **Monitoring earthquake**

Earthquake Monitoring: Magnitude vs. Intensity

Earthquake monitoring started long ago, but the technology has advanced dramatically from its origin in 132 AD in China where the first "seismoscope" was constructed with carved dragons and frogs.

Intensity scales measure the amount of shaking at a particular location. Therefore, the intensity of an earthquake will vary depending on where you are. Sometimes earthquakes are referred to by the maximum intensity they produce.

Magnitude scales, like the Richter magnitude and moment magnitude, measure the size of the earthquake at its source. Thus, they do not depend on where the measurement of the earthquake is made. On the Richter scale, an increase of one unit of magnitude (for example, from 4.6 to 5.6) represents a 10-fold increase in wave amplitude on a seismogram or approximately a 30-fold increase in the energy released. Except in special circumstances, earthquakes below magnitude 2.5 are not generally felt by humans. Often, several slightly different magnitudes are reported for an earthquake. This happens because different measurement procedures will often give slightly different magnitudes for the same earthquake.

Management of Earthquake

❖ **Preparedness**

Although earthquake is not a new disaster it is necessary to be prepared against this disaster. Prediction and forecasting of earthquake is impossible, hence preparation should be taken against earthquake. It may lessen the damages occurred due to the earthquake is less.

i. Pre-Disaster Preventive Measures

a. Long-term measures

- Re-framing buildings' codes, guidelines, manuals and byelaws and their strict implementation.
- Tougher legislation for highly seismic areas
- Incorporating earthquake resistant features in all buildings at high-risk areas.
- Making all public utilities like water supply systems, communication networks, electricity lines etc. earthquake-proof.
- Creating alternative arrangements to reduce damages to infrastructure facilities.

- Constructing earthquake-resistant community buildings and buildings (used to gather large groups during or after an earthquake) like schools, dharamshalas, hospitals, prayer halls, etc., especially in seismic zones of moderate to higher intensities.
- Supporting R&D in various aspects of disaster mitigation, preparedness and prevention and post-disaster management.
- Evolving educational curricula in architecture and engineering institutions and technical training in polytechnics and schools to include disaster related topics.

b. Medium term measures

- Retrofitting of weak structures in highly seismic zones.
- Preparation of disaster related literature in local languages with dos and don'ts for construction.
- Getting communities involved in the process of disaster mitigation through education and awareness.
- Networking of local NGOs working in the area of disaster management.

ii. Post-Disaster Preventive Measures

- Maintenance of law and order, prevention of trespassing, looting etc.
- Evacuation of people.
- Recovery of dead bodies and their disposal.
- Medical care for the injured.
- Supply of food and drinking water.
- Temporary shelters like tents, metal sheds etc.
- Repairing lines of communication and information.
- Restoring transport routes.
- Quick assessment of destruction and demarcation of destroyed areas, according to the grade of damage.
- Cordoning off severely damaged structures that are liable to collapse during aftershocks

➢ The following efforts will be useful for preparedness:

- Train communities in high-risk areas in post-disaster search, rescue and relief.

- Practice an extensive programme of mass drills in high-risk areas for earthquake damage reduction.
- Train local NGOs and strengthen their capacity and capabilities.
- Inculcate basic know-how amongst school kids on earthquake dos and don'ts along with safety drills.
- Train field personnel in the science and art of carrying out post disaster damage surveys, for (a) urgent relief purposes and (b) for repair, reconstruction and retrofitting purposes. During emergencies, affected people need to be involved in the relief activities so as to create a feeling of self-reliance. Also, the sooner they are integrated, the shorter will the period of relief will be.

➢ Post-disaster work would involve:

- Detailed survey of buildings for assessment of damage and repair/ reconstruction and seismic strengthening or demolition.
- Selection of sites for new settlements, if required.
- Execution of the reconstruction programme.
- Review of the existing seismic zoning maps and risk maps.
- Review of seismic codes and norms of construction.
- Training of personnel, engineers, architects, builders and masons.

Response

In the aftermath of an earthquake, workers are found to be involved in a variety of response and recovery operations. Collapsed structures are a common result of earthquakes. Rescue workers, engineers and emergency responders may have to enter collapsed structures to perform search and rescue activities, and all possible safety and health precautions should be taken to ensure they can perform their duties safely.

Mitigation - case studies

❖ **Earthquake Risk Mitigation**

There is a comprehensive programme for earthquake risk mitigation. The building construction in urban and suburban areas is regulated by the Town and Country Planning Acts and Building Regulations. The BIS (Bureau of Indian Standards) have laid down the standards for construction in the seismic zones but these were not followed properly. Even if it is done, there is lack of knowledge regarding seismically safe construction among the architects and engineers. Moreover lack of awareness regarding their vulnerability among the population led to most of the construction in the urban/sub-urban areas being without reference to BIS standards.

In the rural areas, mode of construction has changed from mud and thatch to brick and concrete construction and the bulk of the housing is non-engineered construction thereby increasing the vulnerability. The increasing population has led to settlements in vulnerable areas close to the river bed areas which are prone to liquefaction. The Government has moved to address these issues.

- **National Core Group for Earthquake Risk Mitigation**

A National Core Group for Earthquake Risk Mitigation has been constituted consisting of experts in earthquake engineering and administrators. The Core Group has been assigned with the responsibility of drawing up a strategy and plan of action for mitigating the impact of earthquakes.

- **Review of building bye-laws and their adoption**

Most casualties during earthquakes are caused by the collapse of structures. Therefore structural mitigation measures are the key to make a significant impact towards earthquake safety in our country. In view of this the States in earthquake prone zones have been requested to review, and if necessary, amend their building bye-laws to incorporate the BIS seismic codes for construction in the concerned zones.

- **Development and Revision of Codes**

There are Bureau of Indian Standard (BIS) codes which are relevant for multi-hazard resistant design and construction. These codes have to be regularly updated. An action plan has been drawn up for revision of existing codes, development of new codes and documents/commentaries, and making these codes and documents available all over the country including on-line access to these codes.

- **Hazard Safety Cells in States**

The States have been advised to constitute Hazard Safety Cells (HSC) headed by the Chief Engineer (Designs), State Public Works Department with necessary engineering staff so as to establish mechanism for proper implementation of the building codes in all future Govt. constructions, and to ensure the safety of buildings and structures from various hazards. The HSC will also be responsible for carrying out appropriate design review of all Government buildings to be constructed in the State, act as an advisory cell to the State Government on the different aspects of building safety against hazards and act as a consultant to the State Government for retrofitting of the lifeline buildings. Rajasthan, West Bengal and Chhattisgarh have already constituted these cells and other States are in the process.

- **National Programme for Capacity Building of Engineers and Architects in Earthquake Risk Mitigation**

Two National Programmes for Capacity Building in Earthquake Risk Mitigation for Engineers and Architects respectively, have been approved to assist the State Govts in building capacities for earthquake mitigation. These two programmes are being implemented for training of 10,000 engineers and 10,000 architects in the States in seismically safe building designs and related techno-legal requirements.

- **Training of rural monsoons**

A programme to assist the States/UTs in training and certification of 50000 masons has been formulated in consultation with Housing and Urban Development Corporation (HUDCO) and the Ministry of Rural Development. The training module for masons to include multi-hazard resistant construction has also been prepared by an expert committee, and revised curriculum will be introduced in the vocational training programme of Ministry of Human Resource Development.

- **Earthquake Engineering in Undergraduate Engineering/ Architecture Curricula**

The role of engineers and architects is crucial in reducing earthquake risks by ensuring that the construction adheres to the norms of seismically safety. In view of this, the elements of earthquake engineering are being integrated into the undergraduate engineering and architecture courses.

- **Hospital Preparedness and Emergency Health Management in Medical Education**

As hospital preparedness is crucial to any disaster response system each hospital should have an emergency preparedness plan to deal with mass casualty incidents and the hospital administration/ doctor trained for this emergency. The curriculum for medical doctors does not include Hospital Preparedness for emergencies. Therefore capacity building through in-service training of the current heath managers and medical personnel in Hospital Preparedness for emergencies or mass causality incident management is essential.

- **Acceleration Urban Earthquake Vulnerability Reduction Programme**

An accelerated urban earthquake vulnerability reduction programme has been taken up in 38 cities in seismic zones III, IV & V with population of half a million and above. 474 Orientation programmes have been organized for senior officers and representatives of the local planning and development bodies to sensitize them on earthquake preparedness and mitigation measures.

- **Mainstreaming Mitigation in Rural Development Schemes**

Rural housing and community assets for vulnerable sections of the population are created at a fairly large scale by the Ministry of Rural Development under the Indira Awas Yojna(IAY) and Sampooran Grameen Rojgar Yojna(SGRY). About 250 thousand small but compact housing units are constructed every year, besides community assets such as community centres, recreation centres, anganwadi centres etc. Technology support is provided by about two hundred rural housing centres spread over the entire country.

Case study: The 2001 Gujarat earthquake

India has witnessed some of the most devastating earthquakes during the last century like the one in Kangra (1905), Bihar-Nepal (1934) and in Assam (1950). In the recent past, earthquakes have caused havoc in Uttarkashi (1991), Latur (1993), Jabalpur (1997), Chamoli (1999) and in Bhuj (2001).

The 2001 Gujarat earthquake

Gujarat lies 3–400 km from the plate boundary between the Indian Plate and the Eurasian Plate, but the current tectonics is still governed by the effects of the continuing continental collision along this boundary. The 2001 Gujarat earthquake also known as Bhuj earthquake occurred on 26 January, at 08:46 AM IST. Location was 10 km. North-Northeast of Jamnagar/290 km. Southeast of Hyderabad in Pakistan. It lasted for over 2 minutes. The epicentre was about 9 km south-southwest of the village of Chobari in Bhachau Taluka of Kutch District of Gujarat, India. The intraplate earthquake reached 7.7 on the moment magnitude scale and had a maximum felt intensity of X (Extreme) on the Mercalli intensity scale. The earthquake killed between 13,805 and 20,023 people (including 18 in south-eastern Pakistan), injured another 167,000 and destroyed nearly 400,000 homes.

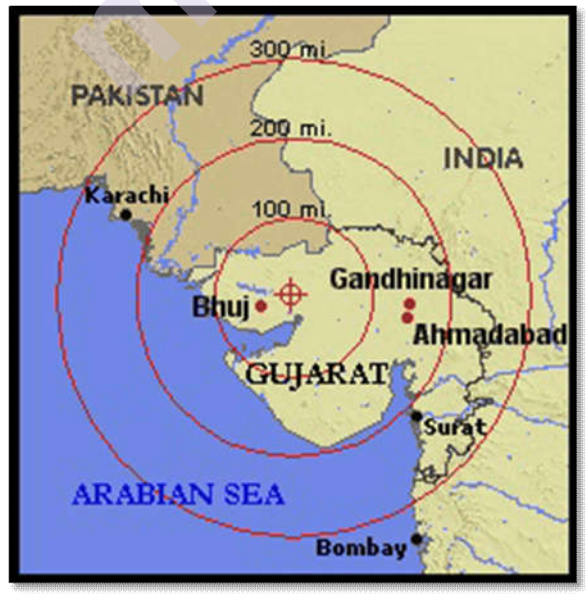

Fig: Map of Bhuj

The effect of the earthquake was felt throughout the Indian sub-continent. Most affected districts in Gujarat were Kutch, Jamnagar, Surendranagar, Rajkot, and Surat. Worst affected towns & cities were Bhuj, Bhachau, Rapar, Anjar, Ahmedabad, Jodiya, Morbi, and Gandhidham. Among industrial Impacts damages on Kandla port is important. Other affected states were Andhra Pradesh, Delhi, Madhya Pradesh, and Maharashtra. Outside India affected countries were Bangladesh, China, Nepal and Pakistan.

Over 7,000 villages in 19 districts were affected either severely or moderately. 13,805 people lost their lives and more than 1,67,000 were injured. About 1.2 million houses were damaged partially or completely. Social infrastructure and public infrastructure were severely damaged. More than 1,000 health units and 12,000 schools were damaged. Roads, bridges, Public buildings, Dams and irrigation structures were also affected severely. The total primary loss was about US $3,189 million and the secondary loss was about US $ 635 million and the tertiary loss was about US $ 2,097 million.

The State Government immediately conceptualized a comprehensive rehabilitation and reconstruction programme which addressed all important concerns that arose from the earthquake starting from immediate relief, economic rehabilitation, livelihood restoration as well as long term capacity building of all stakeholders to fight future disasters.

The Government prepared Gujarat Earthquake Reconstruction and Rehabilitation Policy which encompasses all measures and institutional initiatives taken by the Government in the earthquake affected areas. The Policy represented a framework of entitlements and a prospectus of development which reflected the vision of a successful reconstruction and rehabilitation plan.

After the initial relief phase, Government of Gujarat launched a massive reconstruction and rehabilitation program in the affected areas. It was a great challenge to conceptualize a massive reconstruction program, yet within a very short period government announced a comprehensive reconstruction and rehabilitation policy which included assistance for restoration of private houses, economic rehabilitation, and reconstruction of public infrastructure, prepare the people to face disasters through community participation and multi hazard preparedness programs; human resource development; and livelihood support, based on sustainable economy and ecology. Gujarat State Disaster Management Authority was created as the nodal agency to implement the massive reconstruction program.

- The task accomplished is as follows: ‰

- Over 9,08,710(99%) houses repaired and
- 1,97,091 houses (89%)houses reconstructed ‰
- 42,678 schoolrooms repaired (100%) ‰
- 12,442 Schoolrooms reconstructed (152%) ‰

- 3,391 public building repaired ‰
- 1,245 public buildings reconstructed ‰
- 5,223 km of transmission and distribution lines repaired ‰
- Repair/reconstruction of 640 km of state highways & 3,061 km of rural roads completed ‰
- Laying of 2,750 km of water supply pipelines including drilling of 222 deep tube wells ‰
- Restored the livelihood of 2,00,000 families

Better houses, upgraded infrastructure, good hospitals and schools can certainly be counted as something that has changed for the better in the earthquake affected areas.

The Gujarat earthquake did not only result in changes in focus from relief to mitigation and setting up of institutional mechanism for the same in Gujarat, but has brought about a major change at the national level towards disaster management. At the National level, emphasis now is being laid on disaster mitigation. The planning commission has recommended for utilizing 10% of the plan funds for pre-disaster mitigation and planning. A national level disaster management authority on the lines of GSDMA is being worked out at the central government level. Draft bill on National Disaster Management has been prepared. Many of the lessons learnt and best practices of Gujarat initiated after the earthquake is being replicated at the national level and at the state level in other states including setting up of disaster management authorities and enactment of bills etc. The approach and process of Gujarat earthquake reconstruction is now being looked at as a model for reconstruction in the earthquake-affected areas in Bam and Tsunami reconstruction in Srilanka, Indonesia and in the tsunami-affected south Indian states.

The various initiatives undertaken for integrating reconstruction and long-term disaster management capacity building have resulted in a major change in the way reconstruction programs are being done in India and the neighboring countries. This has in turn resulted in a major shift towards prevention and mitigation of disasters from the age-old relief oriented disaster management in India.

4.5 FLOOD – DISTRIBUTION CAUSES, EFFECT, MANAGEMENT

Floods

a. Floods reference to Nature

Flood is a state of high water level along a river channel or on coast that leads to inundation of land which is not normally submerged. Flood is an attribute of physical environment and thus is an important component of hydrological cycle of a drainage basin. Flood is a natural phenomenon in

response to heavy rainfall but it becomes a hazard when it inflicts loss to the lives and properties of the people.

b. Geographical distribution of floods

Floods occur most often in low-lying coastal areas and river floodplains. Any plain low-lying area adjacent a river, lagoon or lake is more likely to have floods anytime the water level rises. This includes coastal areas and shorelines, as seawater can easily be swept inland by strong winds, tides and tsunamis.

Flood Prone Areas in India

National Flood Commission (RBA) -1980 assessed the total flood prone area in the country as 40 m.ha. which included the unprotected flood area of 33.516 m ha and the balance as protected area. Subsequently, the Working Groups on Flood Management for X and XI Plans assessed the flood prone area in the country as 45.64 m ha.

The states falling within the periphery of "India Flood Prone Areas" are West Bengal, Orissa, Andhra Pradesh, Kerala, Assam, Bihar, Gujarat, Uttar Pradesh, Haryana and Punjab. The intense monsoon rains from southwest causes rivers like Brahmaputra, Ganga, Yamuna etc. to swell their banks, which in turn floods the adjacent areas. Over the past few decades, central India has become familiar with precipitation events like torrential rains and flash floods. The major flood prone areas in India are the river banks and deltas of Ravi, Yamuna-Sahibi, Gandak, Sutlej, Ganga, Ghaggar, Kosi, Teesta, Brahmaputra, Mahanadi, Mahananda, Damodar, Godavari, Mayurakshi, Sabarmati and their tributaries.

Flood prone areas of India

States	1953-78 (mha)	1953-88 (mha)
Andhra Pradesh	1.39	1.39
Arunachal Pradesh	-	0.00
Assam	3.15	3.82
Bihar	4.26	4.26
Goa	-	0.00
Gujarat	1.39	1.39
Haryana	2.35	2.35
Himachal Pradesh	0.23	0.39
Jammu & Kashmir	0.08	0.51
Karnataka	0.02	0.26

c. Causes of Floods

Floods are results of unfavourable combinations of meteorological and physical condition of the drainage basin which leads to excessive water run-off and consequent relative reduction in carrying capacity of channels leading to bank full conditions. The causative factors, in recent times, have

been aided and accentuated by human impact. The various conditions responsible for flood are:

(A) Meteorological Conditions

1. Cyclones.
2. Cloud Burst.

(B) Physical Conditions

1. Narrow outlets.
2. Large catchments areas.
3. Lack of well developed drainage channel.
4. Siltation and rising of channel
5. Presence of unconsolidated soil.
6. Blocking effect of landslides.
7. Meandering.

(C) Human Impact

1. Construction of dams and reservoirs.
2. Bursting of dams
3. Deforestation.
4. Faulty slope practices.
5. Construction of embankments.

(A).Meteorological Causes

1. Heavy rainfall.

India is one of the world's wettest countries receives an annual average rainfall of 115 cm. Nearly 80 per cent of which is received from June to September in all the states, except Tamil Nadu, during the southwest monsoons. It usually exceeds 100 cm in areas east of 78" E longitude. It extends to 250 cm along the entire west coast and Western Ghats and over most of Assam and sub- Himalayan West Bengal. Because of this seasonal concentration of rainfall, rivers remain practically day during summer while in the rainy season they swell, overflowing their banks.Heavy incessant rainfall for long period is the basic cause of floods because a huge amount of water gets collected on the surface flowing as runoff. High-intensity rainfall gives the average annual amount of 250 cms. in the plain area and 500 cms. in the hilly sector in Assam that periodically causes floods in the Brahmaputra valley. High rainfall in the Himalayas and in the plains causes disastrous floods in the Himalayan rivers draining

through the North Indian plains. Higher magnitude of rainfall coupled with a larger catchment area leads to a greater volume of overland flow.

2. Cloudbursts.

Excessive rain within a short period is called a cloudburst. Cloudbursts are very common in the Himalayan region, Orissa, and central and western India including Rajasthan and Gujarat.

3. Tropical Cyclones

Cyclones are the most important cause of floods in the coastal areas. Certain parts of our vast coastline especially Andhra Pradesh, and Orissa coast in the east and the Gujarat coast in the west are particularly prone to onslaught of cyclonic storms which originate and develop over warm seas. These violent storms are accompanied by huge tidal waves and intense rainfall. The tidal waves cause widespread inundations in the coastal belts. It is inevitable that the heavy downpour which accompanies cyclones will bring flood in the affected region. In November 1982 and in 1983 in Saurashtra, cyclones resulted in overflowing of 27 dams some by over 2m. Although floods due to cyclonic storms are a natural calamity we must have some precautionary measures to minimize the impact of cyclonic storms.

(B). Physical Conditions

1. Large Catchment area

A large catchment area collects water from a larger area thus even if the rainfall conditions are not fairly heavy, chances of flooding in the consequent stream is high simply because the volume of water collected from such a larger area becomes very large. The catchment areas of the Ganga and the Godavari are very large and the volume of the water carried by these rivers is also very large.

2. Inadequate drainage arrangement

Even if the catchment area is quite small and the rainfall in the catchment area is not heavy, flood occurs because water, if it does not drain quickly, accumulates and leads to flood. The reasons behind the inadequacy of the drainage arrangement in different regions of the country are as follows.

(a) Under-Developed drainage channels. Particularly in the states of Punjab and Rajasthan, the drainage channels are not well developed. Heavy amount of rainfall in these regions cause flash floods as the rivers are unable to accommodate enormous volume of water. Moreover, unconsolidated soil of this region chokes and blocks the natural drainage thus leading to floods.

(b) Reduced Carrying capacity of rivers. The capacity of channels carrying water is diminished by the accumulation of sediments derived from massive erosion in the catchment areas. The deposition of

the sediment on the beds restricts the passage of the water and hence the carrying capacity of the channel is reduced. This results in spreading of the flood water on the adjacent plain. The extensive flooding in eastern Uttar Pradesh and northern Bihar especially by the Narayani and the Kosi rivers is primarily due to reduced carrying capacity of the rivers choked with sediments which have been derived from accelerated erosion in the Himalayan region and inadequacy of slope in flood plains.

(c) Blocking of natural flow by landslides: Landslides lead to impoundment of water and a consequent rising of the water level leading to bank full conditions. If the natural dam bursts, it causes disastrous floods downstream. This normally happens in the Himalayan region. This was happened with the Bhagirathi River in 1978 when a landslide caused a dam formation. The bursting of this dam, 14 hours later, caused widespread havoc up to Uttarkashi and wiped out the hamlets of Gangnani and Dabrani on the pilgrim route to Gangotri.

(d) Meandering of the rivers. Sinuous and meandering course of rivers obstruct the normal discharge of water thus reducing the velocity which delays the passage of water resulting into stagnation of water. For example the meandering loops in Brahmaputra.

(e) Formation of sand bars. Sand bar formation is a common phenomenon in the coastal regions particularly near estuaries. Long shore drift which leads to formation of sand bars chokes the mouth of estuaries and deltas. This impedes the natural drainage, particularly, in times of heavy rainfall when the river carries a greater volume of water. In the delta areas of West Bengal and Orissa the problem has been aggravated by the influence of sea tides which deposit silt on the mouth of the rivers and also in the drainage channels. This leads to a constant deterioration in the discharge capacity of the river.

(C) Anthropogenic Factors and Human Impact

Flood is a natural phenomenon with the presence of certain meteorological and physical conditions. But in recent times some incidence of flooding has been largely due to human impact on the physical conditions. The flood discharge of stream depends on the amount of run-off or the ground flow of rainwater. Run-off is determined by the amount of infiltration of water which, in turn, is determined by the nature and extent of vegetation, texture of the soil and length and steepness of the slope. The human impact has altered all of these components. The most important of all is the destruction of forest cover.

1. Deforestation

Vegetation has a strong control over runoff as it performs two important functions- by allowing infiltration and hence decreasing runoff. Raindrops are intercepted by forest canopy and thus reach the ground slowly through the leaves, branches and stems of trees. On the ground the lead litters and the grass allows infiltration into the soil and thus reduces runoff. The absence of vegetation on the other hand, exposes the surface to beating

rains. The infiltration gets reduced and most of the water flows as surface runoff bringing floods downstream. Thus wherever man has resorted to indiscriminate deforestation, as in Siwaliks, Lower Himalayas, Chhotanagpur plateau, Western Ghats and elsewhere floods have become a rule in the downstream areas. This is evident in Tista and Torsa in West Bengal, Chambal in Madhya Pradesh, Gandak in Uttar Pradesh and Kosi in Bihar, etc.

2. Siltation

Higher surface runoff resulting from deforestation additionally accelerates erosion and increase the sediment load of the streams. Increased sediment load causes siltation of river beds and filling of the valleys and hence, reduces the water accommodating capacity of the river valleys. In south eastern Nepal the beds of the rivers in the Bhabhar belt are rising at the rate of 15-30 cm/yr. The bed of river Kosi in Bihar is now at a higher level that the flood plain, the river flowing within considerably raised levees. Rise of the channel to a greater or less degree has also been responsible for floods in the Gangetic plain and the Brahmaputra plain.

3. Faulty agricultural Practices

In India, valley side slopes of the rivers are ploughed down to the channel, transverse to the contours. This is done to dry out the moisture which had accumulated during the wet rabi season. After the crops are harvested, the ploughed fields are baked by the blazing sun in the summer and the loose soils become extremely dry. With the first showers in the coming rainy season, the loose soils get saturated with water and slump in to the river bed following overland flow. The river beds thus get gradually stilled. Simultaneously, the cultivation of valley side slopes reduces the gradient of river banks finally flattening the valley. As the flattening gradually proceeds, the water accommodating capacity of the river decreases and the river takes very little time in attaining bank full conditions. The water then spreads over the valley sides inundating the low lying flood plains.

4. Faulty Irrigation Practices

In the Punjab, Haryana and western Uttar Pradesh there is a network of canals in the alluvial formation. The constant seepage of water from the canals raises the water table in the adjoining areas. With further application of water for irrigation, in these regions of inadequate drainage a condition of water logging arises. Under these conditions, even in rainfall is not so heavy the entire rainfall flows as surface runoff because the ground does not absorb the water, bringing floods.

5. Increasing urbanization.

Increasing urbanization helps to increase the surface runoff and thus the dimension and magnitude of floods. The construction of roads, building, pavements, etc., reduces the infiltration capacity and increases the surface runoff. The increases surface runoff finds its way through the drains into

the nearby stream locally increasing the volume and magnitude of floods. Additionally, urbanization has also led to siltation of river beds caused by dumping of garbage from the nearby centres, extension of settlement in the low lying areas, filing up of nallas (urban drains), construction of bridges, roads, embankments, etc. Consequently the drainage capacity of the river has been reduced.

Although the causes of floods are many and each individual cause may bring about flood, floods actually result from a combination of these causes. For example, two factors, namely, heavy precipitation and deforestation have been the most important causes of floods and although there has not been a change in the overall rainfall pattern, deforestation has increased surface runoff and consequently incidence of floods.

d. Impact of floods

Floods are gradually becoming more and more damaging as they appear with an increased frequency, intensity and magnitude. The most important impact of floods is the loss of life and property. Indirect losses result from the breakdown of the communication, disruption of rail and road traffic and other essential services whose restoration may cost crores of rupees.

The impact of flood was not, perhaps felt to the same extent in the past as it is being felt now because earlier only fewer people lived on the land and there was no such proliferation of industrial activity and other works. Now with an increase in population, areas close to the river have also become habituated. The principle where a river has the right of way stay out of its way is not followed by the people who have little option in setting themselves or locating industrial projects. Floods have caused heavy damage on nine occasions in the last 40 years – 1955,1971,1973,1977, 1978,1980,1984,1988 and 1989. On an average, the area affected by floods annually is about eight million ha, out of which the cropped area affected is about 3.7 ha. Rashtriya Barh Ayog has assessed the maximum area prone to the floods in the country to be about 40 million ha, out of which 32 million ha is a protectable area. The maximum area damaged in any one year was 17.5 million ha in 1978. the average (period 1953-91) annual total damage to crops, houses and public utilities is about Rs. 9500 million, while the maximum annual damage was Rs. 46300 million in 1988.

In India, states like Assam, Bihar and parts of Gangetic Uttar Pradesh are quite prone to floods during the rainy season. The Ganga and Brahmaputra rivers and their tributaries are most susceptible to floods. However, heavy rains cause occasional floods in parts of Gujarat, Maharashtra, Karnataka and Tamil Nadu. Flooding, in India, is a major problem and some part or the other is affected by the fury of floods usually during the months from July to September.

These figures indicate the magnitude of the flood problem in the country.

Sl. No.	Item	Average flood damage 1953-90	Maximum drainage in one year (Year)
1	Area affected (in Million ha)	7.94	17.50 (1978)
2	Population affected (in Million ha)	32.86	70.45 (1978)
3	Cropped Area Affected (in Million ha)	3.66	10.14 (1988)
4	Value of damage to crops (in Rs. Crore)	448.32	2510.90 (1988)
5	Houses Damaged (in Million Nos)	1.22	3.51 (1978)
6	Value of damage to Crops (in Rs.Crore)	132.31	741.60 (1988)
7	Cattle Lose (Nos.)	102.905	618.248 (1979)
8	Human Lives Lost (nos.)	1532	11316 (1977)
9	Value of Damage to Public Utilities (in Rs. Crores)	347.38	2050.04 (1985)
10	Total Damage to Crops, houses and Public Utilities (in Rs. Crore)	937.56	4630.30 (1988)

e. Forecasting, warning & monitoring of floods

Disasters do not recognize or respect national geographic boundaries. In the increasingly globalized world, more disasters will be spread over many countries and will be regional in nature. India has set up an example of responding internally and simultaneously in neighbouring countries for the other countries to follow. At the present time, warning is possible for droughts and famines, cyclones and most severe weather phenomena, volcanoes, large scale fires, and in some cases earthquakes.

i. Flood Forecasting

By monitoring events, specialists look for indicators that tell when, where, and what magnitude the disaster may be. This is known as prediction or forecasting.

Advance information about flood plays a key role regarding flood control. Losses due to flood, especially of human life and livestock, can be considerably reduced by flood forecasting and early warning to the affected areas. Normally a flood peak takes a few hours to few days to pass from a point downstream along a river. So, if the water level is constantly monitored, it is possible to issue forecast of floods downstream well in advance for the local authorities to take precautionary steps to

minimize the loss of life and property. Flood forecasting is the most effective way of flood management.

The Central Water Commission (CWC) is entrusted with the task of forecasting floods. It has a network of 157 forecast stations in 11 flood prone states and 2 Union territories. Bihar has the largest number of flood forecasting stations. The network uses INSAT extensively for monitoring and transmitting data. In 1992, the accuracy of forecasts was 96%.

During IX Plan, 55 telemetry stations were installed in Mahanadi and Chambal Basins besides setting up of two Earth receiving Stations (ERS) at Jaipur (Rajasthan) and Burla (Orissa). During X Plan, modernization of 168 stations was undertaken; out of which 166 stations besides 11 Modelling Centres have been set up till date. During XI Plan, additional 222 stations and 10 Modelling Centres are proposed to be installed; which would help the concerned States in taking appropriate measures in advance for evacuation of people and shifting them and their properties to safer locations.

ii. Warning Phase

The objective of warning phase is to provide disaster (flood, in particular case) managers with enough information so they can give the people at risk adequate notice or warning to prepare for the disaster and, if necessary, to evacuate. Work is also underway in refugee management to develop early warning techniques that will let relief agencies know of impending refugee crises.

Early Warning- Building codes do not exist against storm surge inundation. Prescribed means today to save life and properties against storm surge inundation is to evacuate people to safer places as quickly as possible on receipt of warnings. Coordinated early warning systems against tropical cyclone are now in existence around the globe and it is possible to warn the affected population at least 24 to 36 hours in advance about the danger from a tropical cyclone. By taking advantage of early warning systems, it is now possible by prepared and knowledgeable communities to minimize the loss of lives and properties.

iii. Monitoring flood

In India, a two tier system of flood management exists as briefly described below:

State Level Mechanism - The State Level Mechanism includes the Water Resources Departments, State Technical Advisory Committee and Flood Control Board. In some States, the Irrigation Departments and Public Works Departments look after flood matters.

Central Government Mechanism – The Union Government has set up following organizations and various expert committees to enable the State Governments in addressing flood problems in a comprehensive manner:

Central Water Commission (CWC) – The Government of India set up Central Water Commission as presently named in 1945 for achieving the goal of furthering and promoting measures of flood control, conservation and utilization of water resources throughout the country in the areas of beneficial uses, irrigation and hydropower generation, flood management and river conservation.

Brahmaputra Board – The Government of India set up Brahmaputra Board under Brahmaputra Board Act, 1980 (46 of 1980) under the then Ministry of Irrigation (now Ministry of Water Resources) The jurisdiction of Brahmaputra Board includes all NE States in Brahmaputra and Barak Basin. The main functions of Brahmaputra Board are as under:

- Survey and investigations in Brahmaputra and Barak valley.
- Preparation of master plans to control floods, bank erosion, and improvement of drainage system.
- Preparation of DPRs for dams and other projects
- Standard specifications for construction operation and maintenance of dams.
- Construction of multipurpose dams and maintenance thereof.
- Any other function for implementation of Brahmaputra Board Act-1980.

Brahmaputra Board prepared master plans for the flood management for river Brahmaputra and Barak. Besides this, the Board has undertaken survey and investigations for preparation of master plans for tackling the problems of flood, erosion and drainage congestion including DPRs for multipurpose projects.

Ganga Flood Control Commission - The Ganga Flood Control Commission (GFCC) was set up by Government of India in 1972 for preparation of comprehensive plan of flood control for Ganga Basin and to draw out a phased coordinated programme of implementation of works and monitoring & appraisal of flood management schemes of Ganga basin States. The GFCC has prepared comprehensive plans of flood management of the 23 sub-basins in the Ganga Basin besides drawing out a phased programme of implementation of these works to proper standards, examination and monitoring of various flood management schemes in the Ganga Basin States.

Farakka Barrage Project Authority – The Farakka Barrage Project Authority carries out anti-erosion and river bank protection works in its jurisdiction in near river vicinity of the Barrage.

National Disaster Management Authority (NDMA) - For prevention and mitigation effects of disasters including flood disasters and for undertaking a holistic, coordinated and prompt response to any disaster situation, the Government of India has set up a National Disaster

Management Authority (NDMA) in 2005 under the Chairmanship of Honourable Prime Minister of India. The functions of the NDMA are:

(i) lay down policies on disaster management;

(ii) approve national Plan;

(iii) approve plans prepared by the Ministries or departments of the Government of India in accordance with the National Plan; (iv) lay down guidelines to be followed by the State Authorities in drawing up the State Plan;

(v) lay down guidelines to be followed by the different Ministries or departments of the government of India for the purpose of integrating the measures for prevention of disaster or the mitigation of its effects in their development plans and projects;

(vi) coordinate the enforcement and implementation of the policy and plan for disaster management;

(vii) recommend provision of funds for the purpose of mitigation;

(viii) provide such support to other countries affected by major disasters as may be determined by the central Government;

(ix) take such other measures for the prevention of disaster, or the mitigation, or preparedness and capacity building for dealing with the threatening disaster situation or disaster as it may consider necessary;

(x) lay down broad policies and guidelines for the functioning of the National Institute of Disaster Management.

The NDMA has issued guidelines in January, 2008 for management of floods and the roles of various Central and State agencies have been specified for preparation of flood mitigation plans and taking relief measures during flood disasters.

Management of floods

Development of a culture of prevention is an essential component of an integrated approach to disaster reduction. Prepare and maintain in a state of readiness 'Preparedness and Response Plans' at National, State and District levels and adoption of a policy of self reliance in each vulnerable area. Education and training in disaster prevention, mitigation and preparedness for enhancement of capabilities at all levels. There should be identification and strengthening of existing centres of excellence in order to improve disaster prevention, reduction and mitigation capabilities.

Preparedness means those actions taken to limit the impact of natural phenomena by structuring response and establishing a mechanism for effecting a quick and orderly reaction. Preparedness activities could include pre-positioning supplies and equipment; developing emergency action plans, manuals, and procedures; developing warning, evacuation,

and sheltering plans; strengthening or otherwise protecting critical facilities; etc.

Culture of Preparedness -To cope with the effects of natural disasters post-disaster management involve many problems such as law and order, evacuation and warnings, communications, search and rescue, fire-fighting, medical and psychiatric assistance, provision of relief and sheltering, etc.

After the initial trauma of the occurrence of the natural disaster, like flood, is over within the first few days or weeks, the phase of reconstruction and economic, social and psychological rehabilitation is taken up by the people themselves and by the government authorities.

Experience has shown that by the presence of a well-functioning warning system, combined with preparedness on the part of the vulnerable community, destruction from floods may be minimized. A community that is prepared to face disasters receives and understands warnings of impending hazards and has taken precautionary and mitigatory measures will be able to cope better and resume their normal life sooner.

❖ **Flood preparedness and response in India**

In order to respond effectively to floods, Ministry of Home Affairs has initiated National Disaster Risk Management Programme in all the flood-prone States. Assistance is being provided to the States to draw up disaster management plans at the State, District, Block/Taluka and Village levels. Awareness generation campaigns to sensitize all the stakeholders on the need for flood preparedness and mitigation measures. Elected representatives and officials are being trained in flood disaster management under the programme. Bihar Orissa, West Bengal, Assam and Uttar Pradesh are among the 17 multi-hazard prone States where this programme is being implemented with UNDP, USAID and European Commission.

Mitigation - case studies – flood

❖ **Mumbai flood - July 26, 2005**

The following are the glimpse of complexity of Mumbai Flood

- **Mumbai,** with an Area of 437 Sq. Km, is originally a group of 7 islands having many reclaimed areas that are just 5 mtrs. above low tide sea level.
- Mithi River divides the city into the western & the eastern suburbs can cause floods.
- Rapid urbanisation in the city with mostly private houses has blocked the waterways.
- Railway lines typically 10 mtrs. above low tide level & Subways close to high tide level are highly affected by floods. So, there are 82 chronic flooding spots in Mumbai.

- The ratio of > 75 mm rainfall days to flooding days increased from 1:7 to 1.5:1 during the last sixty years.
- Existing technology does not forecast rainfall >250 mm accurately – limitations with India Meteorological Department (IMD).
- July 26, 2005 – 944 mm rainfall. Rainfall from clouds few kms. long could not be predicted.
- Sea level rising by 3 mm ever year.
- Multiplicity of organisations: over 20 agencies from the GoI, GoM, and MCGM
- The scourge of rainfall -Mumbai get about 2500 mm of rainfall , but in Mumbai the water has to discharge in one-sixth of the time, due to concentration of rainfall in monsoons during July and August

Government Recovery Plan

1. Storm Water Drainage

- Upgrade the storm water drainage system to mitigate the effects of events like July 26th 2005, when almost 35% of annual rainfall occurred on a single day.
- Widening and deepening of existing water channels and causeways.
- Providing smooth transition for waterways near bridges
- Moderating the river course by replacing existing sharp bends with longer gentler bends

2. Actions by MCGM

- Operates a control room - the Main Centre of Communication
- Discharge pumps – 196 nos. deployed to discharge water
- 6 Nos. search and rescue teams kept ready under the fire brigade
- 600 personnel from Civil Defence and 10 persons per ward from NGO
- 500 buses kept ready by the transport service provider
- De-silting of Mithi river - 5.68 lakh M^3 silt removed pre-2007 and 3.70 lakhs M^3 thereafter
- 2652 residential and 1148 commercial structures removed.
- 1769 residential and 349 commercial structures rehabilitated
- Additional bridges at Kranti Nagar and Kurla-Kalina Road started.

3. Actions by State Government

- Active traffic management- diversion when roads are waterlogged
- State government hospitals/ supplement municipal hospitals.
- Home Guards & Civil Defence for disaster management
- 288 retaining walls in 74 places have been undertaken by the Slum Improvement Board
- The Chief Minister of Maharashtra acts as the highest coordinating authority - Chairs a 'Monsoon-preparedness' meeting
- Regular follow-up meetings by the Chief Secretary and Additional Chief Secretary (Home Department).

4. Actions by Government of India

- Honorable Prime Minister sanctioned a special grant of Rs. 1200 crores outside the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) as 100% subsidy
- The work involves widening of drains and construction of pumping stations
- Rehabilitation of slums up to 01.01.2000.

5. Conclusion and Recommendation

- Shift from conventional / reactive approach to strategic approach
- Step up structural measures such as gates on Vihar and Tulsi lakes, holding ponds upstream of airport on Mithi river, augmentation of railway culverts
- Contour mapping of city required for better storm-water management
- Upgrade flood warning and forecasting measures to "nowcasting".
- Network of Doppler Weather Radars to be put in place
- Restoration of existing water bodies, natural drainage, resettle the encroachment, enforcement of rain water harvesting etc. to moderate the discharge.
- Create public awareness about warnings, teach people how to react and ensure self help grooming; collaborate with NGOs
- "Flood insurance" products have to be encouraged to cover partial loss to business

6. Mumbai Floods - Aftermath - Lessons Learnt

- Sustainable and meticulously planned growth is the key. Expert reports prepared for future planning
- In India - post 2005 Mumbai floods - disaster management bill passed, policy is emerging
- Political action is necessary. Regular monitoring by political executive became order of the day
- Informed, trained bureaucrats can offer co-ordinated response. Regular interaction with experts in training and research institutions
- Effective communication is the key. It can make or break the response measures
- Disaster response has to be 'people centric'. People with strong civic sense and resilience make all the difference
- Local committees trained in facilitating self help foster the government initiatives
- Empowered communities respond better

4.6 CYCLONE - DISTRIBUTION CAUSES, EFFECT, MANAGEMENT

A cyclone is a large-scale, atmospheric wind-and-pressure system characterized by low pressure at its center and by circular wind motion, counterclockwise in the Northern Hemisphere, clockwise in the Southern Hemisphere. They are usually characterized by inward spiraling winds that rotate counterclockwise in the Northern Hemisphere and clockwise in the southern hemisphere. All large-scale cyclones are centered on areas of low atmospheric pressure. A cyclone is formed when a warm temperature of the sea reaches a threshold level and the wind structure is rising. In other words, cyclone derives their energy from the warm tropical oceans and do not form unless the sea-surface temperature is above 26.5°C. However, once formed they can persist at lower temperatures and dissipate over land or colder oceans. The eye of the cyclone is the centre of the cyclone where the focus lies. The areas surrounding the eye will be most affected because of the strong wind.

Geographical distribution of cyclone

World distribution of tropical cyclones is limited to six regions, all of them over tropical and subtropical oceans.

1. West Indies, Gulf of Mexico, and Caribbean Sea;
2. western North Pacific, including the Philippine Islands, China Sea, and Japanese Islands;
3. Arabian Sea and Bay of Bengal;

4. Eastern Pacific coastal region off Mexico and Central America;
5. South Indian Ocean, off Madagascar;
6. Western South Pacific, in the region of Samoa and Fiji Islands and the east coast of Australia.

Causes of cyclones

In tropical oceans the water in the oceans' surface layer heated by the direct solar radiation. As a result the air above the tropical ocean is characterised by high temperature and humidity resulting in air inflation that easily leads to low density per unit volume of air. Weak wind near the equator causes the lighter air to soar and incur convection that further attracts inflow of surrounding cooler air. The intake air then warms up and soars again, creating a positive feedback cycle that eventually forms an air column with high temperature, light weight and low density. This is how the tropical depression forms. Cyclones form only over warm ocean waters near the equator. To form a cyclone, warm, moist air over the ocean rises upward from near the surface. As this air moves up and away from the ocean surface, it leaves less air near the surface. As basically the warm air rises, it causes an area of low air pressure below. Air from surrounding areas with higher air pressure pushes in to the low pressure area. Then this new "cool" air becomes warm and moist and rises, too. And the cycle continues. As the warmed, moist air rises and cools the water in the air forms clouds. The whole system of clouds and wind spins and grows, fed by the ocean's heat and water evaporating from the ocean surface.

As the storm system rotates faster and faster, an eye forms in the centre. It is very calm and clear in the eye, with very low air pressure. Higher pressure air from above flows down into the eye. When the winds in the rotating storm reach 39 mph (63 kmph), the storm is called a "tropical storm". And when the wind speeds reach 74 mph (119 kmph), the storm is officially a "tropical cyclone" or hurricane. Tropical cyclones usually weaken when they hit land, because they are no longer being "fed" by the energy from the warm ocean waters. However, they often move far inland, dumping many centimetres of rain and causing lots of wind damage before they die out completely.

❖ **There are four stages that form a cyclone which include:**

1. Formative Stage
2. Immature Cyclone
3. Mature Cyclone
4. Decay stage

To form, tropical cyclones require large bodies of warm water (26.5o C over a depth of at least 50m). The atmosphere must also be conducive to convection (i.e. it must cool rapidly with height to ensure a warm air

parcel from the surface will continue to rise to a high enough height to form a cumulonimbus cloud – A thunderstorm). They must form at least 500km (300miles) from the equator to ensure the Carioles 'force' is strong enough to allow the central low pressure to be maintained, otherwise air would move in too quickly and 'fill' the low pressure killing the storm. An existing area of disturbance (to provide some weak spin) is also required in formation – The storm cannot form spontaneously out of the blue. Finally less than 10m/s of vertical wind shear (how much the wind varies with height). If shear is greater than this than the deep convection will be disrupted and the developing storm can be 'torn' apart. Tropical cyclones obtain all of their energy from latent heat (the energy released when water cools from water vapour to liquid water i.e. in a cloud). This heat originated in the warm, tropical oceans as mentioned above. If a tropical atmospheric disturbance occurs (such as a tropical wave leaving the west coast of Africa), thunderstorms can begin to develop more widely in the warm, humid tropical air. As air rises into the thunderstorms, further air is entrained into the surface low and this enhances the weak circulation that initiated the thunderstorms. The large quantity of rising air also creates a high pressure system above, leading to diverging air aloft enhancing the upward motion of air in the thunderstorms. As the surface winds increase to between 20-34 knots, the disturbance becomes known as a tropical depression. A distinct area of low pressure usually forms at this point at the centre of the group of thunderstorms and the wind moving faster inwards causes the spin to increase (just as an ice skaters spin increases when they move their arms inwards). The sea now becomes rougher, leading to greater friction and so the winds converge further into the centre of the low. A feedback mechanism now occurs. The rising air has extra heat and moisture from the increasingly choppy sea. This results in more and stronger thunderstorms which release more latent heat. This causes the surface pressure to lower further, causing stronger winds, choppier seas and greater surface convergence of winds. When winds reach between 35-64knots the weather system is classed as a tropical storm. Above 65knots we call it a tropical cyclone (or hurricane etc depending on geographic location). By this point the distinctive eye usually forms where slowly sinking air in the centre of the storm creates a region of relative calm (the eye) surrounded by violent winds (the eye wall - figure 2). This development will continue until the moisture is cut off (the cyclone moves over land), the heat is cut off (the cyclone moves too far north or south), or wind shear increases and shears the storm apart. When the cyclone is 'full' of thunderstorms, latent heat release slows as the entire air mass warms and this also limits cyclone growth. These factors mean that wind gusts in cyclones rarely exceed 200knots. Tropical cyclones generally last about a week but this can vary considerably. The oldest cyclone (Hurricane Tina 1992) lasted for 24 days. The average diameter is around 500km and they extend to a height of around 15km. Tropical cyclones can release up to 200x1018J per day (approx 1PW = 1x1015Watts!). This is equivalent to exploding a 10 megaton nuclear bomb every 20 minutes! Obviously when tropical cyclones make landfall the strength of the wind causes considerable damage. However the storm surge is often the most deadly part (~90% of tropical cyclone deaths are due to the storm surge) caused

partly by the very low central pressure causing a rise in sea levels but mainly by the winds whipping up the sea by up to 5m. Hurricanes, typhoons, cyclones, Willy-willy's are all words used for tropical cyclone. The different terms are used in different parts of the world.

❖ **India also has history of suffering from cyclones.**

- The 1935, tropical cyclone killed 30,000 people.
- In 1942, tropical storm in Orissa and West Bengal killed 40,000 people.
- In 1943, Rajputana tropical storm, 5,000 people were killed.
- In eastern coast of Orissa, 1971 tropical storm killed 9,658.
- In 1977 cyclone, in Tamil Nadu, Andhra Pradesh and Kerala 14,204 people were killed.
- The biggest cyclone disaster is the Orissa super cyclone. It hit the Orissa coast of India on October 29, 1999 accompanied with 155 mph (250 km/h) cyclone winds and water surge from the sea. It caused the deaths of over 10,000 people, and heavy to extreme damage in its path of destruction. Following the cyclone, with the help of the World Bank, Orissa State Disaster Management Authority was formed.

Impact of cyclone

Tropical storms are a type of severe spinning (rotating) storm that occurs over the ocean near the tropics. As they gather speed, the spinning of the earth, the Coriolis effect, pushes them westward and away from the equator. If they reach land there are several things that you would notice

High Winds: The extreme wind speeds in tropical cyclones are directly related to the steep pressure gradients near the cyclone centre. Wind damage increases exponentially with increased wind speed. In severe cyclones the maximum sustained winds can approach 200 km/h with short period gusts closer to 300 km/h. Such violent winds can devastate natural vegetation and all but the strongest man-made structures.

Storm Surge: As a tropical cyclone crosses the coast the combination of low pressure near the centre and strong onshore winds can produce a large increase in sea level, called a storm surge. This can bring about sea waves breaking into areas not normally affected, producing absolute destruction of buildings or other facilities. In highly vulnerable areas such as the Ganges River Delta of Bangladesh, where a large population inhabits the fertile flats close to sea level, the results can be disastrous. Storm surges in this area have resulted in death tolls exceeding 100,000.

Flood Rains and Landslides: In some areas of the world (especially the Philippines, China and Japan), torrential rain brought by tropical cyclones can produce landslides in mountainous terrain, sometimes with disastrous results. In early November 1991 on the Philippines island of Leyte an

estimated 6,000 people died and a further 20,000 were left homeless when flood rains in the wake of Typhoon Thelma caused flash flooding, landslides and a burst dam. Hardest hit was the port city of Ormoc where a huge mudslide occurred on nearby hillsides made much worse by extensive logging operations that had removed the protection of the trees.

Forecasting , warning, monitoring cyclone:

❖ **Cyclone Forecast and Stages of Cyclone Warning**

Tropical cyclone forecasting is the science of forecasting. It states where a tropical cyclone's centre, and its effects, is expected to be at some point in the future. There are several elements to tropical cyclone forecasting: track forecasting, intensity forecasting, rainfall forecasting, storm surge, and tornado forecasting. The skill in regard to track forecasting has increased, but intensity forecasting skill remains nearly unchanged over the past several years.

Cyclones vary considerably in their predictability. Much effort has been dedicated to improving the forecasting skill in both location and intensity. The Bureau of Meteorology routinely issues forecasts of cyclone location and intensity at 12, 24 and 48 hour time-steps. All official forecasts are verified by comparison with the **best track**, the official estimate of the location and intensity of a tropical cyclone. A best track is prepared for every tropical cyclone, after the fact, using all available data.

Unpredictable nature of Tropical cyclones is seen when some exhibit rapid changes in intensity or change course speed up or slow down, primarily in response to changes in the surrounding environment. Cyclone*Lena* (1993), for example, was moving to the west but made a U-turn and returned close to its original path. Also cyclones at the category 1 stage are typically difficult to locate as the centre may not be apparent from satellite imagery, compared to stronger systems that have a well-defined eye. Those systems that markedly change their course or intensity close to the coast present the greatest challenge to forecasters and decision-makers in the community. Community awareness is much higher when a cyclone develops well offshore prior to crossing compared to one that rapidly develops near the coast.

The cyclone tracking, forecasting and advance warning are being done precisely after the Meteorological application program of INSAT series of Indian Geo-Stationary Satellites have become operational since October 1983. Monitoring of the cyclone is done by taking hourly pictures. This has helped the forecaster to improve his skill in issuing the timely warnings to the public. Satellite pictures received by the IMD HQ at New Delhi are further disseminated to all the forecasting Offices through satellite based Digital Meteorological Data Dissemination Systems. The Government has strengthened the Meteorological Department, by providing Cyclone Surveillance Radars at Calcutta, Paradeep, Visakhapatnam, Machilipatnam, Chennai and Karaikal in the east coast and at Kochi, Goa, Mumbai and Bhuj in the west coast for further cyclone warning when they are within a close approach of 500 km off coast.

Area Cyclone Warning Centres (ACWC) and the Cyclone Warning Centres (CWC) of IMD are responsible for cyclone forecasting in the Bay of Bengal and Arabian Sea - the National Cyclone Warning Centre at New Delhi being the coordinator. Computerised Operational Advisory Forecasts on cyclone movements are being issued by the Numerical Weather Prediction (NWP) division of the Department at the H.Q., New Delhi.

After receipt of pre-cyclone watch bulletin issued by HQ, ACWC/CWC will monitor issue of warnings under two stages warning system- Cyclone Alert and Cyclone Warning.

Cyclone Alert, the first stage warning: This is issued 48 hrs. in advance of the commencement of adverse weather, to Collector of coastal districts and the Chief Secretary of the concerned maritime state. After issue of alert message for broadcast, the concerned AIRs are to be requested to maintain round the clock watch to receive & broadcast the subsequent numbered bulletins.

Cyclone warning is the second stage warning: This is issued 24 hrs. in advance of the commencement of adverse weather.

Third stage of warning: If the storm is tracked by radar with a high degree of confidence, any other crucial warning will be sent more frequently to all the concerned recipients (Collectors & Chief Secretaries), subsequent to this warning. These recipients will be informed that subsequent warning on the storm will be broadcast by AIR stations.

The fourth stage of the warning, i.e. Post Landfall Outlook (PLO) meant for Interior districts issued 12 hrs. before the estimated landfall of the storm in order to bring to the notice of the Collectors of interior districts about their area likely to be affected by cyclone.

One of the means of communication, on which IMD depends for the dissemination of these warnings, other than AIR, is satellite, based Cyclone Warning Dissemination System (CWDS) installed at maritime district HQ, so that district authorities can initiate appropriate precautionary measures on receipt of such warnings. This scheme makes use of the S-band broadcast capability of INSAT satellite. At present there are 5 CWDS stations located in Kerala, which are at Thiruvananthapuram, Alappuzha, Ernakulam, Thrissur and Kozhikode.

Fisheries Warnings: When wind speed over sea area is expected to exceed 45 kmph in the sea area up to 75 Nautical miles from the coast, wind warnings are issued and communicated to the Director of Fisheries, all Dy. Directors of Fisheries and Director of Ports through fax/SMS through VPN connection, advising fisherman to be cautious while venturing into the sea.

Heavy rainfall warnings : When rainfall amount is expected to exceed 7 cm, heavy rainfall warnings are issued to District Collectors and various agencies, such as public services, PWD, Irrigation, Hydroelectric, Port,

telegraphs, Railway and Community Project Officials, so that the disaster management machinery can be kept in readiness

Monitoring cyclone

Observation of tropical cyclone has been carried out over the past couple of centuries in various ways. The passage of typhoons, hurricanes, and other tropical cyclones have been detected by word of mouth from sailors recently coming to port or by radio transmissions from ships at sea, from sediment deposits in near shore estuaries, to the wiping out of cities near the coastline. Moreover, since World War II, with the advancement in technology planes have been used to survey the ocean basins, satellites to monitor the world's oceans from outer space using a variety of methods, radars to monitor their progress near the coastline, and recently the introduction of unmanned aerial vehicles to penetrate storms. Recent studies have concentrated on studying hurricane impacts lying within rocks or near shore lake sediments, which are branches of a new field known as paleotempestology.

Management of cyclone

❖ **National Cyclone Mitigation Project**

A project for Cyclone Mitigation (estimated cost Rs. 1050 crore) has been drawn up in consultation with the cyclone prone States. This project envisages construction of cyclone shelters, coastal shelter belt plantation in areas which are prone to storm surges, strengthening of warning systems, training and education etc. This project has also been given in-principle clearance by the Planning Commission and is being taken up with World Bank assistance.

The Government of India has approved a National Cyclone Risk Mitigation Project (NCRMP), to be implemented in cyclone prone coastal States and Union Territories. The Project will be implemented in three phases as a Centrally Sponsored Scheme with 75% contribution by the Central Government and 25% contribution by the State Governments for the component consisting of structural and non-structural measures.

A Project Oversight Committee will be constituted under the chairmanship of the Home Secretary for overall review and policy level directions of the scheme. A Project Steering Committee chaired by Secretary, NDMA will be constituted with representation of key Ministries/organisations. At state level, a Project Implementation unit will be set up.

The National Disaster Management Authority (NDMA) has been designated as the implementing agency. The scheme is regularly monitored by NDMA and MHA.

Objectives of NDMA

(i) To upgrade cyclone forecasting, tracking and warning systems and capacity building in multi-hazard risk management.

(ii) To construct major infrastructure including multi-purpose cyclone shelters and embankments.

After the Orissa Super Cyclone of 1999 under the influence of reconstruction donor organizations, led by the World Bank, the Government of Orissa established Orissa State Disaster Management Authority (OSDMA). This was an institutional innovation for speedy reconstruction, disaster management planning, preparedness, training, and related matters, avoiding the bureaucratic red tape.

Preparedness and Response of cyclone

The significant improvements in disaster management, preparedness, forecasting capabilities and early warning, such as the improvements exhibited by India during Cyclone Phailin in October 2013, have helped to mitigate some disaster-related impacts. Preparedness and early warning communications and activities had been much improved since the comparable Cyclone 05B 14 years earlier.

On the evening of October 12, 2013 a very severe tropical cyclone, Phailin, brought torrential downpours, damaging winds of more than 220 kilometres per hour (km/h) and storm surges of up to 3.5 metres (m) to the eastern Indian states of Odisha and Andhra Pradesh. Effective disaster planning, preparation and dissemination of early warning information led to a minimal death toll in the wake of the strongest cyclone to hit India in 14 years. In mid-October 2013, Cyclone Phailin swept over the Bay of Bengal and across the eastern coast of India. The evacuation of more than a million people in the states of Odisha and Andhra Pradesh in response to effective early warnings resulted in a much lower death toll than a catastrophic cyclone of similar strength that struck in 1999, leaving 10,000 people dead. Continued early warning efforts could have similar positive results in the future, and when accompanied by good communication and adequate preparation, impacts of disasters could be mitigated or even prevented.

Regarding forecasts, the India Meteorological Department (IMD) was able to predict wind velocity more accurately, contributing to better forecasts and more effective early warning communications. Warnings from the IMD were disseminated as early as four days before Phailin made landfall, as compared with two days of warning provided for Cyclone 05B in 1999. In addition to early warning alerts that prompted evacuations, precautions to protect cattle were taken and reservoirs were lowered to mitigate anticipated flooding. Also, preparedness meetings were held among various Disaster Response Teams in Odisha and volunteer teams, such as the International Federation of Red Cross (IFRC), were also on hand to assist with evacuation and relief.

Case study cyclone: Super Cyclonic Storm, Orissa on 29 October, 1999

Orissa was battered by a Super Cyclonic Storm on 29 October, 1999 that made landfall near Paradip. The estimated maximum wind speed reached

260-270 kmph in the core area which produced a huge storm surge that led to sea-level elevation of more than 20 feet and took away valuable lives of nearly 10,000 people. It was accompanied with exceptionally heavy rains which led to devastating floods and cut off the State from the rest of the country. Undoubtedly it was the most intense one.

It had some unique features such as rapid intensification, small radius of eye wall confining the large surge close to the point of landfall and relatively long life after landfall. Climatologically there is a high frequency of dissipation of cyclones in October because of strong easterly winds aloft. It was first detected when it was at its low pressure stage over the gulf of Siam by the IMD cyclone surveillance system on the morning of October 24, five days before it made landfall. Winds of up to 260 kph raged for over 36 hours. Coastal districts of Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Puri and Ganjam were forced to evacuate their homes. Landfall point was between Ersama and Balikuda in Jagatsinghpur district (southwest of Paradip). Time of landfall was 10.30 am, October 29, 1999. It had very high wind speed. The wind speed of the super cyclone was so high that the anemometer, a device used for measuring wind speed, at the IMD office and at Paradip had failed to record it. Eye of storm was Paradip. There was three days of torrential rain. The super cyclone centered over coastal areas of Odisha for three days was accompanied by torrential rain as a tidal surge of about 7 to 10 metre that swept more than 20 km inland. Diameter of cyclone was 200 km. It originated from about 550 km east of the Andaman Islands as a depression. Many districts and towns were affected by this super cyclone. The storm in 1999 led to 45 cm to 95 cm of rainfall and affected 14 coastal districts, 28 coastal towns and two major cities of Bhubaneswar and Cuttack. Death toll was also noticeable. While the official death toll then was 9,885 people, unofficial sources estimated the toll to be above 50,000. An estimated 1,500 children were orphaned. Of the total casualty, Jagatsinghpur district alone had accounted for 8,119 people. At least 13 million people, including 3.3 million children, 5 million women and nearly 3.5 million elderly people were affected in 1999. The storm had left 7,505 people injured and number of livestock lost was 3,15,886 head of cattle. 16,50,086 houses damaged, 23,129 houses washed away, 7,46,337 houses fully destroyed and 8,80,620 houses partially damaged by the super cyclone.

After the Orissa Super Cyclone of 1999 under the influence of reconstruction donor organizations, led by the World Bank, the Government of Orissa established Orissa State Disaster Management Authority (OSDMA). This was an institutional innovation for speedy reconstruction, disaster management planning, preparedness, training, and related matters, avoiding the bureaucratic red tape.

Within two days after the cyclone hit the Orissa coast, three INSAT portable mobile telephony terminals were handed over to the Civil Administration in Bhubaneswar for relief work. These terminals work with the INSAT-2C Mobile Satellite Service (MSS) transponders. Within 3 to 4 days, five Very Small Aperture Terminals (VSATs) were airlifted

from Delhi and a network of five VSATs was established. HCL Comnet and Essel Shyam supplied the VSATs. At present, VSATs are located at Krishi Bhavan, New Delhi; Secretariat, Bhubaneswar-1; Secretariat, Bhubaneswar-2; District HQ Collector Offices in Jagatsinghpur and Kendrapada; and in Paradeep, Erassama and Balikuda. It helped in establishing contact between the Relief Commissioner at Delhi and the Orissa Secretariat via VSAT network, operating through the INSAT-2C Extended C band transponders. This network of VSATs has now been extended to 13 places.

Use of Remote Sensing Data

Immediately after the super cyclone hit the Orissa coast and the following days, maps showing flood inundated areas were prepared using the data from Indian Remote Sensing satellites and the microwave data from the Canadian RADARSAT. As the affected areas were clouded making it difficult for using optical remote sensing data that is provided by Indian Remote Sensing satellites (IRS), the microwave data from RADARSAT were also procured to complement IRS data. The maps generated at National Remote Sensing Agency, Hyderabad, using the data from the satellites were rushed to Bhubaneswar within 24 hours of data acquisition and provided to various officials for using them for relief and rescue operations. The maps were used by Indian Air Force and the Indian Army who were in-charge of air dropping of food and other essential materials. Maps were also given to officers in charge of health services.

4.7 FAMINE - DISTRIBUTION CAUSES, EFFECTS, MANAGEMENT

DROUGHT

Drought refers to a situation when rainfall fails in general and the ground water loses its potentiality affecting the biotic life adversely. Drought is a relative phenomenon in the sense that the amount of moisture available is not that important to life as its effectiveness.

Drought is basically a distress situation caused by lack of rainfall. The failure of rains may be reviewed from two aspects. Firstly, the rainfall may be insufficient, but secondly, it may be sufficient for the region as a whole but with a wide gap, separating two or more spells of rain. Thus the quantum as well as the time of the rainfall both is important. In other words, drought is a relative phenomenon. Therefore the amount of rainfall is not that important as is its effectiveness.

a. Drought: Type and distribution

❖ **Type of drought**

A distress situation caused by lack of water falls in three categories of drought, depending on meteorological, hydrological and agricultural aspects. Usually, we talk about meteorological drought, which is a situation when the actual rainfall is significantly less than the

climatologically expected rainfall over a wide area. But all observed drought is not meteorological drought. The other form of drought are hydrological drought, surface water drought, ground water drought and agricultural or soil water drought.

- **Meteorological drought**

The special situation in which the rains do not arrive in time or in adequate quantity is called meteorological drought.

As has been pointed above it is the effectiveness of the rainfall rather than its quantity that is more important. The average rainfall rather than its quantity that is more important. The average rainfall in India is 105 cm. and it is considered to be the largest anywhere in the world for the country of comparable size, but it fluctuates widely. It is either delayed or it ends earlier or in between there are long breaks or the rainfall is concentrated in just one part and is completely absent in another.

- **Hydrological drought**

Hydrological drought comprises surface water drought and ground water drought. It is associated with the drying up of surface water such as rivers, streams, lakes and reservoirs. Hydrological drought occurs when meteorological drought is sufficiently prolonged.

- **Surface water drought**

Apart from meteorological drought there are many other processes through which water scarcity gets generated. Deforestation and hydrological destabilization in the mountain catchment of rivers can make rivers and streams dry up in the post monsoon period. In such a situation surface water drought occurs even though the rainfall is normal. This has happened in Cherrapunji where it has become normal. With the destruction of hydrological capacity of the mixed natural forests in the catchment, the entire 450 inches (1200 cm) of rainfall instantly runs off as soon as monsoon is over the springs and the streams start drying up and water scarcity sets in one of the wettest spot of the earth, during march-April

- **Ground – Water drought**

Most of the ground water that is utilized in India comes from the shallow aquifer zone with depth less than 400 to 500 feet.

The lowering of the ground water table as a result of excessive pumping without a compensatory replenishment creates an almost irreversible ground water drought even in normal rainfall conditions. Except in the alluvial areas of the Indo-Genetic plain, the rest of the country especially in the Peninsula has very limited ground-water potential due to existence of hard cry stalling rocks.

- **Agricultural drought**

Agricultural drought or soil water drought occurs when soils lose their effective moisture conserving capacity through a complex of diverse processes and consequently leads to land aridisation. Agricultural drought may not be present even when meteorological drought exists and vice-versa.

❖ **Distribution of drought**

Various Governmental agencies have devised ways to delineate drought prone areas.

On the basis of coefficient of variation

The coefficient of variation varies from 15 to 30 percent in India. So there are areas of higher variability and areas of lower variability. Lower the variability higher is the reliability and vice versa.

The highly variable rainfall areas are Rajasthan, Gujarat and Kachchh where variability is from 50 to 80 percent. Other areas where the variability is from 30 to 50 percent include the interior of the Peninsula to lee of Sahyadris or Western Ghats.

The Indian Meteorological Department (IMD) approach

The Indian meteorological department uses two measures the first describes rainfall conditions while the second represents drought severity.

Rainfall conditions are defined as follows.

Excess + 20 percent or more of the average of 70-100 years

Normal+ 19 per cent to 19 per cent of the average of 70-100 years

Deficient - 20 percent to 59 percent of the average of 70-100 years

Scanty - 60 percent or less of the average of 70-100 years

The precipitation is expressed on a weekly and monthly basis.

Drought is described as moderate or severe if the seasonal rainfall (southwest monsoon) deficiency is 26-50 percent or more than 50 percent of the normal, respectively. The criteria used by the Indian Meteorological Department are the most accepted measure of drought, principally because of its simplicity. Other measures of drought have been proposed. Subramanyam (1964), for example, defined drought intensities using standard deviation of the aridity index, while Krisbnan and Thanvi (1971) used the aridity index of the Kharif (monsoon season) cropping season to describe the drought intensity. A drought prone area is defined as one in which the probability of a drought year is greater than 20 percent. A chronic drought prone area is one in which the probability of a drought year is greater than 40 percent. A drought year occurs when less than 75 per cent of the normal rainfall is received.

b. Geographical distribution of drought

The drought area and the chronic drought affected areas are:

(a) Drought affected areas

- Gujarat, Rajasthan and adjoining parts of the Punjab, Haryana, West Uttar Pradesh and west Madhya Pradesh
- Madhya Maharashtra, interior Karnataka, Rayalseems, South Telengana and parts of Tamilnadu.
- Small portion of north-west Bihar and adjoining east Uttar Pradesh, south west Bihar including Palamau and Garhwal district.
- Small portion of north east Bihar and adjoining portion of West Bengal.

(b) Chronically drought affected areas.

❖ This includes western part of Rajasthan and Kachchh. Thus the three drought areas are:

- The track comprising the desert and semi arid region of India in a rectangular from running from Ahmedabad to Kanpur and From Kanpur to Jalandhar comprising an area of about 0.6 million sq. km.
- The track comprising the regions lying in the lee of Sahyadri comprising an area of about 0.37 million sq. km.
- Pockets of drought which comprises Thirunelveli and Coimbatore districts of Tamil Nadu, Saurashtra and Kachchh region, Puruliya district of West Bengal and Kalahandi region of Orissa comprising 0.1 million sq. km. Thus are total area affected by inadequate rainfall is over 1 million sq.km. Thus the total area affected by inadequate rainfall is over 1 million sq. km.

The rainfall criterion described above is useful for a continuous monitoring of the monsoon season. The sum of the season's rainfall becomes the basis for describing a region under moderate or severe drought. When more than 50 percent of the area in the country is under moderate of severe drought, the country is described as severely affected by drought; and when the affected area is 26-50percent of the country, it is described as an incidence of moderate drought.

It is seen that most of the areas susceptible to drought fall between arid and semi arid zones of the country and chronically affected drought areas are identified with extreme arid conditions. However, droughts may occur outside this zone in areas like Maharashtra, Chhattisgarh in Madhya Pradesh and some areas in the east in sub humid regions.

c. Causes of droughts

There are six major causes of drought as far as rainfall is concerned

1. Late onset and early withdrawal of monsoons
2. Lean rainfall due to absence of depressions (low pressure system) passing over India.
3. Prolonged breaks in monsoon rainfall
4. Re-establishment of southern branch of jet stream
5. Up welling of cool water over the Arabian Sea and extension of cool Somali currents over the Arabian Sea
6. The movement of monsoon trough closer to the Himalayan zone

The reasons behind late onset and early withdrawal of monsoons are not clearly known. The physical mechanism which leads to this meteorological situation is not fully understood. The more information on cloud structure will definitely help to know the conditions that leads to the late or an early onset of monsoon.

The absence of depressions and low pressure systems passing over India is actually associated with the global weather systems. The southern oscillation is one such meteorological system that affects the generation of these depressions. The low pressure system which dominates the area around Tahiti in central Pacific and associated high pressure over land on Asia and southeast region naturally prevents the formation of cyclones and depressions over Indonesia and the Bay of Bengal.

The prolonged break in monsoon rainfall is again part of the global weather dynamics. Previous rainfall data suggests that prolonged breaks in monsoon rainfalls have a tendency to occur towards the second half of the season that is in August and September. This type of phenomena occurred in 1974, in 1979 in 1981. These breaks are linked with quasi stationary anti-cyclonic circulation that establishes itself over North West India. This anti cyclonic circulation inhibits the upward motion of air suppressing rainfall generating conditions. Again how meteorological features influence this type of circulation is not fully understood.

The re-establishment of the southern branch of jet stream is also a part of the global weather dynamics which cannot be fully explained. The effect of re establishment of jet stream is the suppression of convection. Suppressed convection inhibits cloud formation and consequently rainfall.

The upwelling phenomenon over the Arabian Sea caused due to pushing of cool Somali current decreases the sea water temperature by as much as 2 to 4 degrees. The low surface water temperature decreases evaporation and consequently the moisture content of the wind. With lowered moisture content, the amount of rainfall all along the western coastal belt and in the lee of Sahyadri is also lowered.

Rainfall along the axis of the monsoon trough is heavy because the trough is the passage ways of smaller depressions. Thus when the monsoon trough lies close to the Himalayas there is abnormally heavy precipitation in the foothills. This causes floods while the rest of plain goes dry and invites drought.

Lack of water cannot be considered as the sole criteria for drought. If it was so then the areas receiving heavy rainfall such as North-Eastern India and the Western Ghats regions would have not been drought affected. But drought like conditions does exist in these places during March-April. It must be recognized that climatic and rainfall variability is intrinsic part of tropical meteorology. India's weather conditions like many part of tropical world a characterized by short term fluctuations which are not adequately explained. When the monsoons appear over India, depressions and cyclonic disturbances can cause appreciable spatial variations in rainfall. At the same time these disturbances do not give a common pattern. For example, during 1917 and 1918 monsoon season the numbers of disturbances were equal while 1917 and 1918 are the wettest and driest season of India, respectively, during the period 1901 to 1960.

Droughts' resulting from failure of rainfall is a product of meteorological variability. Droughts are bound to re-occur because they are, after all, a part of tropical meteorology. Except for small pockets of north east there is no area in India that has not been affected by drought at one time or the other.

Probability of Occurrence of Drought in Drought Prone Meteorological Subdivisions

Meteorological Subdivisions	Frequency of Deficient Rainfall (75 % of normal or less
Assam, Northeast Region	Very rare, once in 15 years
West Bengal, West Madhya Pradesh, Konkan, Coastal Andhra Pradesh, Maharashtra, Kerala, Bihar, Orissa.	Once in five years.
South interior Karnataka, Eastern Uttar Pradesh, Vidarbha, Gujarat, Eastern Rajasthan, Western Uttar Pradesh	Once in five years
Tamil Nadu, Kashmir	Once in Four years
Rayalseema, Telangana, Western Rajasthan	Twice in five years

d. Impact of drought

Although the drought is short term phenomena, its impact is felt over a much longer period. Its adverse impact is felt widely in the form of depletion of underground water resources, lowering water table, death of human, animal alike, etc., and these are greatly aggravated by the cumulative impact of successive droughts. This happens only if the drought is severe. A mild drought followed by a good season may not leave its marks.

Drought has manifold impact on the geography of a country that can be studied under the following heads.

I. Physical impact

Meteorological drought has an immediate effect on the soil moisture, ground water table and surface runoff. The water table is lowered and the surface runoff is reduced to lower the reservoir levels. The absence of recharge, lower water table and cause the wells to dry up. The drying up of wells has an adverse effect on irrigation. A meteorological drought also causes the runoff to decrease causing the rivers to dry up during the dry season. This in turn also affects the lowering of the reservoir water level.

II. Impact on Agriculture

Indian agriculture is still largely monsoon controlled. It is dependent on environmental factors such as rainfall, ground water condition and soil moisture condition. Hence it is largely prone to meteorological, hydrological and agricultural drought. The effect is manifested in the shortfalls of agricultural production in drought years.

The major drought of 1918, 1965, 1966, 1972, 1979 and 1982 caused losses in food grain production.

Extent and impact of drought in important drought years

Drought Year	% of the Country Affected	% Reduction in Food Grain Production over the Previous Peak year	Total food Grain Production (in million metric tons)	Import of Food Grains (in million metric tons)
1918-19	73	32.3	-	-
1965-66	54	18.8	72.4	10.6
1972-73	43	7.7	97.0	3.6
1979-80	41	17.0	109.0	0
1982-83	37	3.7	128.4	0

A shortfall in production may be the direct impact of meteorological drought but consecutive meteorological drought, hydrological and agricultural and agricultural droughts have a long range and far reaching impact on agriculture. This impact may be in the form of changes in cropping patterns and impoverishment in cattle.

III. Social and Economic Impact

Droughts do affect the social and economic life of people, but the severity of the impact depends on:

a) The manner in which it is tackled.

b) The stability, strength and resilience of the economy of the society.

The consequences are:

1) Decline in crop acreage.

2) Set bank to agricultural production (crop production, milk production0.

3) Fall in employment in the agricultural sector due to showing down of agricultural activity.

4) Fall in purchasing power of those engaged in agriculture

5) Scarcity of drinking water, fall in water-table.

6) Scarcity of food grains.

7) Rise in the price of food grain and other commodities

8) Scarcity of fodder.

9) Distress sale of cattle.

10) Loss of cattle life.

11) Low intake of food.

12) Malnutrition especially among children.

13) Ill health and spread of diseases like diarrhoea, dysentery or cholera famine and ophthalmic diseases caused by starvation.

14) Distress sale and mortgage of land, jeweller and personal property.

15) Migration of people in search of employment, depopulation of area.

16) Death due to malnutrition/starvation/diseases,

17) Fall in effective demand from agriculture sector leading to dislocation of productive processes and slowing down of the economic activities in the secondary and tertiary sectors.

18) Low morale of people

19) Social stress and tension, disruption of social institutions and relationships and social crimes. E.g., looting of grain shops.

20) Growth of fatalism, reliance on heavenly powers.

The impact is greatest on the most vulnerable sections of the society who have a hand to mouth economy and very little margin and staying power. These include the landless and marginal farmers, the artisans like the weavers whose very existence depends on local demand. On the contrary the richer sections take advantages of scarcity and high prices of food to make a fortune out of their surplus stock.

To conclude it may be said that a severe drought followed by a moderately good season leads to a secular decline of the economy. On the contrary, a milk drought followed by good seasons and effective handling of the consequences may not come in the way of secular upward movement of the economy. In the long term, some consequences of drought may be easily overcome, but most of them leave a permanent imprint on the economy.

In spite of some irreversible changes, like loss of life, assets and wealth if a drought is followed by a good rain, it will lead to an increased fodder production. It will also replenish the depleted food stocks and may also increase opportunities of gainful employment.

e. Forecasting, warning & monitoring of drought

Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature.

Management of Drought

Drought can be managed in two ways

1) Preventing the causative aspects of drought.

2) Providing relief to victims of drought and also rehabilitating them.

The reoccurrence of drought can be prevented by eliminating the causes which are responsible for it.

Management of Meteorological Drought

Meteorological drought will be a part and parcel of India's climate conditions as long as India is in the tropical realm. The complexity of meteorological phenomena on such as re-establishment of jet stream, movement of monsoonal trough close to the Himalayas, El Nino effects and global pressure changes (walker's Circulation), the upwelling phenomena in Arabian Sea, etc., cannot be managed as they are part of a complex atmospheric circulation.

The meteorological drought can be managed by predicting the variability of changing weather to some extent. By predictions the impact of climatic variations may be lessened. A prediction that the rainfall will be less than the normal will help the farmer to judiciously choose crops that are less water demanding. On the other hand, if a water demanding crop is sown, in the absence of current information about rainfalls, an artificial drought condition may occur.

Management of Hydrological Drought

In so far as hydrological drought is concerned which is readily manmade, management can be done through various techniques and methods.

Hydrological drought management aims at preventing the drying up of surface streams and checking the fall in ground water table. This can be done by

a) Biological Methods

b) Engineering Methods

c) Involving local people

Biological Methods

Biological methods involve taking help of vegetation, i.e. bringing about overall change either in the type of tree grown or overall planning in integrated manner.

1) A deforested region decreases percolation hence lowers the ground water table. This increases run-off and flood incidence. Therefore, checking indiscriminate deforestation growing apace in the hilly region is important.

2) Treatment of watershed by planting suitable trees under social forestry and farm forestry. It should be an integral part of watershed management. This will reduce the prospect of flooding in the lower portion and consequently surface water drought and at the same time, recharge the aquifers through its input into the intake basins.

3) Converting monoculture plantations of pine or eucalyptus by ecologically suitable trees. This will provide adequate defence to the soil against the direct hit of raindrops during intense storm reducing the prospects of flash flood and hence prevent surface water drought. This method will be particularly effective in the lower Himalayan region. In addition, monoculture eucalyptus plantation which drains a large amount of water through its enormous evapotranspiration capabilities should be replaced by trees which provide not only economic security but also ecologic security to the people. This will also help in raising the water table and tiding over artificial ground water drought.

Engineering Methods

Engineering methods involve artificial recharge of ground water by different methods. These are stated under:

Aquifer recharge

In the mountainous terrain, the most effective and appropriate way of recharging ground water is to cover the watershed with thick vegetation multi-storeyed forests with trees, shrubs and grasses and thick carpet of litter. This will allow greater infiltration of rainwater.

In flatter terrains ground water can be recharged artificially in addition to putting the ground under forest cover. This can be done by allowing the flood water to spread on the fields and fill the excavated trenches, tanks,

ditches and furrows on the sides of the roads and railway lines. The stored water will eventually find its way to underground reserve.

Another way of artificial recharge is injecting water through wells in areas where excessive water has been withdrawn such as the southern and central parts of Mehasana district of Gujarat. This method, to a large extent, will help to reverse the irreversible drop in water table. These types of efforts have been made in the Ghaggar basin at Kurukshetra and near Ahmedabad where water from the Sabarmati River was injected through siphon pumps. In the peninsular regions the traditional tank system causes one such mechanism to recharge ground water, by increasing percolation from surface storage of rain water.

Diversion and storage of excess water

Diverting water from a water surplus region to water scarce and drought prone areas will considerably abate the distress situation. Rajasthan Canal Project has done the same thing. It has brought the water of the Himalayan river to the dry lands of Jaisalmer Bikaner division in the desert; The Yamuna canal likewise transfers of water as the main plank.

Involving local people

The involvement of local people and the mobilization of the energy for water conservation are necessary. If the people are given leadership they would themselves undertake such projects despite unwillingness of administration. One of the examples of this type of mass action in India is by Mukti Sanbarsh Babini in Sangli district of Maharashtra where the people through Sbramdan (donation of labour) constructed a small dam across a dry river.

Management of Agricultural Drought

The choice of crops in India has evolved according to the variations of climate and soil conditions. It is in this perspective of the built in resilience of indigenous practices and enhanced vulnerability of green revolution agriculture that the droughts in India are to be analyzed. The HYV's need more water thereby creating an artificial drought condition in the wheat monoculture region of the Punjab, Haryana and Uttar Pradesh. Hence the first task would be to resort to the original cropping pattern suitable to that agro climatic region. The native crops are not only less water demanding but the indigenous mix also helps to check the nutrient deficiency in the soil. Alternatively, stress should be put on drought resistant verities and crops like sorghum, pearl millet, sunflower in drought prone areas.

b. Preparedness and Response

Post Drought Management

The impact of drought can be mitigated by providing relief and rehabilitation. The Government has launched the Drought Prone Area Programme with a view to mitigate the effects of drought.

Drought Prone Area Programme (DPAP)

The precursor of the Drought Prone Area Programme (DPAP) was the Rural Works Programme (RWP) initiated at the beginning of the country's Fourth Five Year Plan. This was based on the decision that much of the amount, the Central Government spent on relief in famine affected areas could be so deployed in the areas of chronically affected by the drought as to generate considerable employment in the rural sector largely related to a pre planned programme of rural works. Soon after the implementation of the RWP, it was realized that mere rural works would not be meaningful in bringing about drought mitigation and needed to be given area development approach. As a part of the midterm appraisal of the Fourth Plan, the TWP was redesigned as DPAP and funding on this basis commenced from 1972-73. After a number of reviews presently the DPAP cover 415 blocks in 95 districts of the country. The Minhas Committee, constituted by the Planning Commission had recommended that DPAP should aim at integrated development of agriculture with focus on restoration of ecological balance. Apart from irrigation, forestry, soil and moisture conservation, it recommended changes I agronomic practices, restructuring of cropping pattern, livestock development, rural communication and drinking water supply as important elements of the strategy of integrated rural development. Later in 1980, the entire programme was reviewed by a Task Force under the Chairmanship of M. S. Swaminathan, the then Member (Agriculture), Planning Commission. The Task Force redefined the scope and objective of DPAP and DDP. While reiterating the ongoing approach and strategy, it emphasized on:

a) Promoting a more productive dry land agriculture on the basis of the soil water climate resources of the area

b) Development and productive use of the water resources of the area;

c) Soil and moisture conservation, including promotion of proper land use practices;

d) Afforestation, including farm forestry; and

e) Livestock development, including development pasture and fodder resources.

Desert Development Programme (DDP)

The DDP launched in 1977-78, covering presently 131 blocks in 21 districts, was also to have a similar approach with accent on control of desertification.

In 1987, the Central Sanctioning Committee sought to sharpen the focus by limiting the programme activities to the core sectors of soil conservation, water resource conservation, and afforestation and pasture development.

The following are the suggestions stated for drought mitigation:

1. Drought prone areas should incorporate short term and long term development projects such as fodder bank, pasture development/rangeland management as disaster mitigation practice.

2. An area specific watershed model development plan should be prepared for arid, Semi arid and sub humid regions of the country.

3. In rain fed agricultural zones (having less rainfall and frequent droughts), considerable stress should be placed on development of khadi and village industries/college and handicrafts industries projects to provide gainful employment to the local people and check people's migration towards cities.

4. The development programmes such as national Watershed Development Programme for rain fed areas, DPAP, Desert Development Programme, National Rural Employment Programme, Drinking Water Programme and Poverty Alleviation Programmes should be integrated to form a comprehensive Drought Mitigation Programme.

5. Public participation and use of traditional practices for Disaster Mitigation should be give proper attention.

Local communities have devised indigenous safety mechanisms and drought oriented farming methods in many parts of the country. From the experience of managing the past droughts particularly the severe drought of 1987, a number of programmes have been launched by the Government to mitigate the impact of drought in the long run. These programmes include Drought Prone Area Programme (DPAP), Desert Development Programme (DDP); National Watershed Development Project for Rain fed Areas (NWDPRA), Watershed Development Programme for Shifting Cultivation (WDPSC), Integrated Water Development Project (IWDP), Integrated Afforestation and Eco-development Project Scheme (IAEPS).

c. Mitigation - case studies Latur, Maharashtra

Drought has devastated the once-prosperous Latur. Latur, with a population of about half a million, is one of the eight districts in the Marathwada region facing severe drought. The vagaries of nature have already taken their toll: the farmer in the hinterland has no way out, and the common man clings to a collapsing water infrastructure in the cramped city. Geographically, the impact of the crisis has varied. The north-eastern belt, Jalkot, Ahmedpur, Deoni, Nitur, Udgir, faces more of a hydrological drought and scarcity. The slightly better-off and greener north-western Bel, Renapur, Latur City and Ausa, is hit by both agricultural and meteorological drought.

There are some man-made factors also.

1. Current drought is a disaster of water management, accompanied by corruption, water-intensive cropping patterns and absence of a long-term view to manage water and drought.

2. Government's plans of irrigation failed as its plans for upcoming projects were entangled in corruption, plagued with delays and cost overruns.

3. Building unviable large dams, wrong cropping patterns, water diversion for non-priority uses, neglect of local water systems and unaccountable water management by the State government, the Centre and the Maharashtra Water Resources Regulatory Authority

4. The precarious state of water in the state can be blamed on the increasing area under sugarcane cultivation in Maharashtra, water-intensive activities like running of sugar and wine factories in drought-affected districts.

5. Real estate builders continue to exploit the land further by coming up with massive construction projects in drought affected areas. These luxurious projects often target the elite who prefer large swimming pools in their backyards. And to top it all, the Indian premier league, which is the country's most popular Cricket tournament, is going to be held in Maharashtra this month.

Natural factors:

1. One third area of Maharashtra falls under semi-arid climatic zone – therefore deficient rainfall pattern – and non-perennial rivers.

2. El-Nino – leading to warming of central Pacific waters and consequently drought conditions in India. 2014 and 2015 have been reported to have witnessed worst El-Nino in metrological history.

3. These region lies in the leeward side of Western Ghats, therefore receives very less rainfall and absence of perennial forests also affects the rainfall pattern.

Groundwater levels at Jalkot being 4.7 metres are at an alarming level while at Ahmedpur it is -4.38m and at Deoni, is 4.08m. According to the groundwater act, levels below -1m are 'manageable scarcity', below -2m are 'critical' and below -3m are 'alarming'. Jalkot hit the danger mark in October 2015, when the average fall was -3.53m across its ten talukas.

It has been noticed that after three deficient monsoons in a row the east's few barrages and dams have gone bone dry. In the 33 small water projects at Ahmedpur, with a total capacity of 14.4 million cubic metres (mcm.), current water availability is zero. Same is observed in Jalkot's 10 water projects (capacity 25.26 mcm).

Ironically, this is in an 'assured rainfall' zone (it gets 700–800 mm each monsoon), while the prosperous western sugar belt is a 'Declared DPAP (Drought Prone Areas Programme) Zone'. This is because it is home to

three powerful sugar factories, and has major sources of water, including the Manjra dam and Bhandarwadi barrage, among others.

Suggestions to mitigate droughts in Latur

1. Mostly all the drought affected districts are the major producers of sugar, therefore needs a shift in cropping pattern, more focus to cultivation of other crops that require lesser amount of water.

2. Restoration of ecological balance – By Conserving, developing and harnessing land, water and other natural resources including rainfall

3. Integrated watershed management – under National Watershed Programme – and with focus on strategies like Agro-forestry, Agro-horticulture

4. Adoption of micro-irrigation methods and new technologies in agriculture for high yield and less water usage (Drip and Sprinkler irrigation systems)

5. Drought resistant crops with technological intervention (bio-technology)

6. Replicate water harvesting technique prevalent in other states – TN – compulsory roof top, Rajasthan's traditional practice of storing water in Tanks.

7. Empowering farmers with knowledge of water management techniques, drought resistant crops, conservation of ground water. Awareness and self regulation among people will help to conserve the limited water resources.

The water train *Jaldoot*, commissioned by the railway ministry in collaboration with the Maharashtra government, was one of the key measures to alleviate the situation, transporting half a million litres of water on each of its trips from Miraj in Sangli district. Miraj gets its water from the Warna dam, downstream of river Krishna. The dam has a storage capacity of 34 thousand million cubic feet (tmcft) and currently has around 14 tmcft left. The railway ministry and the Maharashtra government zeroed in on Miraj because it has surplus water and offers the logistical convenience too for this difficult operation.

Indian Railways and local government authorities in Latur have made arrangements to run a 50-wagon service soon, with each wagon carrying at least 50,000 litres. A 25-wagon service is supposed to run on Tuesday and Wednesday. Considering Latur's population of 500,000, each water train journey has theoretically brought one litre of water to every Latur resident. In normal times Latur's water demand is 60 million litres per day, which works out to around 100 litres per day per person.

4.7 SUMMARY

We already know that natural event such as a flood, drought, earthquake, landslide or cyclone causes great damage or loss of life. India is one of the most disaster-prone countries in the world because of its locational and geographical features.

As India has a long coast line of 8,000 kms. it experiences about five to six tropical cyclones on an average, which form in the Bay of Bengal and Arabian Sea every year.

India has the lofty Himalayan mountain ranges in the north. These are considered to be the world's youngest fold mountain ranges. The subterranean Himalayas are, therefore, geologically very active and are earthquake prone zone.

Moreover, the Himalayan, the north-east hill ranges and the Western Ghats experience considerable landslide activities of varying intensities.

To combat all these natural disasters long term planning and preparedness are considered as a part of the process of development planning in India. A number of special programmes are in operation over many years for mitigating the impact of natural disasters. Among other disaster monitoring systems GIS is considered as the best method to analyse cyclones because it could be used as a tool for developing a spatially enabled system.

4.8 CHECK YOUR PROGRESS/ EXERCISE

1. True false

a. Landslides cause property damage, injury and death and adversely affect a variety of resources.

b. Areas existing on old landslides are generally prone to landslide.

c. As hospital preparedness is not at all crucial to any disaster response system each hospital should not have an emergency preparedness plan to deal with mass casualty incidents.

d. No casualties during earthquakes are caused by the collapse of structures.

e. There are Bureau of Indian Standard (BIS) codes which are relevant for multi-hazard resistant design and construction.

2. Fill in the blanks

a. Every tremor produces different types of seismic waves and P waves travel much faster than the _____ waves.

b. _____ are usually caused when underground rock suddenly breaks along a fault.

c. When earthquake occurs in the sea bed, the sea waves rise in the sea dispensing large volumes of water, it is _____.

d. In earthquake monitoring _____ scales measure the amount of shaking at a particular location.

e. _____ is the most destructive and turbulent form of landslide.

3. Multiple choice question

a. There are four stages that form a cyclone which include:
i. Formative Stage, Immature Cyclone, Mature Cyclone, Decay stage
ii. Formative Stage, , Mature Cyclone, Decay stage, Immature Cyclone
iii. Immature Cyclone. Decay stage, Formative Stage, , Mature Cyclone

b. Orissa was battered by a Super Cyclonic Storm on 29 October, 1999
i. that made landfall near Digha.
ii. that made landfall near Bhubaneswar.
iii. that made landfall near Paradip.

c. An earthquake is the result of a sudden release of energy in the Earth's crust
i. that creates cyclones
ii. that creates heavy rainfall
iii. that creates seismic waves.

d. Earthquake intensity is measured with the help of seismometers known as
i. Richter scale
ii. Barometer
iii. Anemometer

e. Collapsed structures are a common result of
i. Earthquakes
ii. Flood
iii. drought

f. Areas that are typically considered safe from landslides
i. On soft, jointed bedrock that has moved in the past.
ii. On hard, non-jointed bedrock that has moved recently.
iii. On hard, non-jointed bedrock that has not moved in the past.

4. Answers the following Questions

1. What is Cyclone?
2. Define Earthquakes?
3. Define Landslides?
4. How earthquake is caused? What are its impacts?
5. What are the impacts of cyclone? Explain your answer with an example.

6. What are the Preparedness and Response of earthquake?
7. What are the Preparedness and Response of cyclone?
8. What are the Preparedness and Response of landslide?
9. What do you understand by forecasting earthquake?
10. Stat the Geographical distribution of earthquake, cyclone and landslide.

4.9 ANSWERS TO THE SELF LEARNING QUESTIONS

1.a.true

1.b.true

1.c. false, hospital preparedness is crucial, should have an emergency preparedness plan

1.d. false, Most casualties

1.e. true

2.a. S
2.b. Earthquakes
2.c. Tsunami
2.d. Intensity
2.e. Flow

3.a.i.
3.b.ii
3.c.iii.
3.d.i.
3.e.i.
3.f..iii

4.10 TECHNICAL WORDS:

1. **Fault plane**- the flat surface of rock along which a geological fault occurs.
2. **Elastic-rebound theory** -explains how energy is spread during earthquakes.
3. **Rain gauge-**an instrument for measuring rainfall
4. **Aftershock**-a smaller earthquake following the main shock of a large earthquake
5. **Earthquake swarms** – these are sequences of earthquakes striking in a specific area within a short period of time

6. **Fault-** Itis a crack in the Earth's crust resulting from the displacement of one side with respect to the other
7. **Opticalfibre**-a thin flexible fibre with a glass core through which light signals can be sent with very little loss of strength
8. **Landslide**-a collapse and rapid downward movement of a mass of earth or rock from a mountain or cliff
9. **Geographic information system (GIS)** –it is a system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data.
10. **Storm Surge**-a rising of the sea as a result of wind and atmospheric pressure changes associated with a storm

4.11 TASK

1. In a map of India point out the earthquake prone zones.
2. In a map of India point out Kedarnath, Uttarakhand.
3. In a chart describe National Landslide Risk Mitigation Project.

4.12 REFERENCES FOR FURTHER STUDY

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5

ANTHROPOGENICAND THEIR MANAGEMENT IN INDIA

After going through this chapter you will be able to understand the following features:

Unit Structure :

5.1 OBJECTIVES

By the end of this unit, you will be able to –

- Understand the Industrial Hazards - cause, Effect, management case study.
- Discuss the Terrorism - causes, Effects, Management

- Discuss theWild Fire – Types, causes, Effects, Management
- Know the Accident causes, effects, and Management
- Discuss the case studies – man-made hazards
- Define Man-made disaster
- Learn the distinction between man-made disaster and natural disaster
- Understand causes of man-made disasters
- Discuss basic facts of man-made disaster
- Understand the need and scope for improving disaster management systems
- Discuss types of man-made disasters
- Learn response to man-made disasters
- Understand specific risk reduction and preparedness measures
- Define typical post-disaster needs
- Discuss case studies
- Define Forest Fire with reference to nature , geographical distribution , causes and impact, response to man-made disasters, specific risk reduction and preparedness measures, typical post-disaster needs, case studies
- Learn Terrorism with reference to nature, geographical distribution, causes and impact, response to man-made disasters, specific risk reduction and preparedness measures, typical post-disaster needs, case studies

5.2 INTRODUCTION

In the previous chapters we have studied about natural disasters and disaster management. We have discussed about natural disasters like flood, drought, cyclones, landslides, earthquakes; its causes and impact. Different case studies regarding these natural disasters in India have also been done. In the present chapter we are going to learn and define Man-made disasters and how is it different from natural disasters. The contrast between the two will help us to understand the causes of man-made disasters, basic facts of the same and the need and scope for improving disaster management systems. There are a variety of man-made disasters among which we are aiming to study Forest Fire and Terrorism with reference to nature, causes and impact, response to man-made disasters, specific risk reduction and preparedness measures, typical post-disaster needs, case studies.

5.3 SUBJECT DISCUSSION

The United Nations defines a disaster as a serious disruption of the functioning of a community or a society. To lessen the impact of disasters around the world disaster management, with its various tools, plays a pivotal role. The interior as well as the exterior of the earth is in a mode of constant change. Some of these changes become very devastating in their after effects and are often recognized as environmental disasters. But not all environmental disasters are the result of natural change. Human error, carelessness has significant part in disasters termed as man-made. A debate continues on the topic of natural disasters and on the role of human in the same. Manmade disasters can be both intentional and unintentional. History of mankind is loaded with both natural and man-made disasters. Hence people of the world have always faced both types of disasters. Man-made disasters play havoc on human in modern times.

Forests fires, most common hazard in forests, are as old as the forests themselves. The Man made causes behind forest fire may be attributed to naked flame, cigarette or bidi, electric spark or any source of ignition that comes into contact with inflammable material. They create a very serious threat not only to the forest wealth but also to the entire regime to fauna and flora. The bio-diversity and the ecology and environment of a region also get disturbed.

Terrorism is not a new phenomenon and there is no universal agreement regarding the definition of terrorism. Terrorism is defined as the illegitimate use or threat of violence to further political objectives. It threatens the public with widespread death and disease, fear, panic, and disruption to society – both psychologically and economically.

ANTHROPOGENIC / MAN-MADE DISASTER

Events which are caused by man either intentionally or by accident are know**n as Anthropogenic / Man-made Disasters.** Some of the examples are wars, civil wars, terrorism, errors in designing, nuclear disasters, industrial disasters etc. As their occurrence is unpredictable, man-made disasters pose a challenging and severe threat to public health and /or well-being which must be dealt with with thorough vigilance and proper preparedness and response. Information on the major sources of man-made disasters helps to educate the public about their cause and effects so that emergency planning relating to these disasters becomes easier. With the advent of time as mankind has developed and become technologically advanced, the frequency and magnitude of man-made disasters have increased in the same proportion. Man-made disasters are the results of industrial and material progress. Accidents happen due to negligence on the part of man. The Bhopal Gas tragedy is a result of an accident which played havoc on the local residence.

5.4 INDUSTRIAL HAZARDS - CAUSE, EFFECT, MANAGEMENT WITH REFERENCE TO BHOPAL GAS TRAGEDY.

❖ INDUSTRIAL HAZARDS – CAUSE:

There are a number of factors that can lead to industrial accidents, including everything from improper lifting techniques to mishandling hazardous materials. Below are some common causes of accidents in the workplace.

a. Environmental Causes of industrial Hazards:

Accidents which occur from environmental causes refer to those workplace accidents that happen because of the working environment. The environmental factors can be both natural and man-made such as workplace design. Common environmental causes of accidents include:

1. **Poorlighting –**
   Low visibility is a common cause of slips, trips, and falls.
2. **Ambient temperature –**
   If a workplace is too hot, overheating can occur. If the workplace is too cold, frostbite or hypothermia can occur.
3. **Air pollution –**
   Breathing issues can develop if a workplace has poor ventilation and/or air pollution.
4. **Sound pollution –**
   The sound in a workplace can cause injury to a worker's hearing.

b. Mechanical Causes of Industrial Accidents

Mechanical causes of industrial accidents are factors that refer to machine or equipment failure or breakdown. Generally, with proper maintenance and safety processes in place, these types of accidents are preventable. Common mechanical causes of accidents include:

1. **Broken or damaged machine –**
   Parts can be easily broken or damaged if made of poor-quality metal.
2. **Power failure –**
   Total or partial power failure can lead to serious injury.
3. **Fire or explosion –**
   Cooling failure or a small spark can lead to a mechanical fire or explosion.

4. **Fair wear and tear –**
   The older machine, the more wear and tear on the parts which can lead to a higher risk of a mechanical accident.

c. Human Factors That Cause Accidents

Accidents caused by human factors refer to incidents in which the accident is directly attributed to the worker involved in the accident. Common human factors that cause industrial accidents include:

1. **Poor housekeeping –**
   An unkemptworkspace can lead to slips, trips, and falls.

2. **Fatigue –**
   When a body is tired, injury is more likely to occur.

3. **Overexertion –**
   Overexertion injuries are the most common type of workplace injury.

4. **Stress –**
   Workers who are stressed are often more distracted and of greater risk of injury.

5. **Dehydration –**
   It is important to consume enough water to ensure you body functions properly.

6. **Improper Lifting –**
   Lower back strains and shoulder injuries are common among workers who use improper lifting techniques.

❖ INDUSTRIAL HAZARDS – IMPACT:

Accidents can happen anywhere, including the workplace. Industrial businesses that process hazardous raw materials are particularly prone to causing accidents, especially when negligence comes into play. Not only can harmful chemicals, including gasoline, pesticides, and other toxic gases, harm workers, but they can also have significant environmental impacts.

It's not rare for industrial accident injuries to cause harm to both workers and the environment around them. That's why it's important to enlist the help of an attorney who is well-versed in the impacts of the chemical industry. With the necessary experience, an industrial accident attorney can help prove your case and get you the compensation and justice you deserve.

1. Impacts On Public Health

Of course, we humans are part of the environment, and, following an industrial accident like a chemical explosion, there can be dramatic impacts on both the workers and the surrounding community. Without the proper equipment, such as gas masks, to both neutralize the danger and

keep residents safe, harmful chemicals can enter peoples' bodies. This can cause a wide list of issues, including respiratory failure due to air quality contamination.

2. Impact On the Environment

While there are some steps that businesses and communities can take to mitigate their risk factor following an oil spill or fire, the same can't be said for the surrounding environment. The damage to nearby ecosystems usually begins right after the industrial accident takes place. Some examples may include the following:

❖ **Air Contamination**

Fallout, dust, or gaseous clouds may disperse pollutants that can harm local flora and fauna, spreading out into neighbouring areas. These gases can cause necrosis or chlorosis, leading to cell death and preventing plants from undergoing photosynthesis properly. Another serious contaminant that may be seen after an industrial accident is acid-rain.

❖ **Soil Contamination**

From industrial accidents to illegal waste dumping, harmful pollutants can be deposited in the soil by a range of sources. This may lead to complete degradation of the soil's chemical makeup which is harmful to the flora and fauna of the area.

❖ **Water Contamination**

Water contamination can also come from several sources. One of the most well-known cases of water contamination was caused by the BP oil spill in the Gulf of Mexico, the largest marine oil spill in history. After an oil platform exploded, large amounts of oil spilt out into the ocean. This ravaged the aquatic water life in the area, which in turn greatly impacted the local community and food chain.

BHOPAL GAS TRAGEDY

On December 2-3 1984 in Bhopal toxic Methyl Isocyanate (MIC) gas leaked from the factory owned by Union Carbide. The gas silently spread out engulfing the densely populated areas around the factory. This was one of the worst chemical disasters globally that resulted in over 10,000 losing their lives and over 5.5 lakh persons affected and suffering from agonizing injuries, even today.

The tragedy was a result of human error and poor supervision at the factory.

5.5 TERRORISM - CAUSES, EFFECTS, ANAGEMENT WITH REFERENCE TO THE 26/11MUMBAI ATTACK

❖ **TERRORISM :**

With reference to Nature :

In the modern sense terrorism is violence or other harmful acts committed against civilians for political or other ideological goals. Most definitions of terrorism include only those acts which are intended to create fear or "terror". These are not a lone attack but perpetrated for an ideological goal. They deliberately target or disregard the safety of non-combatants. Many definitions also include only acts of unlawful violence.

As a form of unconventional warfare, terrorism is sometimes used when attempting to force political change by convincing a government or population to agree to demands to avoid future harm or fear of harm, destabilizing an existing government, motivating a disgruntled population to join an uprising, escalating a conflict in the hopes of disrupting the status quo, expressing a grievance, or drawing attention to a cause.

An International Round Table on Constructing Peace, Deconstructing Terror hosted by Strategic Foresight Group recommended that a distinction should be made between terrorism and acts of terror. While acts of terror are criminal acts as per the United Nations Security Council Resolution 1373 and domestic jurisprudence of almost all countries in the world, terrorism refers to a phenomenon including the actual acts, the perpetrators of acts of terror themselves and their motives.

There is disagreement on definitions of terrorism. However, there is an intellectual consensus globally, that acts of terror should not be accepted under any circumstances. This is reflected in all important conventions including the United Nations counter terrorism strategy, the decisions of the Madrid Conference on terrorism, the Strategic Foresight Group and ALDE Round Tables at the European Parliament.

Official definitions determine counter-terrorism policy and are often developed to serve it. Most government definitions outline the following key criteria: target, objective, motive, perpetrator, and legitimacy or legality of the act. Terrorism is also often recognizable by a following statement from the perpetrators.

Violence- According to Walter Laqueur of the Center for Strategic and International Studies, "the only general characteristics of terrorism generally agreed upon is that terrorism involves violence and the threat of violence." However, the criterion of violence alone does not produce a useful definition, as it includes many acts not usually considered terrorism: war, riot, organized crime, or even a simple assault. Properly destruction that does not endanger life is not usually considered a violent crime, but some have described property destruction by the Earth Liberation Front and Animal Liberation Front as violence and terrorism.

Psychological impact and fear- The attack was carried out in such a way as to maximize the severity and length of the psychological impact. Each act of terrorism is a "performance", devised to have an impact on many large audiences. Terrorists also attack national symbols to show their power and to shake the foundation of the country or society they are opposed to. This may negatively affect a government's legitimacy, while increasing the legitimacy of the given terrorist organization and/or ideology behind a terrorist act.

Perpetrated for a Political Goal- Something all terrorist attacks have in common is their perpetration for a political purpose. Terrorism is a political tactic, not unlike letter writing or protesting, that is used by activists when they believe no other means will affect the kinds of change they desire.

The change is desired so badly that failure is seen as a worse outcome that the deaths of civilians. This is often where the interrelationship between terrorism and religion occurs. When a political struggle is integrated into the framework of a religious or "cosmic" struggle, such as over the control of an ancestral homeland or holy site such as Israel and Jerusalem, falling in the political goal (nationalism) becomes equated with spiritual failure, which, for the highly committed, is worse than their own death or the deaths of innocent civilians.

Deliberate targeting of non-combatants- It is commonly held that the distinctive nature of terrorism lies in its intentional and specific selection of civilians as direct targets. Much of the time, the victims of terrorism are targeted not because they are threats, but because they are specific "symbols, tools, animals or corrupt beings" that tie into a specific view of the world that the terrorist possess. Their suffering accomplishes the terrorists' goals of instilling fear, getting a message out to an audience, or otherwise accomplishing their political end.

Disguise- Terrorists almost invariably pretend to be non-combatants, hide among non- combatants, fight from in the midst of non-combatants, and when they can, strive to mislead and provoke the government soldiers into attacking the wrong people, that the government may be blamed for it. When an enemy is identifiable as a combatant, the word terrorism is rarely used. Mass executions of hostages, as by the Nazi military forces in the Second World War, certainly constituted crimes against humanity but are not commonly called terrorism.

Unlawfulness or illegitimacy- Some official (notably government) definitions of terrorism add a criterion of illegitimacy or unlawfulness to distinguish between actions authorized by a "legitimate" government (and thus "lawful") and those of other actors, including individuals and small groups. Using this criterion, actions that would otherwise qualify as terrorism would not be considered terrorism if they were government sanctioned. For example, firebombing a city, which is designed to affect civilian support for a cause, would not be considered terrorism if it were authorized by a "legitimate" government.

This criterion is inherently problematic and is not universally accepted, because: it denies the existence of state terrorism: the same act may or may not be classed as terrorism depending on whether its sponsorship is traced to a "legitimate" government; "legitimacy" and "lawfulness" are subjective, depending on the perspective of one government or another; and it diverges from the historically accepted meaning and origin of the term. For these reasons this criterion is not universally accepted. Most dictionary definitions of the term do not include this criterion.

Types of Terrorism

Terrorism classified terrorism into six categories-

a) **Civil Disorders: -** A form of collective violence interferes with the peace, security, and normal functioning of the community.

b) **Political Terrorism:-** violent criminal behavior designed primarily to generate fear in the community, or substantial segment of it, for political purposes.

c) **Non-Political Terrorism: -** Terrorism that is not aimed at political purposes but which exhibits "conscious design to create and maintain high degree of fear for coercive purposes, but the end is individual or collective gain rather than the achievement of a political objective".

d) **Quasi –Terrorism; -** The activities incidental to the commission of crimes of violence that are similar in form and method to genuine terrorism but which nevertheless lack its essential ingredient. It is not the main purpose of the quasi-terrorists to induce terror in the immediate victim as in the case of genuine terrorism, but the quasi-terrorist uses the modalities and techniques of the genuine terrorist and produces similar consequence and reaction. For example, the fleeing felon who takes hostages is a quasi- terrorist, whose method are similar to those of the genuine terrorist but whose purpose are quite different.

e) **Limited Political Terrorism: -** Genuine political terrorism is characterized by a revolutionary approach; limited political terrorism refers to "acts of terrorism which are committed for ideological or political motives but which are not part of a concerted campaign to capture control of the state.

f) **Official or State Terrorism: -** Referring to nations whose rule is based upon fear and oppression that reach similar to terrorism or such proportions.

❖ **Geographical distribution**

We may think that a geographic ontology would include things such as mountains, rivers, and streams, or perhaps cities, buildings and more abstract things like nations and their boundaries. But we certainly believe that no one would consider terrorism to be a part of such ontology. After innumerable attacks of terrorism in recent past it is believed that there is a

new geography of terrorism, and we must create a new map of potential targets anywhere on Earth. Terrorism is an isolated phenomenon, occurring at various trouble spots around the world and it has no boundary.

❖ **Causes and impact of terrorism**

Many opinions exist concerning the cause of terrorism. They range from demographic to socio-economic to political factors. Demographic factors may include congestion and high growth rates. On the other hand socioeconomic factors include poverty, unemployment, and land tenure problems. Disenfranchisement, ethnic conflict, religious conflict, territorial conflict, access to resources, or even revenge come under political factors.

- **Causes of terrorism:**

❖ **All terrorist acts are motivated by the following facts:**

1. Social and political injustice: People choose terrorism when they are trying to fight what they perceive to be a social or political or historical wrong. When they have been stripped of their land or rights, or denied these.

2. The belief that violence or its threat will be effective, and usher in change. Many terrorists in history said sincerely that they chose violence after long deliberation, because they felt they had no choice.

3. Ethno-nationalism: When a population desire to break away from a government or ruling power to create a state of their own can cause the formation of terrorist groups. In the 20th century this was seen often times with regions or states attempting to gain independence from their colonial era masters.

4. Alienation /Discrimination: A sense of alienation felt by diasporas, acts as a driver of terrorism. Many times these groups face discrimination in the countries they reside, leading to further feelings of isolation. They commonly move from poorer countries, particularly Muslim states in the case of Europe, to wealthier ones to go to school or find work.

5. Religion- Perhaps the most commonly held belief today is that terrorism is caused by religion. Though it is not the main cause for terrorism, religion does play a significant role in driving some forms of it.

6. Socio-Economic Status- A sense of relative depravation and lack of upward mobility within society is another reason that drives terrorism because Globalization and the modern media have given the 'have nots' an acute awareness of their situation compared to the 'haves'. The economic differences between themselves and the Western world can infuriate some in underdeveloped countries, increasing tension and hostilities.

7. Political Grievances- A lack of political inclusiveness in states or grievances against a certain political order may cause individuals to join or create terrorist groups. Left and right wing terrorists often seek to a political system.

8. **The Accidental Guerrilla-** "Accidental Guerrilla" a theory put forwarded by David Kilcullen. According to him when terrorist organization moves into an area with poor government or that is conflict ridden, then uses this safe haven to spread their ideologies to other areas and as a base to carry out violent acts. When outside forces then intervene to deal with the threat posed to them by this group, this causes the local population to reject the 'foreign invaders' and ally with the terrorist group, thus creating more terrorists and popular support for terrorist movements.

❖ The Intent of Terrorist Groups

A terrorist group commits acts of violence to -

- Produce widespread fear
- Obtain worldwide, national, or local recognition for their cause by attracting the attention of the media
- Harass, weaken, or embarrass government security forces so that the government overreacts and appears repressive
- Steal or extort money and equipment, especially weapons and ammunition vital to the operation of their group
- Destroy facilities or disrupt lines of communication in order to create doubt that the government can provide for and protect its citizens
- Discourage foreign investments, tourism, or assistance programs that can affect the target country's economy and support of the government in power
- Influence government decisions, legislation, or other critical decisions
- Free prisoners
- Satisfy vengeance
- Turn the tide in a guerrilla war by forcing government security forces to concentrate their efforts in urban areas. This allows the terrorist group to establish itself among the local populace in rural areas

A global research report An Inclusive World prepared by an international team of researchers from all continents has analyzed causes of present day terrorism. It has reached the conclusions that terrorism all over the world functions like an economic market. There is demand for terrorists placed by greed or grievances. Supply is driven by relative deprivation resulting in triple deficits- developmental deficit, democratic deficit and dignity

deficit. Acts of terror take place at the point of intersection between supply and demand. Those placing the demand use religion and other denominators as vehicles to establish links with those on the supply side. This pattern can be observed in all situations ranging from Colombia to Colombo and the Philippines to the Palestine.

Unfortunately the only real way to mitigate this is through economic development of the community, country, and region, but that takes time. For the foreseeable future there will always be those that are disgruntled by the comparison of living standards of the wealthy around the world versus their own, opening the doors to frustration and anger. Thus, this driver is remarkably hard to combat as globalization allows for more mechanisms of comparison between varying global socio-economic levels.

Terrorism is a forceful and unlawful method to achieve the desired goal. Its sole motive is to overthrow the existing law and order machinery. It is a deliberate use of violence against civilians and armed personnel and the state.

❖ **Impact of Terrorism on Society and Economy**:

Terrorism is a deliberate use of violence against civilians and armed personnel and the state. It is a forceful as well as unlawful method towards the achievement of a desired goal. Its sole motive is to overthrow the existing law and order machinery.

a. Social impacts

Terrorism poses a serious law and order problem and leads to disintegration of society. The incident of murder, torture, mutilation, kidnapping, arson and extortion create atmosphere of suspicion, fear and panic all around. Life becomes uncertain. The terrorists kill unarmed civilians including women and children.

Organized crime and violence cause social disharmony. The inter relationship among various insurgent groups and their foreign linkages bring illegal money and encourages smuggling. Many insurgent groups collect certain percentage of money from the employees and businessmen on regular basis. Economic development of the area comes to an end. Our government has to make heavy expenditure to meet the challenges of terrorism.

A sense of victimhood is common to a society experiencing terrorism. The more the civilian population is targeted, the more this sense of victimhood increases. This sense of victimization in turn leads to a de-legitimization of the terrorists and the people they claim to represent. Consequently, the targeted society becomes unwilling or unable to consider the other side's grievances and objectives.

Another major social effect of terrorism is a rise in ethnocentrism and xenophobia as a group increases its solidarity in the face of violence.

b. Economic impacts

The indirect economic impacts of terrorist attacks, however, are potentially more significant than direct economic ones. The most direct economic effect of a terrorist attack is the damage caused to life and property at the site of the attack. The indirect economic effects of terrorism are many and varied, yet they are very difficult to accurately gauge. A long-running terrorist campaign can definitely impact a state's GDP, as happened to Israel during the second Intifada.

c. Psychological impacts

Children are at high risk for experiencing mental health difficulties after a disaster or act of terrorism include those who are near to or actually witness the event, those who lose loved ones as a result, and even those children who merely live in the affected community or watch coverage of the event on television.

❖ **Management Terrorism**

Presumably, there is no direct connection between poverty and terrorist behavior. But in the case of individuals, groups or whole societies, in which a sense of deprivation, relative or absolute, despair, humiliation or general hopelessness about one's future prevail terrorism, will potentially flourish.

Although countering terrorism has been on the agenda of the United Nations System for decades. But the attacks against the United States on 11 September 2001 prompted the Security Council to adopt resolution 1373. This for the first time established the Counter-Terrorism Committee (CTC)

After five years, all Member States of the General Assembly for the first time agreed on a common strategic framework to fight the scourge of terrorism: the UN Global Counter-Terrorism Strategy. The Strategy is a unique instrument to enhance the efforts of the international community to counter terrorism along four pillars:

- Addressing conditions conducive to the spread of terrorism;
- Preventing and combating terrorism;
- Building Member States' capacity to prevent and combat terrorism and to strengthen the role of the United Nations system in this regard;
- Ensuring the respect for human rights for all and the rule of law as the fundamental basis for countering terrorism.
- At the time of the adoption of the Strategy, the General Assembly also endorsed the Counter-Terrorism Implementation Task Force (CTITF), which had been established by the Secretary-General in 2005. Consisting of 38 entities of the UN and affiliated organizations, CTITF

works to promote coordination and coherence within the UN System on counter-terrorism and to provide assistance to Member States.

- The UN Counter Terrorism Centre (UNCCT) provides capacity-building assistance to Member States and carries out counter-terrorism projects around the world in line with the four pillars of the Global Strategy.

- The Security Council works to enhance the capacity of Member States to prevent and respond to terrorist acts through its subsidiary bodies, which include the Counter-Terrorism Committee, the 1267/1989/2253 ISIL (Da'esh) and Al-Qaida Sanctions Committee, as well as the 1540 Committee on the non-proliferation of nuclear, chemical, and biological weapons. The Committees are supported in their work by different entities; whereas the Counter-Terrorism Committee has its Executive Directorate (CTED) to carry out its policy decisions and conduct expert assessments of Member States, the 1267 Committee draws on a Monitoring Team.

Specific risk reduction and preparedness measures :

We cannot eliminate terrorist attacks completely, but the effects of these attacks can be mitigated to a large extent with precautions and pre-emptive strategies. The major characteristic of contemporary terrorism is its unexpectedness hence the time and manner of attacks are unpredictable. Today's terrorists kill in quantity and kill indiscriminately and normally their target is innocent civilians. They use unconventional weapons such as anthrax and radiological material. The physical damage from terror attacks may be smaller than that from large natural disasters but psychological damage of terror attacks is not at all negligible.

❖ The action of reducing the severity, seriousness of the effects of terrorist attacks is possible on four fronts, like

a. Intelligence

b. Deception

c. Physical & Operational Protection

d. Structural Hardening

a. **Intelligence**

To prevent the occurrence of potential terrorist threat we should use intelligence measures which can be done by understanding, preventing and pre-empting moves of the terrorists.

b. **Deception**

Now in deception tactics, the following measures must be followed:

I. the facility is made to appear to be more protected thereby not drawing the attention of an un-researched terrorist

II. the attacker is misdirected to a portion of the facility that is non-critical.

c. Physical & Operational Protection

The third level of preparedness considers implementing physical security measures along with on-line operational security forces in the form of surveillance, guards, and sensors.

d. **Structural Hardening**

When all the previous three measures fail to ward off the attacker, this strategy is built-in to save lives and to facilitate evacuation & rescue.

In spite of the fact that the above stated four strategies of intelligence, deception, physical & operational protection and structural hardening is required to fend off terrorism these can be effective in a different sequence also depending on the type of facility being protected and on the prevalent terrorist threat.

Typical post-disaster needs

Whatever their source or scale of disasters like terrorism may be they bring with them the potential to cause distress. Sometimes that distress is severe. The estimated number of deaths from terrorism worldwide rose from 3,329 in 2000 to 32,685 in 2014, according to a November 2015 analysis by the Institute for Economics and Peace. The vast majority of lives lost to terrorism in 2014 — 78 percent — took place in the five countries where most terrorism activity occurred: Iraq, Nigeria, Afghanistan, Pakistan, and Syria.

a) Psychosocial Support

Every person who is directly or indirectly involved in such an event may be affected and many may need **psychosocial** support. A sizeable minority of people may develop other psychosocial conditions and/or mental disorders for which they require more substantial and, sometimes, sustained intervention, including treatment.

There is high incidence of terrorism. Evidence of numbers of persons affected has increased very rapidly along with the numbers of people killed by these events.

Strategic preparedness supports psychosocial resilience and is, thereby, likely to improve responses to peoples psychosocial needs and reduces the risks of severe distress and mental disorder.

b) Economic needs of Terrorism:

Studies dating back to the early 1990s have investigated the microeconomic consequences of sector-specific attacks particularly in the fields of tourism, trade, and financial sectors. Attacks against tourist venues (e.g., airports, hotels, or attractions) or tourist mode of transportation (e.g., airplanes) make a tourist consider the risks involved with their vacation plans. Even a single heinous act at a popular terrorist venue can cause tourists to alter plans by vacationing to a terrorism-free country for a holiday. So government should take some strategy to ensure people so that tourism does not lose its position as economic support to the country.

c) Insurance claims

The terrorism is also costly for specific sectors of the economy as there are always unexpected claims on insurance companies. Following the attacks, insurers generally stopped offering policies that covered losses due to terrorism, and these days, the costs of insuring against terrorism are subsidized by the federal government.

d) Net foreign direct investment

Foreign investors must be aware of all kinds of risks, those posed by terrorism.

CASE STUDY: MUMBAI TERRORIST ATTACKS OF 26/11

Since independence India has seen a number of terrorist attacks but the worst among all of these attacks was the 26/11 Mumbai attack of 2008.Multiple coordinated terrorist attacks occurred on November 26–29, 2008, in Mumbai (Bombay), Maharashtra, India's largest city, financial capital, and home to the Bollywood film industry. By selecting to attack Mumbai's most opulent and iconic hotel, the terrorists have sent a powerful message to India's leaders, foreign investors and tourists.

26/11 attack was different in a sense that for the first time, terrorists trained in Pakistan, used the sea route to enter India. The terrorists who participated in 26/11 Mumbai attacks were highly trained. Their objective was to create terror and get some key terrorists released who were involved in Kandahar hijacking episode.

- **The most notable targets were:**

1) Chhatrapati Shivaji Terminus – formerly known as Victoria Station
2) The Taj Mahal Palace and Tower Hotel
3) Leopold Café
4) The Trident-Oberoi Hotel
5) Nariman House, a Jewish community center
6) Cama Hospital

There were also shootings in the streets and strikes on many other locations.

Ten gunmen, believed to be connected to Lashkar-e-Taiba, a Pakistan-based terrorist organization, carried out the attacks. Attackers enter the grounds of the hotel between 9:35 and 9:45 p.m. on November 26. Militants first attack guests around the swimming pool and then move inside to the bars and restaurants of the hotel. Armed with automatic weapons and hand grenades, the terrorists targeted civilians at numerous sites in the southern part of Mumbai, including the Chhatrapati Shivaji railway station, the popular Leopold Café, two hospitals, and a theatre. While most of the attacks ended within a few hours after they began at around 9:30 pm on November 26, the terror continued to unfold at three locations where hostages were taken—the Nariman House, where a Jewish outreach centre was located, and the luxury hotels Oberoi Trident and TajMahal Palace & Tower.

- **Casualties**

172 people were killed in the attacks. These included many local Mumbaikars, as well as visitors from all over the world. At both hotels, many staff died or was wounded as they attempted to protect their guests.

- **Loopholes**

The terrorist attacks in Mumbai exposed loopholes in the security system that India had in place to deal with this "new brand" of terrorism. These are urban warfare characterized by symbolic attacks, multiple targets, and high casualties.

Although subsequent reports indicate that there were several intelligence warnings by Indian along with U.S. sources before the attacks but that authorities, had ignored them. Moreover, the lack of coordination between authorities in the Indian capital of New Delhi and officials in Maharashtra state also weakened the immediate crisis response.

The November attacks prompted the Indian government to introduce important new institutions as well as legal mechanisms to fight terrorism. On December 17, 2008, the Indian parliament consented to the creation of the National Investigation Agency, a federal counterterrorism group whose functions would be similar to many of those of the U.S. Federal Bureau of Investigation. Parliament also approved amendments to the Unlawful Activities (Prevention) Act that incorporated stringent mechanisms to contain and investigate terrorism.

5.6 WILD FIRE – TYPES, CAUSES, EFFECTS, MANAGEMENT WITH REFERENCE TO UTTARAKHAND FOREST FIRE 2016

With reference to Nature

A Forest Fire is an uncontrolled fire, occurring in nature in an area of combustible vegetation, that wipes out large fields and areas of land. These fires tend to thrive in very warm and dry climates, rather than the thick, moist rainforest types. These fires sometimes burn for days and weeks and may be so large that it becomes hard and takes a long time to gain control over the situation by the fire fighting crews. This could result in massive destruction by wiping out an entire forest and destroy almost every organic matter in it.

Although the causes of a significant number of forest fires remain unknown it is estimated that as many as nine out of ten forest fires are caused by humans. The most common cause of such fires is the use of open flames and disposable barbecue grills. Even a cigarette that is not properly extinguished can cause a forest fire.

Some forest fires also start as a consequence of downed power lines, sparks from trains, sparks from hedge trimmers along roadways or sparks from tools and forestry machinery doing work in the forest. Natural forest fires are due to lightning strikes.

In Norway, averages of about 1100 forest fires occur each year. Most of these are small and relatively easy to control. Only two per cent of the registered forest fires in Norway are larger than 100 decares.

Forest fires can be broadly classified into three types - ground fires, surface fires, and crown fires, depending on the type of fuel involved and its vertical arrangement. These two factors not only determine the intensity of the fire, but how fast it spreads as well.

- **Geographical distribution :**

Forest fires typically occur in areas that suffer from extended periods of hot, dry weather. They usually begin in the summer or fall, and occur when branches dry out and fall from trees, becoming highly flammable. At that point, anything from human carelessness to lightning or volcanic activity can cause a forest fire.

Statistical data on fire loss is weak and in most of the cases unavailable. But it is estimated that the proportion of forest areas prone to forest fires annually ranges from 33% in some states to over 90% in others.

Most of the world burnt biomass matter is from savannas, and because2/3rd of the earth savannas are in Africa, that continent is now recognized as burnt centre of the planet. Biomass burning is generally believed to be a uniquely tropical phenomenon because most of the information we have on its geographical and temporal distribution is based

on the observation of the tropics. Because of poor satellite coverage, among other things, little information is available on biomass burning in boreal forests, which represent about 29% of the world's forests.

As per the Forest Survey of India (FSI) report on Vulnerability of India's Forests to Fires (2012), 42 million ha forest area in 168 districts of the country is highly vulnerable to forest fires. This includes around five million ha of very dense forests, 21 million ha of moderately dense forests and 16 million ha of open forests.

- **According to FAO report "Fire Management- Global Assessment 2006", regional estimates of human induced forest fires as follows:**

a) Mediterranean- 95%

b) South Asia 90 %

c) South America 85 %

d) North America 80 %

e) Balkan countries 59 %

The natural causes of forest fires are common in remote areas only.

❖ **Causes and impact :**

The 'fire triangle', fuel, oxygen and a source of heat are the three prerequisites for a fire. The availability of these three elements can unleash an intense fire in the forest too. Forest fires can be witnessed throughout the world and they usually occur in cycles.

The extensive size and the speed, in spreading of forest fire have made them astounding. Forest fires can easily spread and engulf a vast area because of their ability to change direction and overcome barriers like rivers, roads, and firebreaks. A forest fire can be ignited by several factors, including both natural factors and human activities.

Forest fires can be broadly classified into three types - ground fires, surface fires, and crown fires, depending on the type of fuel involved and its vertical arrangement. These two factors not only determine the intensity of the fire, but also how fast it spreads. Ground fires are usually fuelled by subterranean roots, buried organic matter, and dead vegetative parts like leaves, branches, and bark and stems of trees that exist on the soil surface at various stages of decomposition. Though quite infrequent in nature, ground fires can burn slowly for days to months. They basically burn by smouldering, and can literally destroy all vegetation leaving behind only bare earth. Surface fires are fed by low-lying vegetation, shrubbery, leaves, grass, and other debris. A surface fire is usually less intense as compared to a ground fire, and it does not pose major risks to mature trees and their roots. But factors like the build-up of fuel over a period of time, and drought or dry spells can increase the intensity of the surface fire, and cause it to spread rapidly to become a ground fire.

Causes of Forest Fires

Right from lightning and volcanic eruptions to unattended campfires can cause forest fires. Sometimes, a lighted cigarette left in the forest can also ignite a forest fires. The following are some of the most important factors that can cause forest fires, or increase their intensity to the extent that they can wreak havoc on the flora and fauna of the affected area.

a. Lightning

It has been estimated that lightning strikes the earth about 100 times in a second, and is responsible for causing almost 12% of the total forest fires in the United States.

Forest fires are usually caused by dry lightning or lightning not accompanied by rain. They often occur in isolated areas, and this is the reason why wildfires caused by lightning burn more areas than fires caused by human activities.

b. Volcanic Eruptions

Volcanic eruptions can also ignite forest fires, as the hot lava or magma burns everything that comes in its way.

c. Underground coal fires

Underground coal fires or the smouldering of coal deposits is another important contributory factor in reigniting, as well as spreading forest fires. Generally caused by lightning or a forest fire, an underground coal fire can continue to smoulder for a long time after the ground fire has been extinguished, and thus, it can reignite a forest fire.

d. Spontaneous Forest Fires

At times, wildfires can be spontaneous, especially when the weather is extremely hot and dry to create enough heat that can induce spontaneous combustion. Everything including wood has a temperature at which it burst into flames, which is called its flash point. For wood, the flash point is 572°F or 300°C.

The accumulation of dead organic matter such as leaves, twigs, and dry branches on the ground can increase the heat. At high temperatures, wood can also release hydrocarbon gases that react with oxygen to create a fire. Thus, wood can reach its flash point to ignite spontaneously in extremely hot and dry climatic conditions.

Spontaneous forest fires have been mostly observed in climates that are moist enough to promote the growth of vegetation, but are also characterized by extended hot and dry periods. The vegetated areas of Australia and Southeast Asia, the forested areas of the United States and Canada, and the Mediterranean basin are some areas where such spontaneous wildfires are quite common.

Spontaneous forest fires usually occur in summer and fall, and also during drought, when fallen leaves, twigs, and other organic matter become dry and highly combustible. Strong winds can spread such forest fires to a large area, and make it difficult to contain them.

e. Friction leading to sparks

In dry season, friction may cause sparks by rolling stones in the mountainous areas which will lead to forest fires. A devastating forest fire occurred in Gwar village, located 40 km towards north-east from Rudraprayag district of Uttarakhand in February 2001 is an example of such fire.

f. Rubbing together

In bamboo areas, forest fires may occur by the rubbing together of clumps of dry bamboos.

g. Human Activities

According to forest fire statistics, 9 out of 10 forest fires are of human-caused origin**.**

Human activities, or to be more specific, human carelessness is responsible for causing more than 80% of all wildfires. They are stated under:

- Agricultural activities like burning grass-gorse or stubble.
- Throwing of burning cigarettes end or matches.
- Lighting of fires in restricted areas.
- Burning of wastes and garbage at non-authorized landfill sites.
- Military exercises.
- Hunting activities.
- Residential activities like the use of electrical tools that cause sparks and burn of wastes.
- Arson.
- Short-circuit of power lines.

h. Other Causes

Another important cause of wildfires is the sparks from rock falls. Forest fires can be frequent during the dry summer months, and the periods of droughts and strong winds. Even global warming is believed to play a role in creating frequent forest fires, by increasing the frequency and intensity of droughts.

Impacts of forest fires

Forest fires not only just have an impact on the environment, but on economy, society, and human health as well. Forest fires leave a visual impact because they cause damage to houses and other properties, environmental destruction, damage to local and national economies and the potential for loss of life.

If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. Once ground cover has been burned away, little is left to hold soil in place on steep slopes and hillsides. If the wild land fire destroyed the ground cover, then erosion becomes one of several potential problems**.**

a. The Positive Consequences of forest fires

- Forest fires clean up any dead or decaying matter strewn across forest. This enables an increase in new plant growth.
- Forest fires remove any harmful insects and diseased plants and hence maintain the balance within an ecosystem.
- Moreover there is a benefit of plant removal. It increases sunlight, which can assist in the regeneration of plant seeds.
- Forest fires can also increase the amount of plant and animal diversity within a particular ecosystem.
- In the midst of forest fires exceptional amount of nutrients are released into the soil, which can result in a flood of new plant growth. Some plants even require forest fires to germinate their seeds and stimulate growth, such as the peculiar species of Panderosa pine trees.
- Regular forest fires kill invasive species which in turn allows for indigenous species to continue thriving. If forest fires do not occur regularly, this can lead to forested regions being overrun with underbrush and trees. Subsequently, when these forests are finally subject to a forest fires, they may burn too hot, thereby stifling new growth rather than causing it.

b. The Negative Consequences of forest fires

Too much frequency of forest fires in a particular region can have a devastating impact on the ecosystem.

- Frequent forest fires are harmful for the natural cycles of the forests as it eradicates native plant species. This may also encourage growth of fire-resistant plants and other invasive plant species. Some of these invasive species being highly flammable often cause a perpetual cycle where they increase the risk of future forest fires that further destroy native plant species.

- Forest fires can worsen the levels of carbon dioxide in the atmosphere. Greenhouse effect is already plaguing our earth and forest fires strengthen it.
- Further, forest fires generate ash and destroy available plant nutrients, thereby greatly affecting the biodiversity of forests.
- With an increase in water runoff, forest fires can engender flash flood conditions and enable soil erosion.
- These fires also create heavy smog that is harmful to human and animal life, and they use up a lot of natural resources, including water, which could lead to periods of needed water preservation in the area.

To conclude it may be said, that forest fires whether are positive or negative is contingent on their frequency and cause. Unfortunately, their negative effects often overshadow the positive impacts. To strive towards a sustainable future, some precautionary measures must be taken regarding forest fires. Naturally occurring fires cannot be prevented, especially in areas where there is high risk of forest fires, with high summer temperatures. Therefore we must take extra caution so that man-made fires do not occur. We should be more educated and aware about the potential consequences of forest fires.

❖ **Management of Forest fires :**

In the aftermath of a forest fire, workers may be involved in a variety of response and recovery operations. Some operations, such as utility restoration, cleaning up spills of hazardous materials, and search and rescue, should only be conducted by workers who have the proper training, equipment and experience.

A Forest Fire Response Plan describes how we will manage and report forest fires. In some respects forest fire planning is more important than prescribed fire planning because of the extensive damage that may occur during fire suppression, and the fact that many more sites are susceptible to forest fire than have fire prescribed for them. It is also important to plan for forest fire for good community relations. Large landholdings of flammable fuels may present a risk to neighbouring landowners. It is our responsibility as good neighbours to plan for forest fire and work with community fire-fighters to reduce risk when possible.

❖ **Some key components include:**

- the location of the site
- a physical description of the site (fuels, topography, fire-sensitive areas, etc.)
- a narrative of the procedure to be followed in the event of a wildfire (e.g. notification, evacuation, suppression action)

- identification of the fire control agency responsible for suppression in the area (e.g. volunteer fire department, state forestry agency), with contact phone numbers
- list of Nature Conservancy staff to be contacted in case of forest fire, with phone numbers
- information concerning any cooperative agreement with multiple landowners or agencies, such as a Mutual Aid Agreement
- communications procedures, including radio frequencies of responding agencies
- maps identifying
- roads into and on the site, and access gates
- natural features that could be used as firebreaks, such as streams, lakes, or changes in fuel types
- ecologically sensitive areas to be avoided by response vehicles
- wet or low-lying areas where response vehicles may get mired
- water sources
- location of flammable fuels or hazardous materials storage

In some areas, Conservancy fire programs may decide to develop a media response plan in anticipation of an escaped prescribed burn. This document would designate one or two staff to interact with the media and include a basic framework for a response and a fact sheet on the preserve or site which could be distributed to media contacts.

Specific risk reduction and preparedness measures :

Just as fire is an integral part of the forest**,** risk reduction and preparedness measures is an integral part of forest management. It is the process of planning, preventing and fighting fires to protect people, property and the forest resource. Risk reduction and preparedness are the measures that ensure an organized mobilization of personnel, funds, equipments, and supplies within a safe environment for effective relief. Often costly to achieve, it is found to be successful, though to the detriment of ecological values. The decision to fight a fire or leave it to burn out naturally is based on a hierarchy of priorities set by the government agency responsible for fire management where the fire is burning. Avoiding forest fires can be achieved through various means, but in the end a combination of different measures offers the best protection.

Some of the measures are discussed below: :

a. Fire fighting reservoirs

Since time immemorial water is still the main way to extinguish forest fires. Hence it is necessary to have, or build and maintain, a fire fighting water supply system within suitable water courses or to create artificial reservoirs for water extraction in large, contiguous and fire endangered forested areas. It is important that these extraction points are sufficiently identified and easily accessible by fire engine.

b. Infrastructure

Communication system must be well maintained. Therefore, in order for fire engines to reach a forest stand it is important that the roads can bear heavy vehicles.

c. Machinery and equipment

Nowadays, alongside mobile fire extinguishing equipment, fighting forest fires continues to be hard manual work for as many people as are available to fight the fire. Hence it is the responsibility of forest enterprises of all ownership type in areas with a medium to high forest fire risk to maintain appropriate fire-fighting tools and machinery. These include hand tools such as spades, shovels, fire beaters and axes as well as transport vehicles or tractors and ploughs suitable for working in forests.

d. Forest Fire Monitoring

The introduction of automatic, camera supported forest fire observation systems has remarkable responses. Although the number of forest fires has not reduced but their extent has. It has helped in an early and exact identification of forest fires as well as a fast notification. This has again ensured that the technical team can be onsite quickly and can begin to fight the fire as soon as possible.

e. Aerial Surveillance

Aerial surveillance flights are another possible means to detect forest fires at an early stage during times of high fire risk. Besides the early detection and location of forest fires, this aerial support can also be helpful in directing the operational forces on the ground.

f. Mapping

Forest fire fighting maps at a scale of 1:50.000 using the UTM geographic coordinate system are the basis for all those fighting forest fires. All important elements such as fire fighting water points, towns etc. are shown on these maps. The depiction follows the tactical symbols of the fire service. These maps are prepared by the authorities and are updated at least every five years.

g. Communication equipment

Forest fires can only be quickly and successfully fought with functioning communication between the fire service and forest authority operational teams. Mobile telephones and radios are required. Up-to date telephone lists are also needed.

h. Emergency and deployment plans, Control of operations

Before the outbreak of a fire, emergency and deployment plans have to be created.

i. Cooperation and joint exercises

Regarding forest fire risk reduction and preparedness collaboration between forest owners, the administration and different branches of the fire and emergency services is necessary as these work groups organise joint education and training courses, evaluate forest fire events and develop and update the emergency plans. They share common experiences and get to know each other during the evaluation, planning. Also implementation exercises help in building up a collegial relationship among each other. Therefore mistakes could be avoided, decisions are made quickly and decisively and the area of burnt land reduced.

Typical post-disaster needs :

The most important post-disaster needs for forest fire are efficient and timely generation and transfer of information related to fire warning. It is necessary to enhance the capacity of forest management functionaries at various levels to generate timely warning and translate it into useful information for field staff and others. The forest officials need to be trained in using various indicators to get prior information about forest fire at the earliest time possible to take timely action. The forest department may be provided with necessary equipment in detecting forest fire at the earliest possible. Forest officials are to be trained to use a variety of valuable information available at national and international levels and translate it for local use. Necessary collaboration is required with organisations involved in generating early warning about forest fire. Meteorological Departments and other national and international sources providing weather related information maybe collaborated to get prior information about the temperature and rainfall situation- two main deciding factors for forest fires.

The information available from different sources need to be dovetailed for making use at local level and necessary arrangement be made to disseminate this information at field level to make use in taking appropriate preventive, preparedness and response actions in time. To get prepared and take necessary preventive measures in time, it is necessary that the vulnerability/ risk maps be prepared of forest area, depending mainly on past history, climatic conditions and other human induced factors like population density, socioeconomic conditions etc.

CASE STUDY FOREST FIRE, UTTARAKHAND, INDIA, 2016 :

The frequency of forest fire in Uttarakhand during April 2016 was much higher and widespread than during April 2015. During April 2015, forest fire points were identified only in two districts viz. Nainital and Udham Singh Nagar with 1 and 6 fire points respectively, whereas in 2016, fire spread over 13 districts with a maximum number of fire points observed in PauriGarhwal followed by Nainital. Thus around 32% of the total 1270 fire points were observed in PauriGarhwal followed by around 22% in Nainital during April of the current year. The worst affected districts of PauriGarhwal, Nainital, Pithoragarh, Bageshwar and Chamoli.

A total of 1890.79 hectares of green cover have been destroyed this fire season as a major forest fire. Forest officials fear wildlife could have faced problems too. These fire set mainly in pine forests in the slopes of the sub-Himalayan region, produced clouds of smoke. The first incident of forest fire was reported on 2 February 2016 from Pithoragarh district on in the forests of Uttarakhand.

❖ Cause :

Although the exact damage is yet to be ascertained there are some natural reasons for the forest to catch fire. Some experts suggest dry weather, poor rainfall, El Nino and very high temperatures, climate warming as major causes behind this and the windy conditions that fanned the fire and helped it to spread. Some others opine it was miscreants and the timber smugglers were accused of setting the forests on fire. Besides extraction of timber, other anthropogenic intervention for collection of honey, collection of sal seeds, improvement of growth of grass, hunting wild animals, encroaching forest land and many accidental fires lead to forest fire in Uttarakhand forest. The government has decided to study the reasons behind major fires, especially in summer, and prepare an action plan accordingly.

India has very poor data regarding forest fire and damages caused by them. Losses like carbon sequential capability, soil moisture and nutrient losses due to forest fire are very difficult to be ascertained but are of utmost importance for environmental conservation. It also contributes to global warming.

❖ Effects

The forest fires in Uttarakhand have severely affected the wildlife reserves across the state. Going by the statistics, 70 hectares in Rajaji Tiger Reserve and 60 hectares in Kedarnath Musk Deer Sanctuary had come under fire. The Corbett Tiger Reserve and Kalagarh Tiger Reserve, which are home to famous Royal Bengal tigers – has already witnessed 48 incidents of forest fire that destroyed 260.9 hectares of the forest.

Himalayan glaciers have been affected severely by the Uttarakhand forest fire. Black carbon deposits in the glaciers from smoke and ash of forest fire have high temperature absorbing capacity w. This will cause ice to

melt faster. The glaciers feed the rivers in Northern India. As a result of this forest fire they will now carry harmful chemicals and pollutions due to such carbon deposits on glaciers. Besides much human loss, flora, fauna and wild animal losses were also significantly observed during the two months of forest fire. This will create ecological imbalance with negative impact and disaster in the region in near future.

The damage to biodiversity with loss of flora, fauna, and bird species were significantly high than larger animals such as tigers, deer and elephants, who manage to escape to safer places. Besides, tourism is also very badly affected by this forest fire.

❖ **Preparedness :**

Around 10,000 people of state and central government officials and residents were deployed to douse the fire.

Changes in the attitudes and actions of individuals, stakeholder groups, the private sector, and governments are required for action and implementation of sustainable forest fire prevention policies. Prevention of forest fire will require long-term coordinated efforts by public and private authorities with robust planning and informed policy implementation.

❖ **Measures :**

Taking such a severity into consideration, the concerned Environment Minister has begun trial runs for a pre-fire alert system that will issue warnings via SMS about possible fire outbreaks in the country. The idea is to inform the forest department even before the fire starts spreading.

The Uttarakhand governor has increased the number of personnel deployed to control the fire to 6000. He has asked the SDRF, locals and district administration to do their bit.

The Central Government has earmarked Rs. 5 crore for the fire-fighting operations. Both the Prime Minister's Office and the Home Ministry are closely monitoring the situation.

5.7 ACCIDENT CAUSES, EFFECTS, MANAGEMENT WITH REFERENCE TO SAVITRI RIVERBRIDGE COLLAPSE ACCIDENT AUGUST 2016

ROAD ACCIDENT:

Road accident, considered as a 'global tragedy', is one of the major causes of death and injuries in the world. It has an ever-increasing trend. The problem of road accident is very acute in highway transportation due to complex flow pattern of vehicular traffic, presence of mixed traffic along with pedestrians.

In Asia alone, 400,000 people are killed on the roads annually and more than four million injured. According to WHO, every year, nearly one million people are killed, three millions are severely disabled for life and thirty millions are injured in road traffic accidents. Furthermore, the number of accidents is in constant increase throughout the world. In 1990, death on road accidents remained in 9th rank; and by 2020 road accidents will be the third leading cause of death worldwide.

Traffic accident leads to loss of life and property. Thus the traffic engineers have to undertake a big responsibility of providing safe traffic movements to the road users and ensure their safety. Road accidents cannot be totally prevented but by suitable traffic engineering and management the accident rate can be reduced to a certain extent. For this reason systematic study of traffic accidents are required to be carried out. Proper investigation of the cause of accident will help to propose preventive measures in terms of design and control.

❖ **Road accidents with reference to Nature**

Road accidents are among the major causes of death and tend to be the most serious problem world over. Worldwide, the number of people killed in road traffic accidents (RTA) each year is estimated at almost 1.2 million, while the number of injured could be as high as 50 million.

❖ The nature of road accidents is as follows:

- Lane departure crashes include head on collisions and run-off-road collisions. These occur when a driver leaves the lane they are in and collide with another vehicle or a roadside object.
- The collisions at junctions include rear-end collision and angle or side impacts.
- Collisions involving pedestrians and cyclists
- Collisions with animals

❖ **Geographical distribution**

Major car accidents occur near our home because most driving occurs close to home. The following are some of the most common places where car crashes happen:

1. Neighborhoods

It has been said that most car accidents happen close to home. Studies reveal that 52% of all accidents occur within 5 miles from a person's home. Common neighbourhood collisions include crashing into parked cars, backing out of a driveway and into someone driving by and side-swiping a car to avoid pedestrians or other vehicles in the road.

2. Parking Lots

In parking lots the most accidents occur. It is very common for 2 cars backing out of parking spaces to bump each other.

3. Daily Commutes

In large metropolitan areas such as New York and Los Angeles, people may not be completely alert during their commute, as they are either tired from getting up early or tired from working a long day. Moreover, commuters spend hours each day sitting in traffic travelling to and from work. and use this time to multi-task, such as shaving, eating or even reading the newspaper while behind the wheel.

From the above stated list we come to know the common places where usually car accidents occur. While every car crash cannot be avoided, there are certain steps all drivers can take to ensure their safety on the roads.

❖ **Causes and impacts of road accidents :**

- **Causes of road accidents**

Road accidents are undoubtedly the most frequent one. The reasons for this are the extremely dense road traffic and the relatively great freedom of movement given to drivers. The various causes of road accidents are:

1. Road Users:

a. Excessive speed and rash driving -Failing to follow the speed limit is the most common cause of traffic accidents.

b. violation of traffic rules

c. failure to perceive traffic situation or sign or signal in adequate time

d. carelessness

e. **driver fatigue and falling asleep in the wheel** – According to recently published data driver fatigue is the cause of 2.5-3.0 percent of all roadway related fatalities in the United States.

f. Alcoholic driving: driving while under the influence of a narcotic substance: According to studies driving while under the influence of alcohol results in a 900% increase in the probability of an auto accident.

2. Vehicle-

Common defective automobile and automobile parts failure of the following can cause severe injuries to occupants:

a. brakes

b. steering system

c. tyre burst

d. lighting system

e. seatbelt defects and

f. defective airbags.

3. Road Condition

a. Skidding road surface

b. pot holes

c. ruts

4. Road design–

Defects on Roadway Construction: The improper design of roadways result in hundreds of auto accident fatalities each year.

a. Defective geometric design like inadequate sight distance

b. inadequate width of shoulders

c. improper curve design

d. improper traffic control devices and improper lighting

5. Use of Mobile Phone –

Texting while driving: The proliferation of mobile phone use has resulted into an increased level of danger on our roads.

6. Rubber-necking –

Rubbernecking is another type of distracted driving and takes place when drivers look other things on the road not linked to their driving. Examples include watching other accidents, looking at sunsets, and nice views.

7. Improper Coning off of Construction Zones –

Road work is needed to maintain and built the countries transportation infrastructure. However in many cases road construction crews fail to safely cordon off construction zones resulting in an increased probability of auto accidents.

8. Environmental factors–

Example of weather condition posing the greatest dangers to motorists on the road includes icy roads, high winds, and rain after a prolonged drought resulting in oily surfaces. Moreover, unfavourable weather conditions like mist, snow, smoke and heavy rainfall which restrict normal visibility and makes driving unsafe.

9. Other forms of Distracted Driving –

There are numerous types of distracted driving.

a. improper location of advertisement boards,

b. gate of level crossing not closed when required

c. to loud music or changing the dial

d. reaching for objects in the vehicle.

❖ **The Impacts of Road Accidents**

Road traffic accidents pose a public health and development challenge and greatly affect the human capital development of every nation. The immediate and later physical, social and psychological consequences of a road traffic accident are as follows:

A. Individual –

1. Physical

a. Death

b. Permanent loss of mobility/functioning

c. Fractures

d. Bruising

e. Burns

2. Psychological

a. Feelings of guilt

b. Post traumatic stress

c. Depression

d. Anxiety/fear

3. Economic

a. Loss of earnings

b. Medical bills

c. Damage to property

B. Community

1. Psychological- Traditionally we are aware of the mental health implications of any trauma but most of us tend to associate a road traffic accident with physical injury rather than psychological damage.

a. Loss of trust

b. Loss of family structure

2. Economic

I. Loss of family income

II. Loss of community cohesion

III. Damage to property

C. National

Economic

I. Loss of productivity

II. Cost to taxpayers: medical, legal, increased insurance premiums, administrative costs, counseling, ACC payments, damage to property

❖ **Response to Road Accidents:**

Few road users are aware of the factors that could determine the time needed to respond to a vehicle accident. So importance lies in the awareness of these factors. Also steps that road users can take to assist emergency teams in responding swiftly to accidents must be taken into consideration. Up to 46 per cent of road traffic fatalities could be prevented if the right first aid assistance was available in those first moments.

❖ **Responses to Road Accidents are stated under:**

- All emergency medical calls are categorised and prioritised when they are received and resources are allocated according to the category and priority of the call as well as available resources at the time.
- A straight forward and consistent process is followed regarding the caller number and name, what and where the emergency is with all demographic information.
- This information is sent to the Emergency dispatchers through the Integrated Call Taking and immediate dispatch system who then use satellite tracking to allocate the closest, most appropriate resources to the call.

❖ **Following factors play a role in determining the time before a response vehicle will arrive at an accident scene**

- Callers not able to tell what the problem is.
- Third party callers that are not with the patient result in further phone calls to establish the nature of the emergency.
- Inaccurate demographic information
- Cross streets are not known, callers do not know what suburbs they live in or cannot give landmarks to pass on the staff who will attend to the scene.
- Informal settlement streets are not captured and some of the new estates do not have their internal road systems mapped.
- Meeting points are usually agreed where we then rely on a third party (friend, family, member of the public or security) to direct us to the scene.
- Availability and location of resources - we send our closest available resource according to their position in relation to the incident at the time. If our own resources are not available we will ask service providers in the area to assist where we do not have resources.
- Traffic - we are finding it increasingly difficult to access certain areas during peak traffic times and emergency lanes are often used by non emergency vehicles or have been allocated as additional lanes to assist traffic flow.
- Some drivers are also reluctant to give way to emergency vehicles.

❖ **Possible reason for additional delays, if any**

- Additional delays happen when the vehicles stop responding when they get involved in accidents themselves
- Adverse weather conditions may also cause further delays as normal response driving is not possible.
- Access to the scene of the emergency and the patient is also sometimes restricted when the bystanders come in the way. Sometimes properties also not give easy access once the vehicles arrive.

There are several things can be done by the public also. Those are stated under:

- Public must ensure that they have information such as accurate address details and nature of the incident on hand when calling.
- Landmarks are very useful and in any case, if no street names exist, public must agree on a meeting area at a specific landmark.

- Public should allow emergency vehicle right of way to respond to the emergencies.
- Public should allow access to the scene of the incident and patient/s.
- Send someone to meet the vehicles
- Ensure that security at entrance points are made aware of emergencies in complexes,
- Switch on some outside lights if incident is at night
- Clear access routes and lock away any dangerous or vicious domestic animals.

❖ **Public must be aware of the following facts at the accident scene**

- Emergency services personnel need access to the scene and patients and members of the public can assist by allowing this and leaving them to do their jobs.
- Once the emergency personnel arrive, public must it to them so that they can perform their duty without any hindrance.
- Safety of the public is also a top priority and they must not approach any dangerous area or situation as they may just end up adding to the casualties and increase the workload for the emergency services.
- Members of the public must keep updating the call centre if anything changes or anything may need to change the level of the response or the resources allocated to it and can relay further information to the response team.

❖ **Quick response by emergency medical services to vehicle crashes is an important way to reduce the severity of injuries.**

- Crash victims have a better chance of recovery, if they receive quick medical treatment at the spot of an injury. Hence, improving first aid skills for the general public is a good way to improve survivability after a crash has occurred.
- Improving existing emergency response services, especially where these are currently poor is very important.

❖ **The World Bank suggests the following factors are important for effective post-crash care:**

- Efficient emergency notification
- Fast transport of qualified medical personnel
- Correct diagnosis at the scene
- Stabilization of the patient

- Prompt transport to the point of treatment
- Quality emergency room and trauma care
- Extensive rehabilitation services.

❖ Other emergency services (such as the police or fire brigade) can help make responses times quicker by giving medical services teams accurate information about the location, and the number and severity of injuries.

Several WHO guidelines are also available to help improve post-crash care.

❖ **Specific risk reduction and preparedness measures of road accident :**

The factors involved in accidents are both internal and external. The risk involved, therefore, covers both.

(i) Internal factors: consist of those about the means of transport— the vehicle the driver and the driven.

(ii) External Factors: consist of people on the road, the other colliding factors, the road-side structure etc.

Unless immediate actions regarding road accidents are taken this will be the fifth leading cause of death by 2030, leading to estimated 2.4 million deaths per year. In addition to mortality, road traffic crashes injure or disable between 20 million and 50 million people a year. Road traffic injuries are predicted to become the third largest contributor to the global burden of disease by 2020. Over 90% of the world's fatalities on the roads occur in low-income and middle income countries, which have only 48% of the world's vehicles. In low-income and middle-income countries, the most vulnerable road users are pedestrians, cyclists or users of motorized two wheelers. So there must be specific risk reduction and preparedness measures of road accident. Drivers should carry an Emergency Kit in his Glove Compartment. He should carry a cell phone, a pen and paper for taking notes, a disposable camera to take photos of the vehicles at the scene, and a card with information about medical allergies or conditions that may require special attention if there are serious injuries. Also, keep a list of contact numbers for law enforcement agencies handy. Stock your glove compartment with small water bottles or pouches of water. Snacks with a long shelf life such as energy bars (replace them with fresh ones when you change your smoke alarm batteries).

❖ **When the accident occurs**

- We should keep calm and avoid panic as far as possible
- We must help family and neighbours who are in difficulty.
- We should follow the orders of the captain and the crew.

- We should keep identity papers and important personal documents such as medical and vaccination certificates and details of blood type at hand
- Other personal medicines must be kept with us in case we need them.
- When a major accident occurs in a road with traffic, one should direct the traffic along with taking care of one's own safety.
- We should not touch or move the seriously wounded unless there is a risk of fire or toxic fumes.
- The witnesses are bound to alert the rescue services and give them the exact location and nature of the accident. They should also provide the information about the type of vehicle involved the characteristics (code number) of any dangerous substances and the likely number of victims.
- Witnesses should also provide their names and addresses.

❖ **After the accident**

- One must keep calm and avoid panic.
- We should follow the instructions of the intervening bodies and of the rescue personnel.
- We must also try to collaborate with the rescuers and with the judicial authorities and experts in charge of the investigation.

❖ **Typical post-disaster needs of road accident**

1. Stay at the Scene

One can face serious criminal penalties for being a hit-and-run driver if one leaves, particularly if someone sustains injuries or killed. He should never leave the accident scene until it is appropriate to do so.

2. Check on All Drivers and Passengers

Before assessing property damage, one must make sure everyone involved in the accident is alright. Prompt medical attention must be present at the accident spot for anyone who needs it. If a person is unconscious or has neck or back pain, we should not move them until qualified medical help arrives. But if any hazardous situation requires moving the person, that should be done without hesitation, with proper care and expertise.

3. Call the Police

If there's significant property damage, physical injury, or death, we need to call the police. We should also ask that a police report be filed in situations where police do arrive at the scene, and obtain the name and badge numbers of the responding officers.

4. Exchange Information

Get the names, numbers, addresses, drivers' license numbers, license plate numbers, and basic insurance information from all drivers involved. If there are passengers, also obtain their names, numbers, and addresses. In talking to other drivers, try to be cordial and cooperative.

5. Talk to Witnesses

Every witness must be asked for what he or she saw and if possible their names, numbers, or addresses must be collected. The opinion of the local people is also very important and they must be asked if they have ever witnessed other accidents in the same place before or in the same date.

6. Inform Your Insurance Company

We must promptly tell our insurance company that we have been in an accident and cooperate with them and tell them the truth about what happened and the extent of your injuries. Explain the facts clearly.

7. Keep Track of Your Medical Treatment

Note any doctors, physical therapists, chiropractors, or other medical professionals that you receive treatment from, and each medical provider that referred you to other caregivers. Keep a detailed account of the treatments or medications you receive. Also, request copies of all medical reports and bills as these help you prove your medical expenses later.

Medical expenses are relatively easy to document, but pain and suffering is trickier to prove. Keep a record of how your injuries have impacted your daily life. Include any missed workdays, list any routine activities you can't undertake, and describe how the injuries have affected your family life.

8. Photograph and Document the Accident:

Take photographs of any damage to your vehicle as soon as possible after the accident. Photos helps your insurance adjuster determine how much you should be compensated for the damage to your car and can help in court. Use your camera to document the damage to all the vehicles. We should keep in mind that we want our photos to show the overall context of the accident so that we can make our case to a claims adjuster. If there were witnesses, we must try to get their contact information; they may be able to help us if the other drivers dispute our version of what happened. However, we should in no way interfere with the on-going police investigation. If we cannot take pictures at the scene of the accident, we must take them as soon as possible after the accident.

9. Get a Property Damage Valuation

Obtain your insurance company's damage valuation. If you aren't satisfied with how your insurance company has valued your vehicle, don't give up. Get two independent repair estimates or replacement quotes. Assertively

inform the adjuster of your concerns. If you can't agree on your car's value, consider mediation or consult an attorney.

10. Use Caution in Discussing the Incident

Don't talk to anyone about the accident other than your lawyer, your insurance company, and the police. Don't talk to a representative of another insurance company, without the knowledge of your attorney or insurer. If called by the other insurance company, be polite, but ask them to call your attorney or insurer to arrange an interview. Also, tell your lawyer or insurer about the call.

11. Be Wary of Early Settlement Offers

Be careful if you're offered a settlement from an insurance company. Confirm all your physical injuries have been treated. Some injuries don't show up or reach their greatest level of discomfort until many days, weeks, or months later. Don't settle a claim until you know you'll be compensated for all your injuries, and consult an attorney before signing any settlement documents.

12. Consider Hiring an Attorney

If anyone was injured in the accident, it's best to consult an experienced attorney. An attorney can help you maximize your recovery if you're injured or better defend yourself if you're at fault. Most accident attorneys work on a contingency fee basis. That means that your lawyer only receives a fee if you're awarded damages or receive a settlement. Contact an experienced attorney now for a free claim review.

13. Keep Safety First.

Drivers who are involved in minor accidents with no serious injuries should move cars to the side of the road and out of the way of oncoming traffic. If they leave cars parked in the middle of the road or busy intersection additional accidents and injuries may occur. But in a road accident if a car cannot be moved, drivers and passengers should remain in the cars. They must keep their seatbelts fastened for their safety till help arrives. Make sure to turn on hazard lights and set out cones, flares or warning triangles if possible.

14. File An Accident Report.

Although law enforcement officers in many locations may not respond to accidents unless there are injuries, drivers should file a state vehicle accident report, which is available at police stations and often on the Department of Motor Vehicles Web site as a downloadable file. A police report often helps insurance companies speed up the claims process.

15. Know What Your Insurance Covers.

The whole insurance process will be easier following your accident if you know the details of your coverage. For example, don't wait until after an

accident to find out that your policy doesn't automatically cover costs for towing or a replacement rental car. Generally, for only a dollar or two extra each month, you can add coverage for rental car reimbursement, which provides a rental car for little or no money while your car is in the repair shop or if it is stolen. Check your policy for specifics.

16. Light sticks and string to attract help.

If you are trapped in the vehicle, you can use the string to swing the light outside the window.

17. Other signalling devices include the rear-view mirror and the backs of CDs.

18. The Life hammer, an all-in-one tool that includes a blade to cut seatbelts and a double-sided hammer to easily and safely break side windows if the doors are stuck or the car is submerged.

19. However minor a car accident is, the driver must stop. In fact, failing to do so is an offence under the Road Traffic Act. He should make sure his car's engine is switched off and then turn his hazard lights on to alert other road users to his presence.

20. Keep a file. Keep all your accident-related documents and information together. This information should include a claim number, the claim's adjuster who is handling the claim, names and phone numbers of all contacts, receipts for a rental car and other expenses incurred as a result of the accident.

Despite the above facts one final question that usually arrives with an accident is who will pay for the damage. In case of a minor accident the drivers may decide to handle the damages themselves without the involvement of an insurance company. But this isn't always the best idea, for several reasons.

a. While the other driver may agree to pay for the damage to the other ones car on the day of the accident, he may see the repair bills and decide it's too high. At this point, time has passed and the insurance company will have more difficulty piecing together the evidence if one files a claim.

b. Also, keep we should keep in mind that we have no way of knowing whether another driver will change his mind and report the accident to his insurance company.

❖ **Case study of road accident**

❖ **Indian scenario:**

In India road traffic injury is one of the leading causes of mortality and morbidity. Its India's worst kept secret that we have the world's most unsafe roads and the situation seems to be getting worse by the year. In 2004, India had just one per cent of total vehicles in the world but

accounted for six per cent of total road accidents. Over 400 people were killed in road accidents every day in 2015, government data reveals. Indian roads, which account for the highest fatalities in the world, became yet more dangerous in 2015 with the number of deaths rising nearly 5% to 1.46 lakh. This translates to a death every 10 minutes on Indian roads, 400 deaths a day or one life snuffed out every 3.6 minutes, in what an expert described as a "daily massacre on our roads".

Fresh data submitted by the Ministry of Road Transport and Highways in the Rajya Sabha (May 2016) indicates just how alarming the situation is. 1,46,133 people were killed in road accidents in India in 2015, a 4.6% rise over 2014 when 1,39,671 people were killed.

In the past one decade, over 1.3 million people have been killed in road accidents but there is still no comprehensive road safety legislation in the country. According to the 234th report of the Standing Committee on Transport, Tourism and Culture which has recently been tabled in Parliament, there are several stumbling blocks for replacing the existing Motor Vehicles Act with a proposed Road Transport and Safety Bill, 2015.

According to the report, the Ministry "wanted to change the entire architecture over road transport and road safety in the whole country, basically, setting up a set of authorities at the Central level and the State level to control all aspects of transport and public transport including driving licences."

However, this has not been possible because "the main hitch is on sharing of revenues between the Centre and the state" in implementing the changes which have been proposed. In an effort to still try and push the safety measures through, the government claims it is trying to focus on noncontroversial, achievable goals such as "an increase in the penalty for drunken driving or increasing the penalty for unauthorized driving, minor driving."

While it is well established that our roads and highways are deadly to travel on, according to the data, the states with the highest number of road accidents in 2015 are Tamil Nadu, Maharashtra, Madhya Pradesh, Karnataka and Kerala. These states contribute 29.66% to the total number of accidents recorded nationwide. The same states also recorded the highest number of injuries at 2,75,873 in 2015.

❖ **Road Accident Statistics in India**

- Over 1,37,000 people were killed in road accidents in 2013 alone, that is more than the number of people killed in all our wars put together.
- 16 children die on Indian roads daily.
- 5 lives end on Delhi’s roads every day.
- There is one death every four minutes due to a road accident in India.

- One serious road accident in the country occurs every minute and 16 die on Indian roads every hour.
- 1214 road crashes occur every day in India.
- Two wheelers account for 25% of total road crash deaths.
- 20 children under the age of 14 die every day due to road crashes in the country.
- 377 people die every day, equivalent to a jumbo jet crashing every day.
- Two people die every hour in Uttar Pradesh – State with maximum number of road crash deaths.
- Tamil Nadu is the state with the maximum number of road crash injuries
- Top 10 Cities with the highest number of Road Crash Deaths (Rank – Wise):

I. Delhi (City)

II. Chennai

III. Jaipur

IV. Bengaluru

V. Mumbai

VI. Kanpur

VII. Lucknow

VIII. Agra

IX. Hyderabad

X. Pune

(Source of Information: National Crime Records Bureau, Ministry of Road Transport & Highway, Law commission of India, Global status report on road safety 2013)

❖ **Here's a list of past accidents on the Mumbai-Pune expressway:**

May 28, 2016: Traffic disrupted on Mumbai Mumbai-Pune Expressway as a truck turned turtle, driver injured. A truck carrying heavy load of goods turned and toppled at Mumbai-Pune Expressway. There were no reported casualties in the accident, but the incident caused a massive traffic snarl.

May 27, 2016: Pune expressway accident zone: Builder D S Kulkarni injured, driver killed in car mishap.

May 16, 2016: Car crashed with bus on Pune-Mumbai expressway, 6 dead. A car carrying a family of a six collided with a bus on the Mumbai-Pune Expressway. All the passengers in the car including an eight-year-old died in the accident.

May 12, 2016: Hit-and-run: One killed on Mumbai-Pune Expressway. A monk from Ujjain lost his life in a hit-and-run accident on Mumbai-Pune Expressway. Another individual was left critically injured and was sent for treatment at Nigdi-based hospital.

Mar 17, 2016: Bus accident at Mumbai-Pune E-way, Two dead, seven injured. A speeding private bus carrying around 30 passengers hit a road-divider killing two passengers and seriously injuring 3 on the Mumbai-Pune Expressway.

Nov 24, 2015: Tempo accident at Pune-Mumbai Expressway killed 6.A speeding tempo crashed on a telephone post on Mumbai-Pune expressway and toppled. 6 people were killed and over 20 passengers were injured in the road mishap.

Nov 4, 2015: Major accident on Mumbai-Pune E-way, Two dead. A speeding truck rammed into cars on Mumbai-Pune expressway resulting in deaths of two people. Several people were left injured after the accident.

Sep 29, 2015: Two dead as car rams into stalled truck on Mumbai-Pune Expressway.

A car carrying 5 passengers rammed into a truck which was parked on the wrong side of the lane. The accident led to deaths of two passengers, injuring the remaining three, including an 18-month-old girl.

Sep 22, 2015: Expressway accident: Seven killed in yet another accident.

A speeding SUV rammed into a dumper truck on Pune-Mumbai expressway, killing seven people, including four women. Two people suffered minor injuries in the accident.

A state-run bus from from Telangana carrying 17 passengers and two drivers, rammed into a parked tempo on Mumbai-Pune E-way. The passengers including the driver and the conductor suffered injuries in the mishap.

To conclude it may be said that nothing should outrage a civilized country more than the avoidable loss of human life. When we see the scale of that loss is nearly 1.5 lakh a year with a rising trend our conscience demands action to prevent it. Strict implementation of simple traffic rules and transport norms can go a long way towards drastically reducing these deaths. But if not so, the dubious distinction of being the country with the largest number of road accident victims will remain ours.

RAIL ACCIDENTS

Rail accidents with reference to nature :

Railway accidents are comparatively rare but their consequences can be very severe, involving many injuries and loss of life. A high speed crash or derailment is inevitably very high profile in the media and can cause disruption to transport links for many weeks. The nature of the equipment involved often means that even 'minor' incidents can have significant operational and financial consequences.

Railway accidents include incidents such as:

a. Derailments

b. Collisions with objects on the track

c. Collisions with vehicles on level crossings

d. Potential inadequate maintenance of track and rolling stock

e. Mechanical failure of the permanent way and rolling stock

f. Fires on trains and in the load on trains

❖ **Geographical distribution of Rail accidents :**

Train accidents are common around the world. Unfortunately when these accidents occur, people are often seriously injured or even killed. Accidents involving trains are often the result of mechanical failures and human error, and often it's a combination of both.

Indian Railways (IR), the largest rail passenger carrier in the world, has experienced 11 major accidents due to derailment or collision between trains in the year 2010, leading to several human casualties and large-scale disruptions in traffic. Alarmingly, 8 of these 11 accidents have occurred within a specific geographical region known as the Indo-Gangetic plain.

❖ **Causes and Impact of rail accidents :**

A rail accident is a type of disaster involving one or more trains. Rail accidents occur when trains travelling on the same tracks collide or when trains derail because of technical faults in the rolling stock, the rails or the security systems, or because of landslides, avalanches or objects obstructing the rails by deliberate actions, such as terrorist attacks.

❖ **Causes**

Generally, these accidents cannot be avoided because the train driver or security personnel do not have enough time to react. Such accidents cause direct and indirect damage to people and the environment, especially when they involve trains carrying freight or dangerous or polluting substances.

A majority of the train accidents that take place in India are due to human error. CNN-IBN has accessed an internal safety report of the Railways which says that 18 of 21 accidents in the last four months took place due to human error. Manpower shortage, financial bottlenecks and delay in installing anti-collision devices are among key reasons why safety is being compromised. Reports also show that there are shortages of 16,000 locomotive drivers in the railways. When driver over speed and skip red signals accidents happen. There is shortage of drivers too.

There are a variety of different reasons that these railroad accidents occur, and some of these include:

- Train conductor negligence
- Train derailment
- Improper maintenance of the train tracks
- Faulty equipment
- Collision with another train
- Collision with a car, bus or truck trying to cross train tracks
- Collapsed bridges
- Faulty train crossings- The number of European level crossing crashes between 1990 and 2009 remained the same in relation to the number of passenger kilometers travelled. This makes level crossing crashes a high priority issue. For example, in 1999 a passenger train collided with a tractor-semitrailer at a grade crossing in Bourbonnais, Illinois. U.S.

❖ **Major reasons leading to rail accidents in India are as follows:**

1. Low investment

- Official records say that the Indian Railway is carrying 15 times more people than its capacity for the past 20-23 years. Hence, damaging the old tracks is done by overloading.
- Most of the Indian trains are not equipped with fire detection systems. Sometimes smoke and fire detection systems are installed in AC coaches but not in the other compartments of the same train. Detecting fire in the open coaches is more problematic.
- In some nations devices to automatically stop the train if it crosses red signal are in place. These avert head on collisions to a great extent. But no such devices are provided in Indian Railways leading to certain avoidable collisions.

- Train crashes caused by carriage and equipment failure must be avoided by for example timely inspections and maintenance.

2. Human errors

The Human factor has proved to be the direct cause of several train crashes. Many studies have been carried out within this factor and contain aspects of the human factor through investigations of crash causes and user-friendly instruments and tools. The term is often used to denote the human tendency to misunderstand, make miscalculations, and mistakes. It has been found out by CNN-IBN after assessing the internal safety report of the Railways that 18 out of every 21 accidents occur because of human error.

- As the Indian Railways lacks new technologies, the chances of human error are more. Hence, it is one of the major causes of rail accidents in India.
- Moreover the organizations compromise on the safety measures because of low investment, delay in installing anti-collision devices and shortage in manpower.
- Shortage of staff is another major reason leading to human errors. Less staff means work overload. In India train accidents also occur because of the fault of driver and negligence of railway staff.
- Manual signaling system between stations must be replaced with automated one. Again this needs a huge investment, maintenance and management.

3. Unmanned crossings

- 15,000 crossings out of 50,000 in India are unmanned.
- Existing level-crossings have been improved and the construction of new ones has been minimized.
- Road users do not take proper precautions and cross lines even if the signal is red leading to accident. Overpass bridges, flyovers and fencing are done to reduce the accidents.

4. Physical environment

Physical environment factors can also be reasons for crashes.

- In the early days, trains sometimes collided with cows, but it did not create any severe injury events.
- Bridge collapses were other hazards.
- Improved materials and performance of railway tracks have reduced the number of crashes caused by, e.g., the weather or climate, which

cause heat distortions of tracks, ice formations, problems induced by snow.

- The Physical environment such as bridges or steep embankments can further aggravate the crash.

❖ **Impact of Rail Accidents :**

Train crashes causing severe consequences for passengers are not a problem of the past, rather they continue to be highly relevant today.

❖ **Environmental**

- In a rail accident, the damage is not only limited to the people injured or killed but also affect the environment by contaminating the surrounding area. These damages require extensive remediation and cleanup. Moreover a rail accident has significant effect on individuals as well as organizations regarding property damage and financial loss. They may even be injured or become ill as a result of toxic substances released into the environment by a train crash.

- Disruption of rail traffic.

- Loss of commercial and public confidence in the transport system.

- Often, physical environment made it difficult to evacuate and transport the injured from the steep embankment to the road.

- Further, railway crashes might happen far from roads as was the case when two trains collided head-on due to a signal malfunction in Japan, 1991, The rural setting of the crash hampered rescue efforts.

❖ **Human factors**

The Human factors also play an important role in the post-crash phase.

- Evacuation knowledge and well prepared train crew affect the outcome because, only if passengers are provided with appropriate safety critical information they will be able to know how to handle the situation when it arises.

- Besides the physical injuries, train crashes affect the whole person (psychological, social, and existential).

- There are many studies focusing on, for example, psychological and psychiatric effects such as posttraumatic stress disorder (PTSD) among people who have been involved in serious disasters.

- Survivor's reactions are considered severe immediately after the event, but many people find pathways to recovery. There are survivors who experience trauma affects from 5 years after event to lifelong.

❖ **Socio-economical environment factors**

The Socio-economical environment factors comprise, e.g., guidelines, competence, resources, and disaster plans.

- If rescue personnel are not prepared and trained for a train crash, this will most likely affect the outcome. In a 2008 train crash in Los Angeles, two of the fatalities were passengers trapped under debris. They most likely they died from asphyxia due to the prolonged extrication time.

❖ **Response to rail accident :**

Response: Once the Emergency occurs, the railway authorities coordinate with external organizations, perform the initial measures on the field, deploy staff on the site and define the need of technical means support. In this phase, the Emergency is usually solved by external organizations with the support of the railway authorities.

The first persons arriving at a railway accident site can render valuable assistance to minimise injury and loss of life, reduce property loss through damage, and prevent loss of clues and evidence that can identify the factors that contributed to the accident. Often Police and Emergency Services and representatives of the Railway Network Owner and/or Railway Operator are the first trained personnel to arrive at railway accident sites. In addition, supervisory officers coordinate response and recovery from locations off-site. Some of the responses are as follows:

- Emergency spill and hazmat response
- Licensed transportation services
- Railroad emergency response services
- Scrap metal bin services
- Scrap metal processing
- Site remediation
- Waste bulking and packaging
- Waste characterization and identification
- Waste container services
- Waste manifesting, tracking and reporting
- Waste transportation and disposal services

❖ The following are some reportable matters in relation to rail accidents:

1. The death of, or a serious injury to, a person on board the rail vehicle or in contact with the rail vehicle or anything attached to the rail vehicle or anything that has become detached from the rail vehicle.
2. A collision between the rail vehicle and one or more other rail vehicles, resulting in serious damage to any of the rail vehicles.
3. A collision between the rail vehicle and a person or vehicle at a level crossing, including a pedestrian crossing.
4. A collision between the rail vehicle and an obstruction that results in serious damage to, or destruction of, the rail vehicle or obstruction.
5. A running line derailment of the rail vehicle.

❖ **Specific risk reduction and preparedness measures of rail accident :**

Preparedness: At this stage, the railway authorities define capacities, maintain the resources (human and technical) and define the Emergency Plans and Organization to be prepared for an unlikely Emergency situation. Preparedness largely approaches to achieve risk reduction from ‘‘people’’ side. So, preparedness may be largely common to all hazards but prevention and mitigation have to be hazard specific. Preparedness may be a matter of inculcation and readiness but prevention & mitigation have to be concrete and specific. Preparedness is people and area specific.

Best of preventive measures cannot ensure that disaster would not happen. Therefore it is essential to be prepared for emergency response through having an effective “Disaster Management Plan”, backed by provision of adequate support capacity and empowered delegation to enable response team to tackle the situation. Plan should be supported by provision of requisite infrastructure, reserved and kept spare in readiness for emergency and otherwise. Indian Railways emergency response system has all these elements.

❖ Risk Reduction Programmes are as follows:

- Identifying, collecting and analyzing precursor accident data to identify risks
- Developing voluntary pilot programs in cooperation with stakeholders that are designed to mitigate identified and potential risks
- Propagating and institutionalizing best practices and lessons learned to the entire rail industry
- Providing analytical support, data, and recommendations needed by stakeholders to develop strategies, plans and processes to improve safety and promote positive organizational change

❖ The objectives to be achieved in case of a train accident are:

I. Save life and alleviate suffering,

II. Protect property including mails,

III. Provide succor and help to other passengers at the site of accident,

IV. Ascertain cause of the accident, and

V. Restore through lines of communication.

In order to make the above expeditiously possible, all railway resources in men and material, as warranted specific to the situation, are required to be promptly made available. This is legislated as written instructions. It is also strictly observed should the situation so require.

Railway's rolling stock is of special nature. So, in case of a railway accident, special equipment to clear the site is required. Railway tracks also pass through non-habited zones. Therefore, Indian Railways has provided specialised rail mounted Accident Relief Medical Vans (ARMVs) and Accident Relief Trains (ARTs). These can be either self propelled (SPARMVs / SPARTs) or locomotive hauled. The self propelled units have excellent mobility with superior speed potential. Hence the use of these units have increased and replaced conventional units except in case of ARTs having heavy lift 140T crane in its composition.

The Accident Relief Medical Vans (ARMVs) are specialised vans which have two or three coach units. In a two-coach format one coach has emergency medical relief including a mini operation theatre, while the other coach carries required rescue equipment including portable hydraulic and / or electrical cutters to cut open railway coaches for rescuing trapped passengers should the need arise. The third coach in three-coach format generally carries additional equipment and staff. Movement to the site of accident depends highly on their distance from site. Other factors include obstruction of the railway tracks due the accident. Keeping these points in view Railways always keep co-ordination with various non-railway, government /non-government agencies, as this would help them further and their resources can be requisitioned immediately to help the affected persons.

The Disaster Management Act 2005 envisages participation by all stake holders based on their expertise. It has also been the experience that the golden hour is invariably managed by few on-board railway staff, railway staff working in vicinity, unaffected train passengers, local police and fire brigade, local hospitals and doctors and other rescue workers in the nearby areas.

The Accident Relief Trains are provided with necessary re-railing / handling equipment to clear the site of accident.

The location and beat of each ARMV and ART is clearly laid down and well publicised for information of all concerned. This is also available at all control rooms for requisitioning incase of need. ARMV and / or ART of adjoining and other beats can also be requisitioned should the need arise. Whenever any unit is not available for maintenance or any other reason the same is pre-informed to similar adjoining units so as to be available in readiness.

In order to keep ARMVs and ARTs in good fettle and readiness certain minimum staff is available with these, whereas other required pre-nominated staff is normally employed in their regular duties. In case of requirement these staff is automatically called. This system of dedicated staff supported by sufficient trained additional manpower, when needed, ensures provision of requisite resources, reserved and kept spare in readiness for emergency.

❖ **Training and preparedness of rail accident:**

Cyclic training and retraining of manpower, system of periodic inspections of the resource and rehearsing and examination of preparedness through mock drills are essential ingredients of a sound disaster response mechanism. These all elements are provided in railways disaster response system. The dedicated and nominated staffs for ARMVs and ARTs have specific work assigned to them in case called for. For example if the break down crane has to be brought in use pre-assigned staff by himself takes over the duty of watching supports ensuring stability of the crane. Both kinds of staff are sent for periodic training and knowledge up gradation to zonal as well as divisional training schools. Even the officers are given training on disaster management at National Academy of Indian Railways at Vadodra. Active assistance of NDRF is also being taken for four week training of trainers on disaster management, who in turn becomes nodes for imparting further awareness among frontline staff. Extract from the relevant paras pertaining to disaster management training are at annexure 3 for reference purposes only. There is a well laid out system of periodic inspections of both ARMVs and ARTs at various levels with frequency increasing from weekly inspections at supervisory level to quarterly inspections at divisional officer's level. This is also a scheduled item of inspection during safety audit of the division and / or inspection at zonal level by Principal Head of Department of concerned officer who is invariably an HAG level officer. The preparedness of system is practiced through "mock drills". These are planned/"surprise" exercises wherein a situation is artificially created and ARMV / ART 'ordered' to carry out prescribed task. The exercise is also carried out at a larger scale involving other participants like NDRF and other stake holders in order to have synchronisation and coordination should the need arise. The system is tested for response from time to time by actual ordering of the ARMV and / or ART in day as well as night to check actual response in terms of available of manpower, readiness of system to turn out required unit in specified time etc. Incidentally the prescribed time for turning out ART during day and night is 30 minutes and 45 minutes respectively. Similarly

the ARMV is to be turned out in 25 minutes and 15 minutes depending upon single exit or double exit irrespective of day or night.

❖ **Typical post-disaster needs of rail accident :**

Recovery: This phase begins once the Emergency is solved (usually the injured people have been treated, the site has been processed by all the organizations according to their duties and those external organizations have finished their main tasks). Here, the railway authorities take a leading position with their own resources (human and technical) in order to restore the railway service as soon as possible. The findings of the emergency (accident) investigation are the basis to create or modify the safety rules and recommendations. This is known as the 360º safety circle.

1. Prevent the marshalling of the form of energy in the first place
2. Reduce the amount of energy marshalled
3. Prevent the release of energy
4. Modify the rate of spatial distribution of release of the energy from its source
5. Separate, in space or time, the energy being released from the susceptible structure
6. Separation by "barrier"
7. Modify appropriately contact surfaces (softening)
8. Strengthen the human resistance
9. Prevent aggravation of occurred injury event – emergency care
10. Restoration and rehabilitation of those injured

❖ **Case study of rail accident: India :**

The Dehradun-Varanasi Janata Express (train number 14266) derailed near Bachhrawan in Uttar Pradesh, northern India, on 20 March 2015. The train was the Janata Express from Dehradun to Varanasi. Coming from Dehradun, the Janta Express train was heading for Varanasi, when the engine jumped the rails and its first two coaches, packed with passengers, collapsed, leaving 80 persons trapped. This accident occurred at 09:10 local time when a passenger train overshot a signal at Bachhrawan, Uttar Pradesh. As a result the locomotive and two carriages were derailed. In the train there were more than 400 passengers and 85 members of staff.

At least fifty-eight deaths and 150 people were injured in this accident.

The driver reported by radio that his brakes had failed, and that he could not stop the train. It was diverted into a siding and crashed through the buffers at Bachhrawan.

A team of doctors from the King George Medical University Hospital in Lucknow was dispatched to the scene of the accident. The injured were taken to the King George Medical University and Sanjay Gandhi Post Graduate Institute of Medical Sciences in Lucknow, or to a hospital in Rae Bareli.

The trapped passengers could be brought out only after steel cutting machines reached the site. Rescue workers used cutting machines to free passengers and recover the dead bodies, a witness said. Blood was splattered in and around the wreckage. The rescue operations concluded around 4 pm, with Divisional Railway Manager A K Lahoti declaring. The critically injured were sent to Sanjay Gandhi Post Graduate Institute of Medical Sciences and King George's Medical University in Lucknow, while the others were admitted to the district hospital at Rae Bareli.

The police had a tough time controlling local villagers, who rushed to the spot.

AIR ACCIDENTS

In spite of air travel widely considered to be the safest form of travel it is still in its infancy and when midair calamity strikes, the results are often catastrophic.

Air accidents with reference to nature :

Take-off and landing are different phases of the flight. At these points the risks are greatest. It is found that most accidents occur in the immediate vicinity of airports.

In air accidents vertical distortion and horizontal contusion of the body are symptomatic of injuries of passengers and crew. The injured person is generally found poly traumatized. Hence to preserve life in such cases maximum organization, precision, and speed on the part of the local and regional rescue services is required. Moreover, careful enquiries into such catastrophes are indispensible for the development of effective preventive measures.

Another important point noted that over the last decade that 10% of all fatal aviation accidents occurred while the planes were on the ground. 22% of all fatal airline accidents have occurred during the "takeoff and climb" phase which involve three distinct phases, according to aviation experts.

The takeoff phase occurs when the plane is accelerating down the runway, while the initial climb is the steep ascent as the plane leaves the ground, followed by a gentler climb to cruising altitude.

Over the past ten years, six fatal accidents occurred during takeoff, four during the initial climb, and six during the climb-to-cruising altitude phase.

One such crash occurred in July 2000, when an Air France Concorde struck debris on the runway at Charles de Gaulle Airport in Paris, causing a catastrophic explosion shortly after takeoff.

When accidents do occur during cruising phase, however, they are far more dangerous for passengers. The seven fatal accidents documented in Boeing's study resulted in 774 fatalities — or 20% of the 3,884 fatalities in commercial aviation accidents from 2004 to 2013.

The disappearance of MH370 over the Indian Ocean in March 2014, the shooting down of MH17 over Ukraine in July 2014 and the German wings flight in March 2015 was three notable incidents that occurred while the aircraft were cruising.

The descent, approach and landing phase of a flight is by far the most dangerous.

The point at which the aircraft begins to descend from its cruising altitude in preparation for landing marks the beginning of the phase in which most fatal aviation accidents occur.

Geographical distribution of air accidents :

Despite the series of high profile crashes in recent years that have seen a rise in the number of fatalities, the rate of aircraft accidents is low.

Figures from the Bureau of Aircraft Accident Archives (BAAA) make the German wings crash in the Alps the 17th such incident in 2015 compared to 33 that occurred up to the same point in 2014.

It also takes the total number of fatalities for 2015 so far at 247, which assumes the 150 on board today's German wings crash have all died.

In 2014, the BAAA say 1,328 died in aircraft accidents - the highest annual fatality figure since 2005 due to a series of crashes including Air Asia flight QZ8501 and the downing of MH17 in Ukraine. The organisation counts military transport planes and any aircraft capable of carrying six or more passengers.

The Aviation Safety Network put the number of fatalities, excluding QZ8501, at 526 for 2014, the highest since 2010. The ASN figures only include aircraft capable of carrying 14 or more passengers and exclude military aircraft. It also reportedly excludes casualties from hostile actions, such as the MH17 incident.

Using annual aircraft departure figures collated by the World Bank and the International Civil Aviation Organization, we can calculate the rough accident and fatality rate per million departures for the BAAA and ASN (with AirAsia added) figures up to 2014. I say rough as the coverage of countries in the World Bank dataset varies from year to year.

❖ **Causes and impact of air accidents :**

The Most Common Reasons for air accidents :

Any news of air accident instantly raises questions about aircraft safety and the threat of terrorism. But without knowing the facts, it is not suggestible to speculate on what might actually have caused a specific crash. There are various causes behind any air accident. They are discussed below:

1. **Pilot Error**: The proportion of crashes caused by pilot error has increased. Half of all plane crashes are caused by pilot error. Aircraft are complex machines and so it requires a lot of management. Pilots are actively engaged with the aircraft at every stage of a flight so there are numerous opportunities for this to go wrong. This may include failing to programme the vital flight-management computer (FMC) correctly to miscalculating the required fuel uplift. Pilots must navigate through dangerous weather, respond to mechanical issues and execute a safe takeoff and landing. Some plane accidents are caused when pilots misread equipment, misjudge weather conditions or fail to recognize mechanical errors until it's too late.

Sometimes plane crashes happen when pilots become incapacitated during critical points of a flight. In 2005, a Helios Airways flight to Greece crashed because the flight cabin depressurized, incapacitating the entire flight crew. Some pilot errors can even be the result of mental problems. A flight to Tokyo crashed in 1987 because a pilot who was known to have serious psychological problems put the plane's engines into reverse mid-flight.

While such errors are regrettable, it is important to remember that the pilot is the last line of defence when things go catastrophically wrong.

2. **Mechanical Error**. The second most common cause of plane crashes is mechanical error. Equipment failures still account for around 20%-22% of all aviation accidents, despite improvements in design and manufacturing quality. While engines are significantly more reliable today than they were half a century ago, they still occasionally suffer catastrophic failures. Some mechanical errors occur because of a flaw in the plane's design. For example, in 1974 a Turkish Airlines flight to France crashed because of a design flaw in the latch of the cargo door. Sometimes, mechanical failure occurs when outside circumstances damage the plane. For example, in 1962 a United Airlines flight crashed because it was struck by a single swan that tore off the plane's left horizontal stabilizer. Birds have caused at least seven plane crashes to date.

3. **Weather**. Around 12% of all plane crashes are caused by bad weather conditions. Although flights are often grounded when weather conditions are deemed hazardous, storms, heavy winds and even fog can sneak up on pilots and air traffic controllers. Lightning strikes can

be especially dangerous. Aviation accidents have happened because lightning caused electrical failure, because it ignited fuel tanks and pipes, and even because the flash itself caused temporary blindness.

Sometimes milder weather conditions can cause plane crashes as in the case of a flight to Lebanon in 1977.Here the pilot encountered a thick fog as he prepared to land. Circling back, he retried the landing several more times before fuel ran out and the plane could no longer stay aloft. In 2010, an Indonesian plane carrying 103 passengers crashed when inclement weather conditions caused the pilot to overshoot the runway. The plane skidded into a pool of water at the end of the runway and crashed into a nearby hillside. The impact of the crash caused the jet to break in half.

4. **Sabotage.**Plane crashes that are caused by sabotage account for about 9% of total plane crashes. Some sabotaged flights crash because of hijackers, and of course the most notable examples are the three flights that were hijacked on September 11th. But despite increasingly strict TSA regulations, some passengers still manage to smuggle bombs or firearms onto planes. When they're successful, a single passenger can bring down a jet, killing hundreds of people.

5. **Other Human Error**. About 7%, plane crashes are caused by some kinds of human errors. Several plane crashes are caused by air traffic controllers. Air traffic control mistakes have caused planes to crash into mountains, to land on occupied runways and even to collide in midair. Human error also lies in the field when a plane is loaded, fueled or maintained incorrectly. One of the more common fatal mistakes caused by humans is something called "fuel starvation" – but this isn't always the result of an improperly filled fuel tank. A Coastal Airlines flight in 1948 crashed because the fuel valves were positioned incorrectly, causing both engines to pull fuel from a single tank.

❖ **Impact of air accidents**

Accident of an aircraft leads to human injury or even loss of human life, it also influence the reputation and the economy of air transportation industry of the country. To reduce the rate of accident researchers are addressing problem from various perspectives including improving meteorological forecasting techniques, collecting additional weather data automatically via on-board sensors and flight modems, and improving weather data dissemination.

❖ **Economic effect**

- If fewer people travel then there is a negative effect on the economy. If the same numbers of people travel, just on different airlines, then the overall effect is zero,

- Much cash moves around as there is insurance claims and paying the lawyers,

- At the crash site, there is much localized spending - securing the site, investigating the site, meals and accommodations for all those attending the site,
- An airline needs to buy a new aircraft,
- CNN needs to charter helicopters to fly over the crash site for the next three days. Employment for talking heads in Atlanta goes up,
- Funerals are expensive.
- The cost of rescue operations, recovering bodies, retrieving aircraft wreckage and investigation can run into millions of dollars.

❖ Emotional effect

Although the risk of dying in an air accident is very small (there is a much greater chance of being killed in a road accident), the public reaction to such events is intense. Loss of confidence in an airline, or in flying generally, is common, whether the accident was fatal or not. Crashes have other serious consequences.

❖ Psychological effect

Psychological research has shown that air accidents can cause serious mental health consequences for victims. These consequences take the form of Posttraumatic Stress Disorder and a variety of other disorders and symptoms which have been less investigated.

Response to air accidents :

Emergency Response begins as soon as an air crash is identified or reported. The numbering sequence is not meant to establish priority as all actions should be done as soon as possible.

Aircraft accidents are complex and unfortunate events that require a deft personal and corporate response. A company's first and highest responsibility is to the families of those involved in the accident. Every appropriate provision for their comfort and accommodation should be considered, assigned and acted upon first, prior to internal company or public comment. Company management should take steps immediately to notify the families, offer counseling and other support, make needed arrangements and keep them informed.

The primary sources for information regarding the aircraft, crew and passengers involved typically are internal and can be obtained from sources such as flight department records, flight department personnel not involved in the accident, company human resource departments or personnel departments. The leadership of those departments should be contacted at the outset. Legal counsel, public affairs and investor-relations personnel, and insurance providers also should be contacted immediately.

Aircraft accidents often generate acute levels of public and professional scrutiny previously not experienced by management, in an area outside their expertise. Although this attention typically is long-term as an investigation unfolds, the broader public's interest usually is ephemeral. The early acknowledgment of and stated regret for an obvious tragedy, responsibility for the families of those involved in the accident, and a demonstrable corporate attitude of proactive cooperation with investigating authorities are highly recommended. The public's perception of a company's professionalism in the wake of a crisis often significantly influences public and shareholder opinion of the company's competency.

Ultimately, safety is the responsibility of company management, from the CEO down, and it should be treated as a fundamental matter of the company culture. Management should articulate in writing a strong, permanent and visible commitment to safety. Past aircraft accident investigators have noted that the implementation of corporate safety standards for air transportation often effectively prevent most accidents before they occur.

In the event an accident does occur, company management should have procedures in place to help them respond to the crisis quickly and effectively. The following sections recommend specific actions that company representatives should (or should not) take in the aftermath of an aircraft accident. They also identify the facts company representatives should know about the accident and about business aviation in general in order for them to answer likely press and public inquiries successfully.

❖ To protect life, property and evidence the following should be kept in mind

- Establish a security perimeter around the accident scene.
- Allow Public Safety Personnel access to preserve life, recover the fatally injured and stabilize hazardous materials.
- Prevent disturbance of the accident scene and the wreckage.
- Protect and preserve ground scars and marks made by the aircraft, vehicle, train, vessel, pipeline, and other physical evidence related to the accident.
- Document and photograph pavement evidence prior to re-opening of roadway. Mark possible evidence for analysis by the NTSB investigators upon arrival.
- Remove highway vehicles to a secure location and ensure that recovery operations do not alter critical pre-crash adjustments such as airbrake settings.
- Maintain a record of personnel who enter the accident scene.

Specific risk reduction and preparedness measures air accident :

Risk reduction :

In major aircraft accident wreckage, bodies and survivors may be strewn over a wide area. This situation is further complicated by hazardous cargo. The under stated measures may be taken as risk reduction.

- Automation is supposed to relieve an aircraft pilot's workload and reduce errors. The reality can unfortunately be very different sometimes. When the pilot and the aircraft do not interact as foreseen, automation technology can be the cause of disturbing instability, which has resulted in catastrophic failures.

- A risk reduction strategy has been developed for carriage of dangerous goods by air. When implemented it makes the carriage of these goods an acceptable practice.

- Approach and landing accident reduction (ALAR) has long been among the primary goals of the Flight Safety Foundation (FSF). When the international FSF ALAR Task Force published its report in 1998, it cited data showing that an average of 17 fatal ALAs had occurred each year from 1980 through 1998 in passenger and cargo operations involving aircraft weighing 5,700 kg/12,500 lb or more. The task force's work, and the subsequent safety products and international workshops on the subject, have helped reduce the risk of ALAs — but the accidents still occur.

Preparedness :

Preparedness involves actions designed to save lives and minimize damage. It is planning and training prior to a major air crash for appropriate response when an emergency occurs.

❖ In Preparedness measures the following are taken into consideration. All responders will:

- Maintain a resource inventory of equipment and manpower which could be utilized.

- Train personnel in the responsibilities and emergency duties required under this plan.

- Conduct periodic exercises that will test the effectiveness of this plan.

- Review and update the plan as needed based on exercises, emergency response or changes in policy.

- Follow the established communications network identified in this plan

Typical post-disaster needs in air accidents :

Plane crashes are catastrophic, but not necessarily are un-survivable events. The National Transportation Safety Board stated in a report that the survival rate of crashes was 95.7%, analyzing airline accidents from 1983 to 2000. Sure, there are some accidents where everyone, or nearly everyone, died, but those are much rarer than you'd guess based on what you see in the news. The NTSB found that even in serious accidents where fire and substantial damage occurred, 76.6% of passengers still survived.

- 10 tips that could save a life in air accidents

1. If one has survived the crash landing, one has a chance of getting out of the airplane alive that too within 90 seconds only. This is because it takes, on average, just 90 seconds for a fire to burn through the plane's aluminum fuselage and consumes everything and everyone in it.
2. Young, slender men have the best chances of surviving a plane crash. Escaping a plane crash requires one to maneuver quickly through narrow aisles with luggage and wreckage strung about.
3. If possible travelers should fly in bigger planes if possible. One should also avoid regional carriers if possible as they have an accidents and incidents rate double that of national carriers and their pilots are often less experienced and overworked.
4. One should focus on finding a seat near an exit while flying
5. We should overcome the normalcy bias with an action plan. The Normalcy Bias causes our brains to assume that things will be predictable and normal all the time. When things aren't normal, it takes our brain a long time to process this. Instead of springing to action when something unexpected happens, our brain figures that what has happened cannot be so bad, because truly bad events are so out of the ordinary.
6. The flyer must read the safety card and listen to the flight attendants when they give their pre-flight safety spiel. A frequent flier may think he is justifiably confident, but he probably complacent. The FAA found in a report published a few years ago, that frequent fliers were the least informed on what to do and most susceptible to the normalcy bias in the event of a plane crash.
7. In the aviation world, Plus 3/Minus 8 refers to the first three minutes after takeoff and the last eight minutes before landing. According to flight crash investigators, close to 80% of all plane crashes occur during this timeframe. Hence, if you want to up your chances of survival, you need to be extra vigilant and ready to take action during the first 3 minutes after takeoff and the last 8 minutes before landing.
8. Put on your oxygen mask as soon as it drops. We all know that airplane cabins are pressurized so we can breathe normally even at

30,000 feet. But when a cabin loses pressure, there is very little air at high altitudes that getting oxygen to our bloodstream is certainly impossible. This is the time when oxygen masks are highly needed. They pump pure oxygen into our nose and mouth so that we can get the air we need.

9. Assuming brace position would help us survive in a plane crash and indeed up the chances of survival in an emergency crash landing. The positions help reduce the velocity of your head when it inevitably slams into the seat in front of you. Moreover, they help minimize limb flailing.

10. We must forget our carryon luggage and remember the kids. The thing actually happens is while rushing to get out of the plane, we may forget our kids. Our brain does peculiar things in disasters.

❖ **Case Study of air accidents: Air India Express Flight 812**

Air India Express Flight 812 accident was the third deadliest aviation disaster in India. It was a scheduled passenger service from Dubai to Mangalore, at around 01:00 UTC on 22 May 2010. It overshot the runway on landing, fell over a cliff, and caught fire, spreading wreckage across the surrounding hillside. Of the 160 passengers and six crew members on board, only eight passengers survived.

SEA ACCIDENTS

Just as ashore, at sea also most accidents are preventable. However, the environment and working conditions aboard seagoing vessels pose additional hazards not found ashore. The responsibilities to avoid accidents flow from the top down; from the shore establishment to the Master, to each and every individual aboard. "Safety awareness" by all hands is the biggest single factor in reducing accidents.

Sea accidents with reference to nature :

Maritime disasters involving huge spills of mineral oil have subsequently provoked changes in maritime regulations due to the severe nature of the associated environmental impact and the obvious links with poor vessel operation and maintenance. Hence, shipping accidents have been a catalyst for environmental protection regulation over the past 40 years. Environmental risk is linked to the type and amount of oil and/or hazardous substances being carried and the sensitivity of the marine area where any accident happens.

Areas of concern and contributory factors to shipping accidents are highlighted along with the implications these incidents have on the marine environment. It focuses in particular on the issues surrounding the role of flag states (the flag state is the country the ship is registered to and that has the authority and responsibility to enforce regulations over that vessels) and the extent of their responsibilities with respect to vessel safety and the implementation of international rules and regulations. Environmental risk

is directly linked to the type and amount of hazardous substances, including oil, being transported and the sensitivity of the marine area where any accident could occur. Flag State performance continues to play an important role in the quality and safety of sea-going vessels around the world. Several organisations publish guidelines on flag State performance. These include bodies such as the International Chamber of Shipping (ICS), the Maritime International Secretariat Services (MARISEC) and the International Transport Workers' Federation (ITF).

❖ The list of 12 main known types of maritime accidents as follows:

1. Offshore Oil Rig Mishaps: Offshore oil rigs constitute great danger in terms of their heavy machinery and the complexities of the processes involved.

2. Cruise Vessel Mishaps: Cruise vessels form a very important part in the vacation itinerary of people. However, a major type of maritime accident occurs in cruise vessels. Cruise vessels could capsize or face tough weather conditions causing the ship to develop major problems.

3. Commercial Fishing Mishaps: Even fishing for commercial purposes can lead to fatal incidents, due to inexperienced fishermen. Harsh weather conditions can also could severe damages to a commercial fishing expedition.

4. Accidents on Tugboats: Tugboats are those which help move huge ships to enter docks. They are small in nature but are powerful to ensure that the large vessels are handled safely. But sometimes because of the blockage of the visibility of tugboats by the larger vessels, maritime accidents occur. Also human error on the part of the pilot of the tugboat can also lead to unwanted and unexpected tugboat mishaps.

5. Accidents on Crude Oil Tankers and Cargo Ships: The major cause of accidents on cargo tankers is explosions.

6. Grounding of Ships: Ship grounding occurs when the bottom of the ship's hull scrapes through the ocean-bed. The danger to workers aboard the ship is an important consequence because of the mishap.

7. Maritime Accident because of Drugs and alcohol: If the workers of a particular ship engage in substance abuse or alcohol this could cause the worker to behave erratically and thereby lead to an unwanted maritime accident on board ships.

8. Crane Mishaps: Just like crane operations on the land, marine crane operations on ports and on ship are also risky.

9. Accidents in Shipyards: The shipyard is the place where the ship is assembled and constructed in its entirety. Fitting and welding accidents are common in the shipyard which could spare the worker his life but hamper the worker's overall working abilities. Similarly

constant inhaling of poisonous fumes also becomes another shipyard accident cause.

10. Maritime Accidents on Diving Support Vessels: People who want to explore the mysteries of the deep sea use a diving support craft to take a plunge into the water.

11. Accidents on Barges: Barge mishaps occur mainly because of the overall build of the barges themselves, which allows them limited movement on the water and because of the problems of the barge-towing equipments. These problems could be caused due to inexperience on the part of the person at the helm of the towing boats or due to usage of faulty towing cables.

12. Cargo Hauling Accidents: Cargo hauling maritime accidents are those accidents caused to workers who work as cargo haulers. However, according to several maritime accident investigations, it has been reported that cargo hauling workers overstate their cargo-hauling injuries. The maritime accident investigation, consequentially reports that because of this, this profession has one of the most severe rate of work-place absenteeism.

Geographical distribution of sea accidents :

Despite the tremendous efforts of different maritime organizations to achieve a safe and secure maritime transportation system, the number of maritime accidents and incidents is still increasing.

Geographic Information System (GIS) is an effective and efficient tool for spatial analysis with high visualization. It is used to carry out the analysis of maritime accidents. It identifies the hot spots areas and buffer analysis is used to calculate accidents that occurred in coastal areas. The acquired results stats that the area around the UK is the area with the greatest number of accidents, and the coastal areas around East Asian countries (such as China, Japan, and Korea) and the Mediterranean Sea are the areas with the next highest number of accidents. Moreover, maritime accidents may not frequently occur in the open sea; however, accidents frequently happen in coastal areas with 51.1% of the total accidents happening within 25 miles of the continents and 62.2% within 50 miles.

❖ **Causes and impact of sea accidents :**

Causes

Ships are vulnerable to all sorts of accidents.

- **Human error**

Although the average seafarer is competent and well trained, has been shown the right way to work and has the appropriate equipment for the job, various research and statistics state that over 70% of marine accidents happened due to human error. These include trips and falls, fire, pollution and collisions, and are invariably due to a failure in safe working

practices. These incidents often cause crew injuries or fatalities, with the ship being consequently delayed or damaged.

Human errors include neglected maintenance, insufficient checking of systems, lack of communication between crew members, fatigue, or an inadequate response to a minor incident causing it to escalate into a major accident. From a more practical point of view, analysis of the circumstances surrounding accidents demonstrates the high proportion of spills due to groundings and collisions.

Collisions are generally due to manoeuvring errors, especially in poor visibility and/or busy shipping traffic areas. Groundings are also often a result of manoeuvring errors, often made worse by high winds, challenging currents and bad weather.

- **Mechanical failure**

Human error can play a pivotal role, even when there has been a mechanical failure, either by way of a lack of maintenance or monitoring (failing to pick up a potential problem), a lack of suitable equipment or protective devices, or a breakdown in communication or procedures.

- **Manning Issues**

Crew fatigue and complacency can often be a major factor in incidents. The prudent ship-owner or manager will ensure that these are addressed by way of additional manning or rotating the ship staff more regularly if the ship is employed on a demanding trade route. There are, however, owners and managers who are unable to do this, which could in part be due to a shortage of available trained seafarers, but is more often attributed to commercial or operational considerations. Good equipment can cost more, but safety should be accorded a higher priority, because a ship cannot be operated safely without the seafarer.

- **Ship Design**

Ships were often designed by people who had very little practical knowledge of what they were designing. But at present the ship design team usually incorporates the suggestions of seafarers who are familiar with or have sailed on the type of ship that is being designed. Proper supervision during the building process ensures that discrepancies and potential problem areas can be addressed.

- **Operating Standards**

In most of the marine accidents it has been studied that the operating manuals are hard to understand. Hence improved methodology in ship design does not completely address the problem because the seafarer then has to decipher the operating manuals that are supplied with the equipment.

Language can often be a major problem. The manual may not be written in the language of the crew on board, and is often merely a generic document. Given that adequate facilities are available for translation of manuals into just about any language, this is unacceptable.

- **Lack of Unified Standards**

Equipment problems are further compounded by the lack of a unified standard for essential equipment, including oily water separators, voyage data recorders and lifeboat launching equipment, and until regulatory and industry bodies are able to agree on a common standard, it is the seafarer who will be faced with understanding and operating equipment that is unfamiliar and unduly complex, often in less than ideal conditions.

It is often said that safety and quality must be initiated and led from the top. Unfortunately, this does not always happen. It is our collective responsibility to ensure that a seafarer is provided with an environment in which it is safe to live and work.

Apart from the above stated causes there are several other conditions that can lead to sea accidents that are as follows:

- weather conditions
- accidents caused by weather conditions, such as gales,
- narrow and/or congested waters,
- collision .with unknown objects,
- ship lying at anchor or moored at buoys with strong currents,
- maneuvering at close quarters or
- limited space and adverse conditions in port.
- cargo-related accidents occur through the carriage of dangerous goods, cargo on deck, heavy
- cargo or cases relevant to the ship seaworthiness.
- failure in the steering system, main engine, different devices,
- war, terrorism, piracy, collision and misinterpretation in communications at sea
- Natural conditions such as current, tide and tidal stream, severe wind, reduced visibility (fog, heavy snow and rain), storm seas, darkness etc. affect the ship or those controlling her.
- Technical failures are shortcomings within the ship, such as corrosion, steering failure, engine failure, or hull failure arising from defective materials or construction, or by the shore-based installations, such as aids to navigation.

- Route conditions may include navigational error like over reliance on inaccurate nautical charts, charts of suspect reliability or based upon old surveys, narrow channels with abrupt and angular windings, allowing for very limited maneuverability and exposed to dense marine traffic, such as the Turkish Straits, anchorage contiguous to traffic separation lanes, confined marine areas with insufficient sea room as well as navigational hazards such as shoals, reefs, wrecks etc.

- Ship-related factors could be the weakness of a ship, associated with her larger size, hence less maneuvering capability and stability or draught constraints.

- Human errors may include, inter alia, a lack of adequate knowledge and experience, technical inability, bad look-out, not paying proper attention to procedures and rules, carelessness in commanding a ship, misinterpretations of radar information, fatigue and lack of alertness, overworking, tiredness, insufficient rest periods, etc.

- Cargo-related factors mostly include dangerous goods and heavy cargoes; i.e. their hazardous characteristics (oils, chemicals, nuclear substances), the place/compartment they are stowed onboard ships (on deck or under deck), and degree of diligence that such cargoes need (grain, timber), all of which are related to ships' seaworthiness.

Effects of sea accidents :

Around 90% of world trading is carried out by the shipping industry. Despite shipping is considered a safe, economical, and environmental form of commercial transport, any shipping accident, small or big, is every seafarer's nightmare. Unfortunately, shipping accidents are inevitable cases of maritime field, in contravention of creative and innovative technologies in shipping sector and execution of precautionary safety rules and regulations.

Marine accidents adversely affect the human, the marine environment, properties and activities aboard ships and ashore in various forms and degree of extent. The effects of accidents vary from minor injuries to fatalities and from insignificant damage to very severe damage to the environment and property.

Shipping accidents affect marine environment in different ways. Not only accidents and collisions are the reasons of marine pollution, but also human errors as oil spillage, solid waste, oil transferring or bunkering accidentally may cause marine pollution.

The after effects of a ship collision on marine and human life are immeasurable. The ship involved in a collision suffers from heavy structural and stability damage. Apart from the damage to the ship, collision results in the following effects:

- Collision leads to detrimental environmental effects. If the ship is involved in a collision with a tanker or a chemical vessel then there are

high chances of the chemical or oil leaking to the sea. Both major and minor oil spills can lead to untoward conditions for the marine life and also to the nearby coastal areas.

- Financial loss to both, the ship owner and the nearby local communities is huge.
- Ship collision renders substantial threat to human life. There has been accidents in past when the ship has sank within minutes, giving no chance to the people on board to escape.
- Collision with an offshore structure or a port leads to infrastructure damage and thus causes a heavy blow to human efforts. There has been collisions with bridges and port structures in the past, resulting in heavy financial and efforts loss.

Response to man-made disasters :sea accidents :

Accidents are the consequences of highly complex coincidences. Among the multitude of contributing factors human errors play a dominant role. Prevention of human error is therefore a promising target in accident prevention.

International Maritime Organization, IMO, estimates that more than half of packaged goods and bulk cargoes transported by sea today can be regarded as dangerous, hazardous or harmful to the environment. A great deal of these substances, materials and articles are also dangerous or hazardous from a human safety point of view. The increasing trend in maritime transport of chemicals and dangerous goods also gives rise to an increasing number of accidents involving such products. This development makes great demands on the personnel who are responsible for actions against such accidents in order to protect man and environment from damage.

The efforts to minimize the risks created in an emergency by protecting the people, the environment, and property, and the efforts to return the scene to normal pre-emergency conditions may be described as response.

Spills of chemicals as well as at sea are rarely detected without notice. They are most often involved in maritime accidents and can sometimes be observed, surveyed or monitored in the marine environment close to the site of the accident. Unknown lost packages of dangerous goods are sometimes detected floating at sea or washed ashore. Most often, however, such packages can be connected with known accidents. Hence, occurred accidents, and spills involving chemicals, as well as lost packages of dangerous goods must be reported to all relevant bodies according to national and international agreements and regulations. While responding to accidents involving chemicals or dangerous goods some general steps must be taken which are the same for many accidents.

There is nothing like a typical incident therefore the following list of advices includes such general routines that often should be applied.

- Don't panic. Staying calm will allow you to continue to think clearly and to keep your energy intact.
- Before leaving a ship or boat that is sinking, if you have the time, ensure that you are wearing long sleeved clothes and pants. Try to get a life jacket if you're not already wearing one; staying buoyant is vital.
- See how to escape a sinking ship for precise details on the moment of departure from the sinking vessel.
- Examine yourself. Before anything else, reassure yourself that you're alright, if you have any cuts or wounds, treat them.
- Hypothermia is a real risk when staying for any length in water, and the colder the water, the faster are the chances of it happening.
- Be aware that shock is a real possibility. Ask others for help.
- Assess the well being of others around you.
- Treat any victims who are suffering from shock. Loosen their clothing if it's tight and have them lay down with their head lower and their legs slightly elevated.
- Treat any concussion.
- If you're still in the water and lifeboats are not available, make use of debris. Clamber onto anything that could be used like a raft or cling onto floating debris.
- Keep all survivors together as much as possible.
- If sharks encircle your group of survivors, stay together. Don't panic and stay linked; sharks are more likely to go for an individual.
- Consider whether it's possible to signal for help. If you're in a lifeboat, it should be equipped with rescue flares; read the instructions and deploy them.
- If you're wrecked near enough to land to get cell phone reception, dial for emergency services and ask for the Coastguard.
- If on land, use fire or other means to signal for help.
- Head for land if relevant. If you can see land, steer your craft toward it if you have control over moving the lifeboat.
- Find food and water. You may need to find food immediately if supplies aren't with the lifeboat or if they have been consumed.
- Wait for rescue to arrive. Continue doing everything needed to attract attention.

- We should never rush into a chemical incident, instead try to use our common sense and assess the situation carefully.
- Plan the work on a worst possible case basis.
- Realize that each chemical is different and that a new incident is not going to be the same as an earlier one.
- Get a rapid general view of the situation and judge the need for the most urgent actions to be taken, such as medical care of victims, restriction of access, evacuation, reduction of leakages, etc.
- Warn passers-by, seafarers, public, etc. Inform appropriate authorities, agencies and mass media.
- Identify all involved chemicals. Note their mode of transport (bulk, container, palleted goods, etc.) as well as type of spill or discharge (escaped chemicals, lost packaged dangerous goods).
- Judge the risk for fire, explosion, leakage as well as health risks and risks for adjacent areas (utilize e.g. the IMDG Code, Material Safety Data Sheets, Chemical Safety Cards, and Chemical Information Databases).
- Establish restriction areas (risk zones) and restrict access to these areas by guarding the entrances.
- Make preparations for procedures regarding decontamination, relieving and replacement of personnel, materials and equipment.
- Make appropriate arrangements for beaches, swimming areas, fishing grounds, fresh water intakes, etc., such as restriction of access or restriction of right to use.
- Use monitoring devices continuously for fire, explosion and health risks.
- Assess emission rates, volumes, properties and reactivity for involved chemicals.
- Assess initial drift, spread and evaporation (direction, distance, volumes) and calculate these behaviours by modelling programs and make forecast maps.
- Continuously monitor drift and spread in order to assess the risk, and continuously take appropriate actions based on the judgments.
- Take appropriate steps to stop or reduce damage to environment and property.
- Contact, as soon as possible, relevant environmental bodies and plan for appropriate handling of the hazardous waste that the accident and the operation may yield.

Specific risk reduction and preparedness measures of sea accidents :

Risks assessment is a complex process involving the identification of the risk and its sources, as well as of the occurrence and severity of their consequences. This is used to elaborate strategies for risk diminishing and safety improvement at sea by the adoption of measures for prevention, control and reduce the risks. To increase safety at sea, IMO has developed a structured and systematic methodology for a formal safety assessment (FSA), by using risk analysis and an efficient risk management. Formal safety assessment (FSA) represents IMO response to the necessity of a modern approach of the process of establishing regulations in order to improve safety at sea.

The level of safety at sea has been improved in the recent year but still accidents occur even today so, improvements are very much desired. A modern approach to safety regulation should be as follows:

- proactive – trying to anticipate hazards, rather than waiting for accidents to reveal them;
- systematic – using a formal, structured, methodical process for developing new rules and prioritising research;
- transparent – being clear what level of safety and reliability is achieved and what contribution each rule makes to it;
- cost-effective – achieving a suitable balance between the level of safety and reliability and the cost to the ship-owner in achieving it.

Risk identification consists of hazard identification, which should caused severe pollution of environment. It represents first step which is essential in a risk assessment. A hazard is identified as a situation with a potential for causing harm to human safety, the environment, property or business, regardless of how likely or unlikely such an occurrence might be. The hazards identification must be a well structured systematic and critical process.

The risk evaluation represents in fact an analysis of the risks generated by various dangers. It assumes the evaluation of the likelihood, respectively how often or probable is the risk occurrences and how severe are their consequences. This allows attention to be focused upon high risk areas and to identify and evaluate the factors which influence the level of risk.

The next step is risk assessment. For risk estimation the likelihood and consequences of events are combined to quantify risk.

On this basis the risk classification can be done in priority order for the effort to reduce them, making decisions for new safety measures and improving existing ones. Risk assessment of oil spills is very difficult due to multiple consequences and factors, which influenced their severity.

To conclude it may be said that the results from analysis of risk control, prevention and reduction measures are the basis for recommendation for

decision-making bodies and regulators to bring risk to the lowest possible level. Response plans must clearly indicate the reporting requirements and must assign responsibilities for reporting pollution incident.

Typical post-disaster needs of sea accidents :
Surviving an accident at sea might bring up a different kind of pressure.

The most common reactions to at-sea disasters are

- Trouble sleeping and nightmares.
- Feeling overly jumpy and/or easily startled.
- Loss of concentration.
- Increased irritability or anger.

❖ **The victim may also experience the following symptoms which are extremely common reactions to sea accidents.**

- Flashbacks—memories, feelings, or sensations of the event that come back unexpectedly.
- Intense physical or emotional reactions when you smell, hear, feel, or see things that remind you of what happened (examples: diesel smell, rocking motion).
- A desire to avoid places, people, or other activities that remind you of the event.
- An inability to remember important details about the event.
- A sense of numbing, detachment, or lack of emotions.
- A lack of awareness of your surroundings (being in a daze or things seem "unreal").
- Less interest in your usual activities.
- Hopelessness.
- Feeling that you must always be on the lookout for danger.

❖ Following measures may help the victim of sea accidents

1. Talking or writing about what the victim has experienced and how he is feeling is one of the most effective actions he can take to help himself and prevent future problems.
2. When the victim is in a safe environment, reflecting on what happened helps his mind make sense of the events and gain a sense of control over the difficult memories.

3. While close friends and family can be a great source of support, one should not be discouraged if other people have a hard time understanding ones reactions.

4. Talking about what happened can sometimes be difficult in a small coastal community. The victim might worry that his story will frighten others who also spend time on the water, he may hesitate to talk about the ways human error could have contributed to the disaster, or he may worry about overwhelming his loved ones.

5. It may be easier to talk to someone outside the victim's normal social circle, such as a counselor, doctor, nurse, or clergy person. Professional support can provide much-needed confidentiality, understanding, and a neutral perspective.

6. Engage in pleasant, distracting activities off and on, but try not to completely avoid thinking or talking about what happened.

7. Get adequate rest and eat healthy foods.

8. Try to maintain a normal schedule.

9. Take breaks and reminisce about those who lost their lives in the incident, if applicable.

10. Focus on something practical you can do now.

11. Use relaxation techniques.

12. Keep a journal.

13. Exercise in moderation. Exercising within 24 hours of the event will help your body process the stress hormones that flooded your body during the incident.

14. Focusing on their sense of purpose or mission in life.

15. Attachment to loved ones.

16. Maintaining a sense of humor.

❖ Actions that is not helpful

- Using alcohol or drugs to cope.
- Withdrawing from family, friends, pleasant activities.
- Working too much.
- Violence or conflict.
- Doing risky things.
- Extreme avoidance of places or activities that might remind you of the event.
- Excessive TV or computer games

Case Studies of sea accidents :

The RMS Titanic, the largest passenger liner in service of that time, sank on the night of 14 April through to the morning of 15 April 1912 in the North Atlantic Ocean. It was in her fourth days on maiden voyage from Southampton to New York City. It has been estimated that Titanic had 2,224 people on board when she struck an iceberg. She took two hours and forty minutes to sink on 15 April and the result was deaths of more than 1,500 people. This is one of the deadliest maritime disasters in history.

5.8 SUMMARY

We live in a civilized society where man has become his own enemy because many disastrous events are caused due to negligent human actions. These are known as man-made disasters. In short man-made disasters are those hazards caused directly or indirectly by human action or inaction. There are multiple factors that may relate to manmade disasters such as ignorance, unawareness, illiteracy, carelessly handling danger, chemical weapons etc. Train accidents, aeroplane crashes, collapse of buildings, bridges, mines, tunnels, etc. are some of the common examples of man-made disasters. These happen as a result of human carelessness or mishandling of dangerous equipment's during technological and industrial use. Human has made much progress in the field of science and technology. With this advancement of science and technology human being is able to built nuclear power plants. Nuclear disaster refers to undesirable effect caused to the environment due to radioactive substances or radiations. Moreover, chemical disaster is the unintentional refuse of one or more hazardous substances which could harm human health or the environment. Bhopal Gas tragedies, AMRI Hospital fire, Kolkata are a few examples of man-made disasters. There is ardent need for Disaster management as it deals with situations that occur prior to, during, and after the disaster.

Terrorism is another man-made disaster which is a deliberate, criminal act. Terrorists use a variety of methods to achieve their ends like, biological, nuclear, incendiary, chemical and explosive. Others such as accidental disasters involve hazardous materials and transportation accidents.

So, regarding man-made disasters one may conclude that faulty technology can lead to costly mishaps. Man-made disasters can cause irreversible damage, and we human beings are causing these disasters because of our ignorance and some even being caused by intent. Most of disasters have taken many innocent lives from human, animals and forest. But we should attempt to prevent calamities before they happen and become more cautious so that we can care for our world and lower the rate of man-made disasters. Sometimes the best response to man-made disasters can be effective planning before tragedy strikes.

5.9 CHECK YOUR PROGRESS/ EXERCISE

1. True false

a. Events which are caused by man either intentionally or by accident are known as Man-made Disasters.

b. A natural activity is termed as a natural disaster even if it has no impact on human.

c. Leakage of toxic chemicals from the industries and accidents in the nuclear reactors has short-term effects like blindness, cancer, paralysis, heart trouble, gastric and respiratory abnormalities and long-term effects like genetic imbalances in humans.

d. On December 2-3 1984 in Bhopal toxic Methyl Isocyanate (MIC) gas leaked from the factory owned by Hindustan Carbide.

e. The 'fire triangle', fuel, oxygen and a source of heat are the three prerequisites for a fire.

f. Forest fires can be broadly classified into three types - ground fires, surface fires, and crown fires, depending on the type of fuel involved and its vertical arrangement.

g. Volcanic eruptions never ignite forest fires, as lava or magma never burns a thing that comes in its way.

h. United Kingdom and Mexico, and the Mediterranean basin are some areas where such spontaneous wildfires are quite common.

i. Throwing of burning cigarettes end or matches and lighting of fires in restricted areas are some of the examples of human carelessness that lead to 80% of all wildfires.

j. Terrorism is a deliberate use of violence against civilians and armed personnel and the state.

2. Fill in the blanks

a. Trained _____ _____ personnel can undertake rescue operations effectively during floods, major fires, building collapses, and some manmade disasters.

b. Regarding Forest Fire Monitoring the introduction of _____ camera supported forest fire observation systems has remarkable responses.

c. Terrorism is a man-made disaster which is a_____, criminal act.

d. Aerial _____ flights are another possible means to detect forest fires at an early stage during times of high fire risk.

e. Forest fire set mainly in _____ forests in the slopes of the sub-Himalayan region.

f. Forest fires can be frequent during the _____summer months, and the periods of _____ and strong winds

g. In AMRI Hospital fire, Kolkata patients were _____ inside wards and with no exit possible.

h. Bhopal Gas tragedy was a result of _____ error and poor supervision at the factory.

i. _____ fires clean up any dead or decaying matter strewn across forest.

j. Terrorist attack is carried out in such a way as to maximize the severity and length of the _____impact.

3. Multiple choice question

a. The forest fires in Uttarakhand have severely affected the

i. wildlife reserves across the state.

ii. medicinal plants across the state.

iii. rabbits and hyenas across the state.

b. India has

i. enough data regarding forest fire and damages caused by them.

ii. started data procurement regarding forest fire and damages caused by them very recently.

iii. very poor data regarding forest fire and damages caused by them.

c. Genuine political terrorism is characterized by

i. a revolutionary approach and are committed for ideological or political motives

ii. collective violence interfering with the peace, security, and normal functioning of the community.

iii. violent criminal behavior designed primarily to generate fear in the community

d. The most important post-disaster needs for forest fire are

i. efficient and timely rubbing together of clumps of dry bamboos.

ii. efficient and timely generation and transfer of information related to fire warning.

iii. efficient and timely accumulation of dead organic matter such as leaves, twigs, and dry branches on the ground.

e. In the Gulf War spill in Persian Gulf

i. no marine wildlife suffered.

ii. no question of suffering of marine wildlife as there was no marine life at all

iii. all marine wildlife suffered a great deal of damage and some local species even disappeared.

4. Answers the following Questions

1) Distinguish between Man-made disaster and Natural disaster.

2) What are the causes of manmade disasters? Elaborate your answer stating different type of manmade disasters.

3) State the response to man-made disasters.

4) What are the Causes and impact of Forest Fire? Explain your answer with special reference to Uttarakhand forest fire in India.

5) What are the Causes and impact of Terrorism? Explain your answer with special reference to Mumbai attack 2008.

5.10 ANSWERS TO THE SELF LEARNING QUESTIONS

1.a.true

1.b. false, A natural activity is not termed as a natural disaster until it has impact on human.

1.c. true

1.d. false, Union Carbide

1.e. true

1.f. true

1.g. Volcanic eruptions ignite forest fires, as the hot lava or magma burns everything that comes in its way.

1.h. false United States and Canada, and the Mediterranean basin

1.i.true

1.j. true

2.a. disaster management

2.b. automatic

2.c. deliberate

2.d. surveillance

2.e. pine

2.f. dry, droughts

2.g. trapped

2.h. human

2.i. forest

2.j. psychological

3.a.i.

3.b.iii.

3.c.i.

3.d.ii

3.e.iii.

5.11 TECHNICAL WORDS:

1. **Blast injuries**- the harmful effects on the body of sudden changes in pressure produced by explosion.
2. **CBRN**- CBRN are weaponized or non-weaponized Chemical, Biological, Radiological and Nuclear materials that can cause great harm and pose significant threats in the hands of terrorists..
3. **Terrorism**- the use of violent acts to frighten the people in an area as a way of trying to achieve a political goal
4. **Trauma nursing**- is treating patients in a state of emergency, and handles urgent situations where the cause of injury or disease isn't yet known.
5. **UNDRO**-United Nations Disaster Relief Organization
6. **Ground fire**-Fire that consumes the organic material beneath the surface litter ground, such as peat fire.
7. **Hazard reduction**-Precautionary controlled and managed fire lit during cooler and wetter weather in order to reduce the available fuel load.

5.12 TASK

1. In a map of India point out the locations of five worst man-made disasters in India.
2. In a chart define terrorism and types of terrorism.

5.13 REFERENCES FOR FURTHER STUDY

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4. Sundri Khalsa: Forecasting Terrorism: Indicators and Proven Analytical Techniques
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