UNIT 2 ENVIRONMENTAL CALAMITIES

Structure

2.1 INTRODUCTION

In the previous unit, you have studied about different dimensions of globalisation and its impact on the environment. In the present unit, we shall discuss about environmental calamities that often cause immense loss to our nation in terms of loss of life and natural bounties. The suffering has multiplied due to the policies being followed in this era of globalisation. We often use the words catastrophe, cataclysm, calamity and disaster to refer to personal and public misfortunes that result in grave loss of property and (or) heavy casualties. Though the dictionary meanings may seem synonymous, there are qualitative and quantitative differences in the extent of damage to life, property and the well being of biotic and abiotic entities as well as in the range of the effects on a time scale.

Much before we faced the effects of globalisation, calamities like floods, earthquakes, eruption of volcanoes, and forest fires were wreaking havoc on human lives. But with rapid industrialisation, exploitation of non-renewable natural resources, construction of huge dams, deforestation, indiscriminate use of chemicals and human greed for quick returns with lower inputs contributed to the escalation of the occurrence of these calamities. This, coupled with the man-made disasters like nuclear accidents, industrial accidents, disposal of toxic wastes, accidents in the transportation of hazardous wastes, oil spills and emission of Green House Gases, has created a situation that threatens the existence of humanity. There are sections of scientists and social scientists who argue that all environmental calamities are man-made disasters whereas others argue that development and economic growth cannot be achieved unless we take calculated risks. These issues are debatable but the issue at stake is the survival of humanity. It is to be acknowledged that the margin between natural calamities and man-made disasters (the subject of the next unit) is becoming thinner gradually.

Objectives

After studying this unit, you should be able to:

- define environmental calamities and classify them;
- discuss the impact of environmental calamities on society; and
- highlight the need for preparedness to reduce and meet the eventualities and its adverse effects.

2.2 NATURAL CALAMITIES

According to the World Health Organisation, **an environmental calamity is an event that causes damage, economic disruption, loss of human life and deterioration in the health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area.**

Natural calamities adversely affect the lives of a large number of people, cause considerable damage to infrastructure and property. The ill effects are more pronounced in developing countries due to the lack of preparedness, lack of systems for sufficient warning, lack of facilities for quick access to the site of calamity.

At the global level, Asia is more prone to natural calamities. It is reported that for each major natural calamity in Europe and Australia, there are ten in Latin America and Africa and fifteen in Asia. According to CRED World Disaster Report (1998), the ratio of those killed to those affected depends on the type of calamity, degree of preparedness and the density of population. For example, floods affect many and relatively less number is killed whereas in Earthquake many lives are lost but relatively less number is affected. Table 2.1 gives the annual average number of people killed or affected over a period of ten years (1987 – 1996).

Table2.1: Annual average number of people killed or affected over a period of ten years (1987 – 1996)

Country	**People Killed** (approximate)	**People Affected** (approximate)
Bangladesh	44,000	18,574,000
India	5063	56,563,000
Nepal	780	201,000
Pakistan	750	1,407,000
Srilanka	100	504,300
Bhutan	5	7,000
Maldives	1	30

Source: CRED World Disaster Report (1998)

Natural calamities could be broadly classified under the following headings:

i) **Atmospheric** – Rains, Hail storms, winds, lightning, fog, heat/cold waves, etc.
ii) **Hydrological** – Floods, sea-shore waves, glacier advances, water logging, etc.
iii) **Geological** – Land slides, avalanches, earthquakes, volcanic eruptions, shifting sands etc.
iv) **Biological** – Severe epidemics (in humans, plants, animals), forest fires, pest invasions (locusts) etc.

Fig.2.1: Environmental calamities

Selected natural disasters: Asia and the Pacific

- July 1976: an earthquake in China took 242 000 lives.
- April 1991: a cyclone in Bangladesh accompanied by a storm surge caused 138 866 deaths.
- February 1990 and December 1991: cyclones in Samoa caused losses of US$450 million, about four times the country's GDP.
- January 1995: an earthquake in Kobe, Japan, became one of the costliest natural disasters in history– 5,502 people were killed and more than 1 800 000 affected, with damage estimated at US$131.5 billion.
- October 1999: the Super Cyclone in the eastern state of Orissa in India caused more than 10, 000 deaths, while 15 million people were rendered homeless, left without food, shelter or water and their livestock population devastated – the cyclone damaged 1.8 million hectares of agricultural land and uprooted more than 90 million trees.
- January 2001: an Earthquake of magnitude 7.7 on the Richter scale rocked the state of Gujarat in India, causing more than 20 000 deaths and 167 000 injuries – economic losses estimated at US$2.1 billion.

DoAC India (2002), Super Cyclone Orissa, Natural Disaster Management, Dept. of Agricultural and Co-operation, India.

http://www.ndmindia.nic.in/cycloneorissa/

Recent disasters caused by extreme natural events around the world

The year 2000

- Mongolian herders had their hardest winter for 30 years – 2.4 million livestock died and 45 percent of the country's population was affected.
- In February and March, floods killed 650 people and left more than half a million homeless in Mozambique. Heavy rains also affected Botswana, Swaziland and Zimbabwe.
- Cyclones Eline (mid-February) and Gloria (early-March) left 184 000 people in need of immediate relief support out of the total of 737 000 affected in Madagascar. In early April, a third cyclone, Hudah, hit the north of the island.
- Floods in September and October in Southeast Asia, especially Vietnam and Thailand, killed approximately 900 people and left 4 million homeless or with insufficient shelter. Losses estimated at US$460 million.
- Hurricane Keith in October killed eight and affected 62 000 people in Belize. Direct losses estimated at US$520 million.
- In mid-October, heavy rains caused floods in the Italian and Swiss Alps killing 38 people and causing economic losses estimated at US$8.5 billion.
- Similar floods killed six people and caused US$1.5 billion loss in the United Kingdom in November.

The year 2001

- In mid to late January, heavy rains over Zambezia Province caused the Licungo River to flood in Mozambique. Nearly 500 000 people were affected by the floods.
- In March, floods devastated a wide area of north-eastern Hungary, north-western Romania and western Ukraine. Tens of thousands of people were forced to move.
- Flash floods unexpectedly struck parts of Pakistan on 23 July. The cities of Islamabad and Rawalpindi were the worst affected. 132 people were killed.
- In mid-November, as many as 576 Vietnamese had been killed by natural disasters, mainly floods and typhoons. Material losses amounted to more than US$200 million.
- A persistent multi-year drought in Central and Southwest Asia had affected about 60 million people by November 2001.
- After several months of drought, devastating floods tore through the Algerian capital Algiers on 10 November, killing 751 people. Thousands were injured, and about 40, 000 people were left homeless.

Source: Relief Web (2002) Natural Disasters, Project of the United Nations Office for the co-ordination of Humanitarian Affairs, Munich

http://www.reliefweb.int/w/rwb.nsf

Any one or a combination of several of the above mentioned calamities may result in famine or drought. There have been arguments that famines and droughts are entirely man-made and could not be termed as natural calamities. But famines and droughts had been there even before the present appearance of globalisation or massive industrialisation. Table 2.2 gives the annual average number of people killed due to disasters during the period 1972 to 1996.

Table 2.2: Annual average number of people killed due to disasters during the period 1972 to 1996

Period	Earth quake	Famine/ Drought	Floods	High winds	Land slides	Volcanic eruption	Total
1972–1976	64,170	253,800	7,232	4,877	1,142	9	331,330
1977–1981	5,821	56	4,900	6,729	343	129	17,979
1982–1986	3,210	111,832	4,269	6,494	488	4,740	131,033
1987–1991	15,548	1,852	39,787	57,803	1,184	151	116,325
1992–1996	4,826	489	7,293	3,797	807	56	17,268
(1972–1996) (Average per annum)	18,715	73,606	12,696	15,960	793	1,017	122,787

Source: UECD, 1998 Table.2.1

There is no discernible trend in the number of deaths due to one type of calamity or the other. Famine was the biggest killer in the early 70s. But the situation has considerably improved over the years. Improved preparedness, building up of buffer stock of food grains, early response to mitigating the sufferings of people could be attributed to the lower death toll in recent years.

However, much more needs to be done to prevent hunger and improve food security as you have studied in MED-007. This brings us to the added dimension of globalisation in coping up with natural disasters.

Globalisation could facilitate development processes which enhance society's access to knowledge and resources as well as their application to improve the quality of life of the people in terms of their wellbeing and access to amenities; the same processes could, however, contribute to the frequent occurrence of natural disasters.

You would agree that the ability of an individual, family, community and nations to protect themselves against the adverse effect of a natural calamity is determined by their economic strength. It is estimated that 95 percent of deaths from a natural calamity occur among 66 percent of the world population living in poorer countries. For example, the major impact of drought is felt by agricultural labourers and small farmers, the major impact of floods is felt by the settlements of poorer sections of populations in the developing countries living in flood prone areas and the effects of earthquakes are felt by poor families living in fragile households. It is ironical that these very sections of society are at the receiving end of various economic policies being pursued to promote globalisation. They are becoming poorer and hence more dependent on the state to cope up with adversity in an environment where the state is gradually receding from all sectors of welfare. This has major implications when people are struck by natural calamities as evidenced in the relief and rehabilitation measures undertaken at such times.

What is more, under certain circumstances development can increase disaster proneness. The location of a dam in an area of high seismic activity, the construction of roads in difficult terrains or unstable geomorphologic conditions and promotion of water intensity crops in areas of unpredictable rainfall are examples of development measures dictated by policies of globalisation leading to or aggravating the phenomena of natural calamities. In spite of the absence of prediction mechanisms to pinpoint the location, the timing and intensity of natural disasters, the preparedness, appropriate management, the pre and post operative mechanisms would go a long way in mitigating people's suffering.

With these remarks, we now discuss briefly various kinds of natural disasters.

2.3 EARTHQUAKES

Ancient people believed that earthquakes occur whenever evil deeds outweigh the good deeds on the Earth. Subsequently, earthquakes were known to have resulted due to the rumbling sound in the Earth caused by the movement of hot air masses trying to escape from the hollowed outer parts of its interior. With the invention of highly sensitive seismic instruments, and advancement of science, and studying the pre and post effects of earthquakes in different parts of the world, the geoscientists and seismologists are able to explain the possible reasons for the occurrence of earthquakes. But there have been different explanations for earthquakes in different parts of the world.

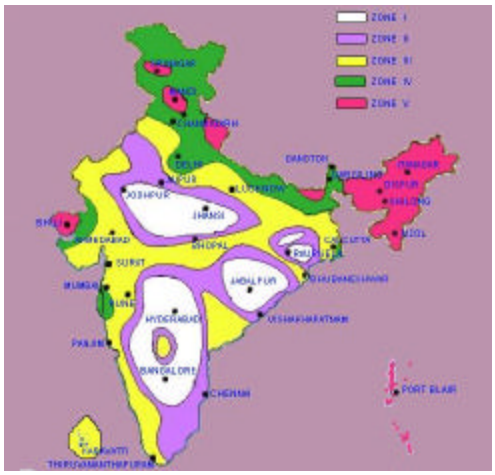


Fig.2.2: Seismic zones in India (**Source** :http://gujarat-Earthquake.gov.in/final/seismic.html)

It is now generally accepted that an earthquake is a vibration(s) of the Earth produced by the release of energy. This energy radiates in all directions from its source (epicentre). Earthquakes can also occur because of atomic (nuclear) explosions or by volcanic eruptions. Large reservoirs with their hydro-static pressure of water may also induce earthquakes. In Fig. 2.2 you can see the various seismic zones of India. These are explained below:

- **Zone V**: This is the most severe seismic zone and is referred to as Very High Damage Risk Zone.
- **Zone IV:** This is referred to as High Damage Risk Zone.
- **Zone III**: This is termed to as Moderate Damage Risk Zone.
- **Zone II:** This zone is referred to as Low Damage Risk Zone.
- **Zone I**: This zone is termed as Very Low Damage Risk Zone.

In order to understand the strength and severity of an earthquake, it is necessary to measure its intensity. There are several methods to measure the intensity by the effect an earthquake produces on life and property. Two Italian seismologists Rossi and Forel introduced a scale known by their names. It consists of ten divisions: the higher the number on the scale, the greater will be the damage caused. This scale was found to be unsuitable and subsequently Mercale scale or Richter scale was introduced.

The Richter scale describes the amplitude of the earthquake wave radiating out in all directions from the focus (epicentre) which is closely related to the amount of energy released. This is also a measure of ground motion as recorded on a seismograph. A

relation between the Mercalli number, characteristic and the Richter scale are given in the Table.2.3.

Table 2.3: Relation between the Mercalli number, characteristic and the Richter scale

Mercalli No.	Effect	Characteristic	Richter scale
I	Instrumental	Detected by seismographs	less than 3.5
II	Feeble	Noticed by some people at rest	3.5
III	Slight	Similar to vibration of a passing truck	4.2
IV	Moderate	Felt indoors, parked cars rock	4.5
V	Rather strong	Most sleepers wake up	4.8
VI	Strong	Trees sway, furniture moves, some dam age caused	5.4
VII	Very strong	General alarm, walls crack	6.1
VIII	Destructive	Weak structure damaged	6.5
IX	Ruinous	Houses collapse, ground cracks	6.9
X	Disastrous	Many buildings destroyed/ razed; Rails bend	7.3
XI	Very Disastrous	Few buildings survive; land slides occur	8.1
XII	Catastrophic	Total destruction, ground formed waves	greater than 8.1

The Gujarat Earthquake 2001

http://www.ndmindia.nic.in/ gallery.htm

The Bhuj Earthquake that shook the Indian State of Gujarat on the morning of January 26, 2001 (Republic Day) is one of the two most deadly earthquakes to strike India in its recorded history. One month after the earthquake, the Government of India figures placed the death toll at 19,727 and the number of injured at 166,000. Indications are that 600,000 people were left homeless, with 348,000 houses destroyed and an additional 844,000 damaged. The Indian State Department estimates that the earthquake affected, directly or indirectly, 15.9 million people out of a total population of 37.8 million. More than 20,000 cattle are reported killed. Government estimated the direct economic losses at $1.3 billion. Other estimates indicate losses may be as high as $5 billion.

A significant part of the damage could have been avoided had local building codes been effectively implemented. Many new buildings had not been properly designed, had not been built on foundations strong enough to resist earthquakes, and had not been sited in areas where the effects of earthquakes would have been diminished.

Source: http://www.cires.colorado.edu/~bilham/Gujarat2001.html

The number, scale and characteristics are deceptive many a times. There have been instances when a lower number caused most severe damage depending on the distance of the place to the focus (epicentre), the density of population, the nature of civil constructions, the nature of the ground and the concentration of physical structures on the ground.

There have been experiments to predict an earthquake and determine the zones that are prone to the earthquakes. However, most of them do not prove to be very satisfactory. For example, changes in seismicity, physico-chemical changes, changes in landforms, changes in animal behaviours are some of the parameters that could lead to the prediction of an earthquake. Though various theories have been developed in the method of prediction, at practical level, none seems to work. Of late, several strategies have been proposed – artificially inducing controllable earthquakes of very small intensity to reduce the building up of energy in the Earth's crust or releasing the stress before it reaches critical levels through underground nuclear explosions. But these may turn out to be uncontrollable to be experimented beyond the laboratories.

It is now accepted that people must be made aware of the methods of minimising the risks. Training the public in Earthquake Resistance Construction in the earthquake prone areas may yield some results.

You may like to reflect on the issues discussed so far. Try the following exercise.

SAQ 1

Collect details about some natural calamities that have occurred in your region in the recent past. Were any of these a consequence of changes in the environment due to human activities? Discuss.

2.4 FLOODS, CYCLONES AND TSUNAMIS

Water is essential for life. However, there are certain phenomena associated with the flow of water in nature that can cause untold misery to human beings. Principal among these are: Floods, cyclones and hurricanes. The recent tsunami caused a great deal of damage in South Asian countries and, therefore, we have included it in our discussion. We discuss some of these calamities briefly.

Floods

Floods are the most common of all natural calamities. Floods regularly claim thousands of lives and adversely affect millions of human beings annually world wide. Bangladesh alone is by far the most flood prone country accounting for about two thirds of global loss of life. India accounts one fifth of global death count and loss of Rupees 600 million every year on an average. More than the loss of life and damage to property, millions of people are displaced every year due to floods in the South Asian countries.

A flood is the discharge of water that exceeds the canal capacity of the river.
Floods are caused by different factors that include:

- climate extremes – heavy and prolonged rainfall
- melting of snow and ice
- collapse of dams
- land slides
- silting of river beds reducing the carrying capacity of rivers
- lack of coordination between officials of adjoining districts or states facing similar problems.

There was a case study of two adjoining districts, for example, A and B that were threatened by floods. The canals flowing from district A were bringing huge quantities of water into villages in district B. There was one canal which breached off from district A into dryer areas. Since its elevation was higher, it was not carrying any

water resulting in heavy inflow of water into district B. The collector of district B, in consultation with his counterpart in district A, installed pumps a little upstream, and pumped water into the canal flowing into dryer areas. This not only saved many villages of district B from inundation but also resulted in meaningful use of surplus flood water for irrigation of dry areas. The collector of district A, however, had to pacify the political discontent and control the misinformation about raising water levels in his district.

This may be only an exceptional example not possible to apply everywhere, but highlights the point that the officials on field, if they search for solutions, can find solutions that may reduce the effects of floods and alleviate the suffering of people and save the properties.

Floods in Bangladesh and India – 2004

The mighty Brahmaputra river, swollen by rain and a Himalayan burst dam, flooded huge swathes of North India and Bangladesh, killing dozens and forcing millions to seek refuge on higher ground in June-July, 2004. In Assam, that brought the death toll from the annual monsoon floods to more than 70 in India and neighbouring Nepal.

In neighbouring Bangladesh, officials said 13 people had died and an estimated 3 million people were marooned – cut off in their flooded homes and on patches of high ground. In the eastern Indian states of Assam and Bihar, military helicopters and soldiers in motor boats tried to rescue thousands of stranded people and dropped cooked food.

All rivers in Assam, including the main Brahmaputra, were overflowing after a week of incessant rains and more than two million people became homeless because of floods. Dams burst in the impoverished state of Bihar, at least 14 people were drowned in two separate incidents when their boats capsized in the swollen Bagmati river.

More than 600,000 people were affected in Bihar. A dam at Tsatitsu lake in the Himalayan kingdom of Bhutan had burst, spilling water into tributaries of the Brahmaputra and flooding Assam. Floods and landslides left thousands stranded on high ground in the neighbouring mountainous kingdom of Nepal, killing at least 12 people. While Assam and Bihar battled floods, the north-western and central regions of India had less rain than normal in the June-September monsoon, raising doubts about the fate of major crops such as rice and oilseed crops.

The north-eastern Bangladesh town of Sylhet, at the centre of the worst-hit district, lay under 60 cm (two feet) of water and road and rail links were cut or threatened by the rising water. The floods covered nearly 20 to 64 administrative districts. Thousands of families had sought refuge on roads and embankments as well as in schools, government buildings and boats after the floods forced them to abandon homes.

Source: **http://www.disasterwatch.net/news/millions%20homeless_south%20asia.htm**

It is possible to reduce the adverse effects of floods by

- construction of dams and reservoirs at appropriate places,
- strengthening the embankments on rivers and canals,
- improving the carrying capacities of rivers, canals and reservoirs by periodical desilting and deepening operations,

- enchancing the deepening, widening and lining of canals and periodically deepening and desilting the drainage channels,
- diversion of flood waters from a river or a channel into other canals and channels,
- introducing flood plain management techniques, and
- preparing natural ponds, reservoirs, tanks and leading channels by removing obstructions and avoiding constructions.

Though it is known or easy to predict before hand the onset of floods, the administration, and people, more often than not, do not wake up to the situation before it is too late to press into service the preventive measures. A study of the damage caused by the floods often indicates that the damage to property and loss of life or displacement of people could be reduced if only the Governmental agencies coordinate their activities and act in time to address the calamity.

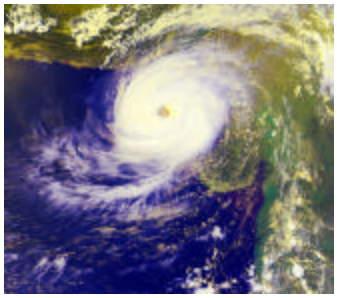
Cyclones

One of the most common coastal calamities is the cyclone. Cyclones claim many lives and cause immense damage to property every year.

A tropical cyclone that struck northern Bay of Bengal in 1970 caused tidal waves of 6 metres height killing three hundred thousand people and destroying 65% of the total fishing capacity of the coastal region. During the cyclonic storms winds move forward with a speed of 25 km/hr, and at times reach 200 km/hr destroying and annihilating everything or anything on their path.

Cyclones are caused in the tropical belt when sea water gets heated up to 27°C and more, so that low pressure areas develop above the water levels. The low pressure areas remain stationary for three to four days and draw energy from the sea surface. As the pressure in the centre falls, the wind speed increases and cloud burst starts spiralling around the centre causing squalls. As the pressure falls in the centre, the winds in the surrounding areas rush inwards creating spirally moving storms. The cyclone then moves landward towards areas of lowest pressure.

Cyclones



The history of no state is as stormy as that of Andhra Pradesh. In this century alone, the state has been pounded by 18 devastating storms causing enormous loss of life and property. The Diviseema cyclone, the worst last century, left more than 10,000 dead and ravaged property worth Rs. 175 crore in 2300 villages. Andhra Pradesh has the longest coastline of all the states in the country. The 760 km length along the sea has laid bare the state to the fury of cyclones that have been a regular feature in the Bay of Bengal. If 1977 saw Diviseema wiped out, 1996 saw Nellore-Prakasam-Konaseema reel under the cyclones of the Bay. The disaster which hit the coast has taken a toll of thousands of lives. Millions of acres of ready-to-harvest paddy have been destroyed, horticultural plantations have been lost. It will take a generation to overcome this loss. The cyclone storm that lashed the paddy rich East Godavari district, especially Konaseema region, has wrought havoc on the coconut grooves, paddy fields and property. The killer cyclone destroyed about five million coconut trees spread over an area of 1000 sq. km. in Konaseema.

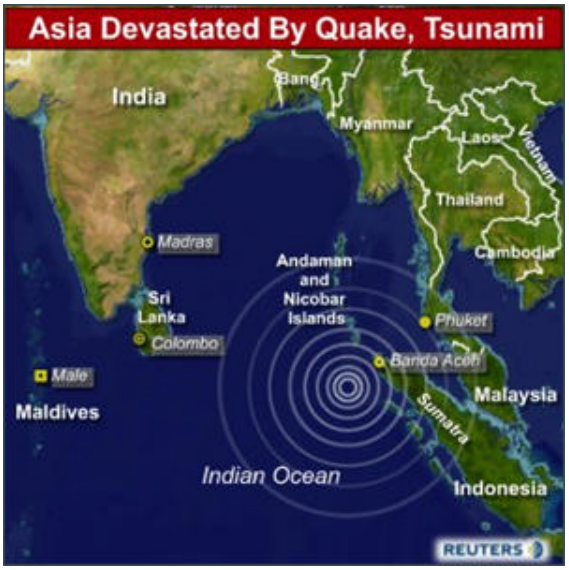
Source: http://www.envis.nic.in/soer/ap/cme_cyc_AP.htm

Today, with the advancement in weather prediction techniques, remote sensing satellites and cooperation between countries in sharing information on weather

conditions, it is possible to predict the birth of a cyclone and monitor its movements to pinpoint the area where it hits the coast. In spite of this, the damage caused is very severe, the well planned relief operations going haywire in the last minute. In the areas that are prone to cyclones, the governmental and non governmental agencies have perfected the drill and the routine to be followed in the pre, during and post cyclonic storms. But more often than not, lack of coordination between different agencies or working at cross purposes and starting the preparations at the last minute can undo all the planning. The case in point is the cyclone shelters constructed along the eastern coast in Andhra Pradesh. None of the shelters is well maintained and have become uninhabitable and unusable when needed.

Tsunamis

Tsunamis are among the most terrifying natural hazards known to man and have been responsible for tremendous loss of life and property. Because of its destructiveness, tsunami has an important impact on the human, social and economic sectors of our societies. In the Pacific Ocean where the majority of these waves have been generated, the historical record shows tremendous destruction.



A tsunami is a wave in the ocean or in a lake that is created by a geologic event. They are also known as tidal waves or seismic sea waves. Most tsunamis are very weak and have heights of only a few inches (or centimetres). But the intensity varies from time to time. Near the place where they are created, these larger tsunamis may have heights of many feet (metres). As they spread out or move into the deep ocean, their heights decrease to a foot or less. However their heights increase again as the tsunami waves reach shallow water near impact areas. The expected heights for these larger tsunamis are around 30 – 70 feet. Tsunamis are most often caused by earthquakes and landslides. Volcanic eruptions can also cause tsunamis.

On 26th December 2004 the Indian coastline experienced the most devastating tsunami in recorded history. The tsunami was triggered by an earthquake of magnitude 9.0 on the Richter scale at 3.4° N, 95.7° E off the coast of Sumatra in the Indonesian Archipelago at 06:29 hrs IST (00:59 hrs GMT).

The 2004 Indian Ocean earthquake devastated the shores of **Indonesia**, **Sri Lanka**, **India**, **Thailand**, and other countries with waves of up to **15 m** (50 feet) high, even reaching the east coast of **Africa**, **4500 km** (2,800 miles) west of the **epicentre**. At least 79,900 people were killed by the earthquake and tsunami in Indonesia. Tsunamis killed at least 41,000 people in Sri Lanka, 10,000 in India, 4,000 in Thailand, 120 in Somalia, 90 in Myanmar, 66 in Malaysia, 46 in Maldives, 10 in Tanzania, 2 in Bangladesh, 1 in Seychelles and 1 in Kenya and the count is still taking place.

Tsunamis caused damage in Madagascar and Mauritius and also occurred on Cocos Island and Reunion. The tsunami crossed into the Pacific Ocean and was recorded in New Zealand and abng the west coast of South and North America. The earthquake was felt (VIII) at Banda Aceh and (V) at Medan, Sumatra and (II-IV) in parts of Bangladesh, India, Malaysia, Maldives, Myanmar, Singapore, Sri Lanka and

Thailand. This is the fourth largest earthquake in the world since 1900 and is the largest since the 1964 Prince William Sound, Alaska Earthquake.

The mangrove forests and coral reefs about which you have studied in Blocks 1 and 2 of MED-001 are natural defences against tsunamis.

Mangroves as a shield

"Though we cannot prevent the occurrence of such natural calamities, we should certainly prepare ourselves to mitigate the impact of the natural fury on the population inhabiting the coastal ecosystems. Our anticipatory research work to preserve mangrove ecosystems as the first line of defence against devastating tidal waves on the eastern coastline has proved very relevant today. The dense mangrove forests stood like a wall to save coastal communities living behind them," said M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation (MSSRF), Chennai. The mangroves in Pitchavaram and Muthupet region acted like a shield and bore the brunt of the tsunami.

An anticipatory research programme, with a two-pronged strategy, to meet the eventualities of sea level rise due to global warming started few years ago. One is to conserve and regenerate coastal mangroves along the eastern coast of the country, and the second is transfer of salt - tolerant genes from the mangroves to selected crops grown in the coastal regions. The MSSRF will soon be publishing a scientific document 'Tsunami and mangroves' highlighting the need to conserve and rehabilitate mangroves as the frontline defence against tidal forces. (The Hindu, 28 December, 2004)

Human Failure: Even though the tragedy could not have been averted altogether, thousands of precious lives could have been saved; there was a collective failure of the tremendous knowledge base in this country. The unfortunate fact is that even with routine things such as flood warning systems in place, precious lives continue to be lost in this country during disasters such as cyclones and floods. Somewhere there is both carelessness and callousness in our administrative mechanisms, which fail to act quickly and efficiently when it comes to preventive action to minimize the loss of lives. But one awaits the day when we will boast of a collective sensitivity that considers our one billion plus population, including the poor and the unprivileged, not a liability but an asset – human capital of the extraordinary variety that deserves to be nurtured and as zealously guarded.

The Government proposes to install the equipment required for predicting tsunamis within the next two-and-a-half years. The indigenous warning system includes putting in place a Deep Ocean Assessment and Reporting system, around 20 data buoys and a software programme that would help predict the location, time and height of any tidal formations like tsunamis based on the changes and disturbances detected underwater following seismic changes. India would approach the Pacific Tsunami warning centre and countries such as Indonesia, Thailand and Myanmar for required international co-operation in its proposed software programme for the networking of the available data on tsunami and deep water oceanic changes.

SAQ 2

a) Discuss the causes of floods in your region/country.

b) What steps can be taken to prevent and mitigate human suffering due to floods, cyclones and tsunamis ?

2.5 DROUGHTS

A 'drought' can be defined as a prolonged period of unusually dry weather, with little rainfall, in a region where rains are normally expected. As such a drought differs from a dry climate which is usually associated with a region that is normally or

seasonally dry. Droughts often last for years. Drought is a creeping calamity because it develops slowly and has a prolonged existence. Droughts are not confined to any particular tectonic or topographic setting and their impact extends over very large areas and regions.

The impact of drought affects the developing countries more severely than the developed countries. The early effects of drought from endemic seasonal hunger and the resulting malnutrition cause immense misery to the poor people.

Drought in Rajasthan – 2000

news.bbc.co.uk/.

Rajasthan, the largest State in India with an estimated population of about 54 **million** was in the grip of a **severe drought in the year 2000**. Out of the 32 total districts in the State drought was prevalent in 31 districts and among these 25 districts were affected severely. Around 73.64% villages were under the clutches of drought; affecting nearly 33.04 million people and 39.97 million cattle. The severity of the drought could be judged from the fact that **out of a total of 2647 major water reservoirs only 300 were filled in that year. Also, nearly 75% to 100% crop had been destroyed due water scarcity.** All this has caused loss of livelihood leading to mass migration in search of employment.

Source: http://www.un.org.in/UNDMT/states/rajas/dstatus.htm

Droughts can be classified into four types:

i) **Meteorological drought**: rainfall deficit

ii) **Hydrological drought**: river flow deficit

iii) **Agricultural drought**: soil moisture deficit

iv) **Famine drought**: food deficit

Though climate is usually the prime reason for the triggering of drought, the situation is often made worse by the way people use the water resources. Felling trees for firewood, denuding the forest for agricultural or housing purposes, mining, unscientific farming method, indiscriminate drawing of ground water are identified as causes of droughts. It is argued that serious droughts in developing countries are more a function of global developmental policies than climatic conditions.

Droughts produce a series of direct and indirect impacts that usually extend far beyond the area experiencing the actual water shortage.

These may be classified as

- **Economic** – Loss of crop, dairy, livestock, fishery produce;
- **Environmental** – Damage to plant and animal species, erosion of soils; and
- **Social** – Food shortage, damage to health, conflicts between water users.

It is possible to take precautions in drought prone areas by constructing reservoirs, educating people in water conservation, scientific farming and optimal use of ground water resources.

Ground water, which is found in aquifers below the surface of the Earth, is one of the most important natural resources. Ground water accounts for about 38 percent of the water in India and the city water departments supply this to households and businesses (public supply). It caters to the need of drinking water for more than 97 percent of the rural population.

Water Harvesting Measures

One of the effective measures to combat drought and the resulting water shortage is to adopt water harvesting measures. It means capturing rain where it falls or capturing the run off in your own village or town and taking measures to keep that water clean by not allowing polluting activities to take place in the catchment. You have studied in Unit 14 of MED-001 that water harvesting can be undertaken through a variety of ways. Some of these are:

- Capturing runoff from rooftops,
- Capturing runoff from local catchments,
- Capturing seasonal floodwaters from local streams, and
- Conserving water through watershed management.

These techniques can serve the following purposes:

- Provide drinking water,
- Provide irrigation water,
- Increase groundwater recharge,
- Reduce storm water discharges, urban floods and overloading of sewage treatment plants,
- Reduce seawater ingress in coastal areas.

In general, water harvesting is the activity of direct collection of rainwater. The rainwater collected can be stored for direct use or can be recharged into the groundwater. Rain is the first form of water that we know in the hydrological (water) cycle; hence it is a primary source of water for us. Rivers, lakes and groundwater are all secondary sources of water. In present times, we depend entirely on such secondary sources of water. In the process, it is forgotten that rain is the ultimate source that feeds all these secondary sources and remain ignorant of its value. Water harvesting means to understand the value of rain, and to make optimum use of the rainwater at the place where it falls.

Source: http://www.rainwaterharvesting.org/whatiswh.htm

We now recount an illustrative example of proactive water harvesting in India.

The Hyderabad Example

The Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB) has set up an ambitious plan of taking up several water harvesting measures in the twin cities of Hyderabad and Secundrabad and its vicinity through active involvement of people during the next one year to improve the ground water level. The Water Harvesting measures, under the Neeru-Meeru (Water and You) Programme, include construction of a recharge pit or a mini-treatment unit, planting a sapling or any other action that would improve water recharge, green cover which ultimately increase the ground water levels. Explaining the motivational strategy at length, the Government officials said that they have plans to sensitise different opinion makers like ex servicemen, retired officials, women's groups and NGOs.

The groups would be sensitised on motivational aspects and techniques of various water harvesting structures. The trained groups would in turn reach out to communities and motivate the people highlighting the importance of rainwater harvesting and its benefits. As part of the strategy, the Board has recently created *water soldiers*, by sensitising ex-servicemen. It has also proposed to involve the student community in a big way so that the schools, colleges and other institutions would contribute to the cause of improving ground water table, thus enabling it to cover 25% of the 7 lakh houses with some type of water harvesting method. You can find out more about this effort at the website:

http://www.hyderabadwater.gov.in/RWH_Note.htm.

While natural calamities cannot be prevented from occurring, we can improve our preparedness and management of these calamities to minimise loss of life, property and human suffering. In this section, we shall discuss these very issues.

2.6 PREPAREDNESS FOR CALAMITIES

There have been specific ways of countering and minimising natural calamities in general but some important strategies can be adopted.

Emergency preparedness is to be viewed as a programme of long term development activity whose goal is to strengthen the overall capacity and capability of a country to manage efficiently all types of emergencies and bring about an orderly transition from relief through recovery and back to sustainable development.

Emergency preparedness is an on-going multi-sectoral activity. It forms an integral part of the national system responsible for developing plans and programmes for emergency management, prevention, mitigation, preparedness, response, rehabilitation and reconstruction.

We now briefly describe the UNEP programme for disaster preparedness.

Prevention and preparedness to reduce the costs of disasters

The fundamental goal of the UNEP disaster management programme is to reinforce the centrality of environmental concerns in disaster management. The other cornerstone is the adoption of preventive strategies and practical measures to reduce the potential loss of human lives and property, as well as destruction of the environment.

The success of this approach depends on increasing public awareness of the risks that natural, technological and environmental hazards pose to societies, and on educating people about the value of existing approaches for prevention and preparedness. UNEP contributes to this process through its programmes on environmental law, early warning and assessment, and Awareness and Preparedness for Emergencies at Local Level (APELL).

UNEP's APELL programme, developed in conjunction with governments and industry, recognises that the incidence and effects of environmental disasters can be reduced by prevention and preparedness initiatives at the local level. The APELL concept has been successfully introduced to more than 30 countries and in more than 80 industrial communities world wide. The UNEP strategy includes the promotion of cleaner production processes and technologies, and helping countries establish cleaner production centres.

A major objective of the UNEP early warning and assessment programme is to evaluate the increasing vulnerability of human society due to widespread environmental and climatic change in order to emphasise the need for sound integrated environmental management, and to provide early warning of emerging threats for preparedness and response.

The International Decade for Natural Disaster Reduction (IDNDR) was established by the United Nations to function for a period of ten years starting January 1990. The basic aim is to encourage further recent trends in natural disaster management from a reactive strategy of post disaster improvisation, which relies heavily on relief aid, to a more pro-active strategy of pre-disaster planning and preparedness.

According to IDNDR (1992), the five goals of the Decade were:

i) To improve the capacity of each country to mitigate the effects of natural disasters expeditiously and effectively, paying special attention to assisting developing countries in the assessment of damage potential and in the establishment of early warning systems and disaster resistant structures where needed.

ii) To devise appropriate guidelines and strategies for applying existing scientific and technical knowledge, taking into account the cultural and economic diversity among nations.

iii) To foster scientific and engineering endeavour aimed at closing critical gaps in knowledge in order to reduce loss of life and property.

iv) To disseminate the existing and new technical information related to measures for the assessment, prediction and mitigation of natural disasters.

v) To develop measures for the assessment, prediction, prevention and mitigation of natural disasters through the technical assistance programmes and technology transfer, demonstration of projects, and education and training, tailored to specific disasters and locations and to evaluate the effectiveness of those programmes.

The figure below presents the framework for disaster management. You may like to examine its applications in your specific context and modify it.

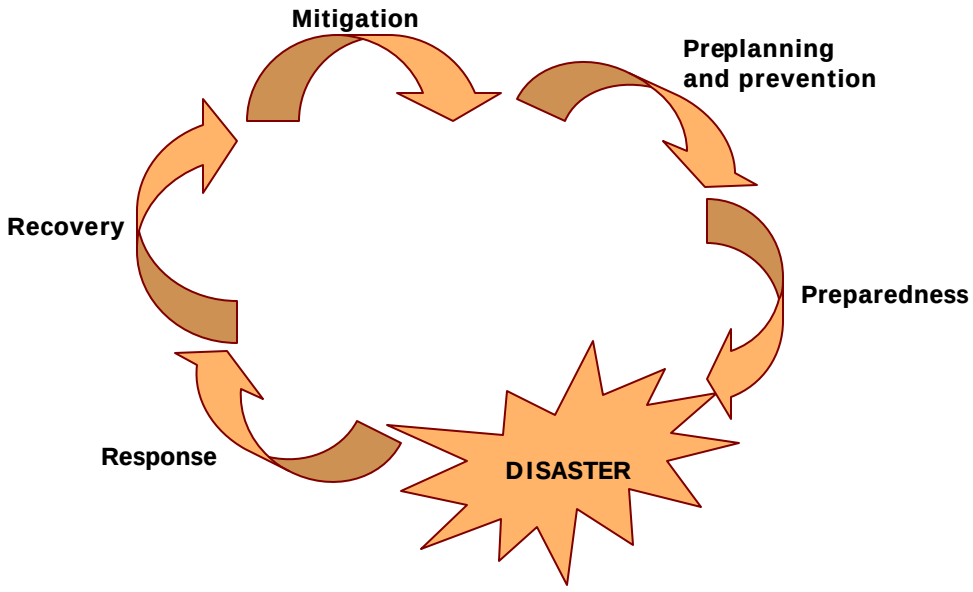


Fig.2.3: A framework for disaster management

Effective risk management of any calamity depends on the implementation of a sequential series of actions. The individual stages often overlap but it is crucial that they operate as a closed loop because the major objective is to learn from the past experiences and prepare an action plan based on the feedback.

- Pre-planning covers a wide range of activities like construction of defensive engineering works, land use planning, formulation, dissemination and maintenance of evacuation plans;
- Preparedness reflects the degree of alertness, immediately before and after the occurrence of calamity, arrangement for emergency warnings and preparedness based on earlier experiences;
- Response deals with events immediately before and after the occurrence of the calamity and pressing into service relief activities;
- Recovery and reconstruction are long term activities that attempt to return to normalcy after the occurrence of the calamity.

It is unfortunate but true that although environment is clearly something that humans value, it is usually low on the priorities of people except when they are faced with threats to their own lives or immediate possessions.

We end this section with an exercise for you.

SAQ 3

a) Analyse the various dimensions of natural disaster management in your own context taking specific examples to highlight your contentions.

b) What steps can be taken to prevent and mitigate human suffering due to droughts?

We now summarise what you have studied in this unit.

2.7 SUMMARY

- Most natural calamities like earthquakes, floods, droughts, and cyclones cannot be predicted in advance and when they occur they cause great loss of life and extensive damage to property and infrastructure. Natural calamities have been occurring from times immemorial but of late the damage caused has become qualitatively and quantitatively more, resulting in loss of human life and property over larger regions disrupting essential services and social structure.

- The United Nations called upon the National Governments to integrate disaster mitigation programmes with the development planning. Development can be the process which enhances society's access to resources and their application to improve quality of life of the members of society in terms of their wellbeing and access to amenities; the same development can contribute to the frequent occurrence of natural disasters.

- The ability of an individual, family, community and nations to protect themselves, against the adverse effect of a natural calamity is determined by their economic strength. It is estimated that 95 percent of deaths from a natural calamity occur among 66 percent of the world population living in poorer countries. For example, the major impact of drought is felt by agricultural labourers and small farmers, the major impact of floods is felt by the settlements of poorer sections of populations in the developing countries living in flood prone areas and the effects of earthquakes are felt by poor families living in fragile households.

- Under certain circumstances development can increase disaster proneness. The location of a dam in an area of high seismic activity, the construction of roads in difficult terrains or unstable geomorphologic conditions and promotion of water intensity crops in areas of unpredictable rainfall are examples of development measures dictated by policies of globalisation leading to or aggravating the phenomena of natural calamities.

- In spite of the absence of prediction mechanisms to pinpoint the location, the timing and intensity of natural disasters, the preparedness, management, the pre and post operative mechanisms help in the mitigation of people's suffering and in reconstruction mechanisms.

2.8 TERMINAL QUESTIONS

1. Explain the factors that cause natural calamities.

2. What are the basic aims of the International Decade for natural disaster reduction?

3. Elucidate the strategies that can be adopted to mitigate the suffering caused by natural disasters.

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