FUNDAMENTALS OF DISASTER MANAGEMENT

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❖ Terminologies regarding Disaster Management:

Disaster:

The term disaster owes its origin to the French word “Desastre” which is a combination of two words ‘des’ meaning bad and ‘aster’ meaning star. Thus the term refers to ‘Bad or Evil star’.

A disaster can be defined as “A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community’s ability to cope using its own resources,

A disaster is a result from the combination of hazard, vulnerability and insufficient capacity or measures to reduce the potential chances of risk.

A disaster happens when a hazard impacts on the vulnerable population and causes damage, casualties and disruption.

Hazards:

The word ‘hazard’ owes its origin to the word ‘hasard’ in old French and ‘az-zahr’ in Arabic meaning ‘chance’ or ‘luck’.

Hazard may be defined as “a dangerous condition or event, that threat or have the potential for causing injury to life or damage to property or the environment.”

Disaster management:

The organization, planning and application of measures preparing for, responding to and recovering from disasters that cause loss of life and property and damage environment is disaster management.

Disaster management may not completely avert or eliminate the threats; it focuses on creating and implementing preparedness and other plans to decrease the impact of disasters . Failure to create and apply a plan could lead to damage to life, assets and lost revenue.

Disaster management comprises of four phases:

1)Mitigation 2)Preparedness

3)Response 4)Recovery

Disaster risk:

Disaster risk is defined as the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time.

Disaster risk reduction(DRR):

Disaster risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development.

Disaster Risk Management:

Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses.

Capacity:

The combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience.

Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management.

Evacuation:

The planned movement of persons from an unsafe or potentially unsafe location to disaster to a safer location and their eventual return.

Mitigation:

Activities and measures intended to reduce or eliminate risks, or lessen the actual or potential effects or consequences of an event.

Vulnerability:

Vulnerability is a key factor in disaster management that refers to the weaknesses and likelihood of a person, community, or system to be affected by a disaster.

In other words vulnerability is the inability to resist a hazard or to respond when a disaster has occurred.

Epidemic:

Epidemic is hazardous event in which disease outbreaks within specific geographical area, region or country.

Pandemic:

A hazardous event in which disease spreads to multiple areas, regions or entire globe and eventually causing more damage.

Mapping:

Disaster mapping, also known as crisis mapping, is a method used to evaluate, record, and communicate data regarding the location of a disastrous event as well as the distribution of its effects or potential effects.

❖ Scope and nature of Disaster Management:

The term “Disaster Management” encompasses the complete realm of disaster-related activities.

Traditionally people tend to think of disaster management only in terms of the post-disaster actions taken by relief and reconstruction officials; yet disaster management covers a much broader scope, and many modern disaster managers may find themselves far more involved in pre-disaster activities than in post-disaster response. Those are

1. The refugee field of disaster management is highly specialized and requires not only many development skills but also a broader awareness of political, legal, and humanitarian issues.
2. DM aims and objectives, elements, Natural/man-made Disasters,
3. Victims, Relief Systems,
4. Phases of Disaster Response/Relief Operations, Government’s Role,
5. Refugee Assistance Models,
6. Prevention and Mitigation Tools, Preparedness Tools,
7. Tools of Post-Disaster Management, Mapping,
8. Aerial Photography and Remote Sensing,
9. Information Management.
10. Logistics, Epidemiology.

Historical Evolution of Disaster Management:

Since 1900 to the present, more than 22000 mass disasters have occurred around the world. As one of the most effective disasters after World War II., the current COVID-19 pandemic was unprecedented in terms of the global spread, damage and casualty of the virus.

The nature of these disasters, is such that not only can we not eliminate them, but rather we have seen an increase in them across the world, so that disasters have become one of the major challenges of development; in response, communities have always attempted to adopt measures to deal with the adverse consequences of disasters. All actions taken in this direction pursue a common goal, which today is referred to as the concept of "Disaster Risk Management".

The concept of Disaster Risk Management (DRM) has changed throughout history. Identifying changes and related factors can be effective in adopting logical, scientific and evidence-based approaches in the future.

DRM evolution started with the emergence of civil defense 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 along with first two phases.

DRM evolution during the last century depends on 3 important events which include Yokohama, Hyogo, Post Hyogo or Sendai.

1) The Yokohama Strategy in May 1994, the United Nations announced that it was necessary to hold an international conference on natural disaster reduction to assess the achievement of the goals previously set for IDNDR in Yokohama, Japan.

At the meeting, Yokohama's strategy and its plan of action were formulated to create a more secure world, as it was recognized that humanity needs world-class risk management. Since the prevention of disasters is the most important long-term solution to this threat, the biggest challenge of the decade was to create a global prevention culture. In this context, the IDNDR Secretariat at the United Nations organized the Forum IDNDR program in the final years of this decade. Following the positive advances made by the United Nations and a number of countries in the 1990s, the UN General Assembly set up an international agency in December 1999 called the International Strategy for Disaster Reduction (ISDR).

2) The HYOGO Framework for Action (HFA):

When the Kobe area was severely affected by the 7.7 magnitude, Great Hanshin Awaji earthquake on January 17, 1995, Japan, which was prepared to respond to major disasters, was once again evaluated in this respect. In the Kobe earthquake, which affected vast areas in Hyogo, about 6400 people died and 40000 were injured.

In 2005, 168 countries gathered at the international conference on disaster reduction in Kobe, Japan and designed the Hyogo Framework for Action during the years 2005 to 2015, in order to make nations and communities resilient against disasters. The10-year program, called the HFA plan, has led the international community to adopt a more comprehensive and holistic approach to mitigate disaster risk.

It also called for countries to pursue 3 strategic goals during the decade,including:

(1) Integrate Disaster Risk Reduction (DRR) programs into all sustainable development policies and programs, (2) Develop and strengthen institutions, mechanisms, and capacities to create resiliency against hazards, and (3)The systematic implementation of risk reduction approaches in implementing emergency preparedness, response and recovery.

3) The Post-2015 Framework (Post-HFA):

After the huge tsunami following the 9-magnitude earthquake on March 11, 2011, in Sendai, Japan, infrastructure and buildings remained intact, largely due to Japan's resiliency and law enforcement, especially in construction and earthquake-related technology.

After that, the third world conference on disaster reduction was held to examine the outcome of the years of preparedness which was decided upon after the implementation of the Hyogo frame-work in 2015, and to formulate a new global framework. At this time, the international community's desire was to continue to make progress with respect to the international cooperation to reduce the risk of disasters based on knowledge, practice, and the implementation of each of the previous efforts.

The elements that were proposed in the new framework, after the2015 program, at the Sendai world summit on disaster reduction, include goals and recommendations. The objective of this DRM framework was to develop at the local, national, regional, and global levels in order to make people, communities and countries resilient. Some of the recommendations presented in this regard included guiding principles, implementation measures, and areas of focus (including public awareness and education, international cooperation, monitoring, reporting, and reviewing).

Another important issue discussed at this meeting was how to change the previous measures to the necessary measures based on the new framework. It is worth noting that the points that were specified as the global aims, encompassing reducing disaster losses by 50% by 2025 (or by a certain percentage over a given period);the reduction of disaster-induced economic damages by 2025;and the reduction of disaster-related damages to housing, education, and health services by the year 2025.

❖ Causes and Effects of DISASTER:

A disaster is a mishap or hazard which causes huge loss of life and property and disrupts the balance of the economy. It is a tragic event with drastic consequences for living beings as well as social and individual development.

A disaster can be caused by either natural or man-made factors. Both these factors need to be taken care of to prevent a disaster or lessen its impact. Disasters also arise due to inefficient management of risks. If a safety net is devised to address the potential risks, it would lead to reduction in damages triggered by disasters. Developing countries are more vulnerable to disasters.

Causes of Disasters:

Based on the type of disaster, natural or man-made, the causing agent changes. Generally, natural disasters are caused by shifts in air pressure, abnormal seismic activity, soil erosion, and others. While the majority of manmade disasters are due to human negligence. Some of the major causes of Disasters are

Political Issues – Enmity between countries often creates friction leading to wars and famine among the people which led to severe starvation and death. These issues can be avoided by accepting and finding a solution through steady cooperation.

Industrialization – Due to the rapid use of products by humans on a large scale, the consumption of resources has increased which has also increased waste production. This has led to various diseases and a scarcity of valuable resources.

Environment Degradation – Due to the increase in development activities, humans have degraded the environment through mining, and deforestation, which has increased the danger of earthquakes, and floods.

Effects of Disasters

Here are some of the effects of Disaster management –
Disasters affect people physically (diseases, disability, or death) as well as psychologically
It can cause a shortage of essential items like food and clean water.
It forces people in the affected region to relocate which comes with a new set of challenges like poverty and a clean environment.
Likewise, it also draws a heavy load on a country's economy.
Extinction of different bio diversities like flora and fauna is possible because of disasters.

❖ Disaster Management Cycle:

Disaster Risk Management includes sum total of all 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.
Let's take a closer look at what the disaster management phases mean and how a facility condition assessment helps you in each one.

Phase 1: Mitigation

Meaning: To prevent future emergencies and take steps to minimize their effects

The mitigation phase occurs before a disaster takes place. Here, an organization will take steps to protect people and property, while also decreasing risks and consequences from a given disaster situation. The organization's main goal is to reduce vulnerability to disaster impacts (such as property damage, injuries, and loss of life).

Examples of mitigation may can include measures such as:

- Clearing space around buildings to create a defensible space against fires.
- Improving property drainage to protect from flooding.
- Securing walls to help prevent damage/injuries during earthquakes.
- Re-locating structures to less disaster-prone areas.

Phase 2: Preparedness

Meaning: To take actions ahead of time to be ready for an emergency.

Examples of preparedness include hosting training, education, drills, tabletop exercises, and full-scale exercises on disaster preparedness. This ensures that stakeholders know what to do in the event of an emergency. Updating egress plans also falls under preparedness.

Organizations may also assemble a team to create a business continuity plan and list of resources needed to recover from a disaster.

Phase 3: Response

Meaning: To protect people and property in the wake of an emergency, disaster, or crisis.

The response phase occurs in the immediate aftermath of a disaster. Organizations must focus their attention on addressing immediate threats to people, property, and business. Occupant safety and wellbeing largely depends on your preparedness levels before disaster strikes.

The most notable example of the response phase is ensuring that people are out of harm's way. The organization can then move on to assess damage, implement disaster response plans, triage cleanup efforts, and start resource distribution as necessary.

Phase 4: Recovery

Meaning: To rebuild after a disaster in an effort to return operations back to normal

The recovery phase takes place after a disaster. This phase is the restoration of an organization following any impacts from a disaster. By this time, the organization has achieved at least some degree of physical, environmental, economic and social stability.

An example of recovery is creating strategic protocols and action plans to address the most serious impacts of a disaster. The protocols should give clear steps to follow for various disaster events and cover multiple scenarios.

In this phase, the organization works to obtain new resources, rebuild or create partnerships, and implement effective recovery strategies. The organization also takes steps to reduce financial burdens and rebuild damaged structures.

❖Types of Disasters:

1.Natural disasters:

Natural disasters are those hazardous events which occur naturally. They are caused by sudden changes in the environment. Natural disasters include earthquakes, cyclones, volcanic eruptions, forest fires, tornadoes. They can cause heavy loss of life and damage to physical structures, leading to huge financial losses.

The magnitude of these disasters may vary. Every area is susceptible to its own set of natural disasters and thus it is important to take preventive measures accordingly. For example, the areas where tectonic plates are too close would be susceptible to earthquakes, whereas areas near volcanic formations would be more likely to suffer from volcanic eruptions. Governments must make necessary arrangements to protect people from area-specific natural disasters. This would ensure minimum damage.

One effective way to reduce the impact of disasters is to use latest technology.

Natural disasters can be of various kinds, the most prominent of which, have been listed as follows:

- Land-movement disasters: These kinds of disasters can further be classified into the following:

o Avalanches
o Earthquakes
o Landslides and mudflows
o Volcanic eruptions

- Water disasters: The various water disasters are:

o Floods
o Tsunamis

- Weather disasters: The disasters caused by weather disturbances are:

o Blizzards
o Cyclonic storms
o Droughts
o Hailstorms
o Tornadoes

- Natural fires (like forest fire)

2.Anthropogenic Disaster:

Anthropogenic disasters are threats that have an element of human intent, negligence or error or have witnessed failure of a man-made system. They are also known as man-made disasters since they are the result of a failing or error on the part of humans.

Man-made disasters are caused by human intervention or activities. These may be dangerous to life, physical elements or economic components of the environment and the resultant damage could prove disastrous for the whole economy. Man-made disasters occur due to a variety of reasons.

One reason is the hardened human attitudes and approaches to view things and situations in certain ways. These lead to man-made disasters such as big crimes, arson, civil disruption, war, and terrorism. accidents involving transport means such as cars, planes, ships, trains or space shuttles.

With the growing climatic changes and unstable landforms all over the world, human beings are becoming more vulnerable to disasters and hazards. The drastic changes in the weather patterns have also led to a number of occurrences of the disasters. Technological advancements and the growing population density have also contributed to the world becoming increasingly unsafe.

3. Technological Disaster:

A technological disaster is a sudden, catastrophic event caused by a breakdown in a technological system. These disasters can be caused by human error, dangerous procedures, or infrastructure failures. They can result in intense damage, such as:

Structural collapses, like bridges, mines, and buildings .

Industrial accidents, like chemical or nuclear explosions.

Long-term manmade disasters, like pollution.

The release of toxic substances or radiation.

Technological disasters often have little or no warning, and victims may not know they've been affected for years.

Difference between man-made and technological disaster:

Human-caused disaster are defined as those induced entirely or predominantly by human activities and choices. Technological disaster are also human-caused, but are defined as those that originate from technological or industrial conditions, dangerous procedures, or infrastructure failures.

❖ Disaster Risk:

Disaster risk is defined as the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time.
Risk is a function of the probability of particular hazardous event and the losses each would cause."

The level of risk depends upon:

- Nature of the hazard
- Vulnerability of the elements which are affected
- Capacity/Economic value of those elements

A community/locality is said to be at 'risk' when it is exposed to hazards and is likely to be adversely affected by its impact.

Disaster Risk Reduction(DRR):

Disaster risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development.
Disaster Risk Reduction can take place in the following ways:

1. **Mitigation:**

Mitigation embraces measures taken to reduce both the effect of the hazard and the vulnerable conditions to it in order to reduce the scale of a future disaster. Therefore mitigation activities can be focused on the hazard itself or the elements exposed to the threat. Examples of mitigation measures which are hazard specific include water management in drought prone areas, relocating people away from the hazard prone areas and by strengthening structures to reduce damage when a hazard occurs.

2.Preparedness:

This protective process embraces measures which enable governments, communities and individuals to respond rapidly to disaster situations to cope with them effectively. Preparedness includes the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories 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. Preparedness therefore encompasses those measures taken before a disaster event which are aimed at minimizing loss of life, disruption of critical services, and damage when the disaster occurs.

❖ Vulnerability:

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

Vulnerabilities can be categorized into:

1. Physical vulnerability
2. Socio-economic vulnerability

1.Physical Vulnerability: It includes notions of who and what may be damaged or destroyed by natural hazard such as earthquakes or floods. It is based on the physical condition of people and elements at risk, such as buildings, infrastructure etc; and their proximity, location and nature of the hazard. It also relates to the technical capability of building and structures to resist the forces acting upon them during a hazard event.

2.Socio-economic Vulnerability: The degree to which a population is affected by a hazard will not merely lie in the physical components of vulnerability but also on the socioeconomic conditions. The socio-economic condition of the people also determines the intensity of the impact. For example, people who are poor and living in the sea coast don't have the money to construct strong concrete houses. They are generally at risk and lose their shelters whenever there is strong wind or cyclone. Because of their poverty they too are not able to rebuild their houses.

Causes of Vulnerability

Vulnerability to disasters can be caused by a combination of social, economic, environmental, and institutional factors:

1.Social factors

These include culture, social diversity, gender roles, power and privilege, low wages, and age. Social factors are considered one of the most important causes of vulnerability.

2.Economic factors

Communities with lower economic standing have fewer resources to withstand disasters.

3.Environmental factors

Environmental degradation can increase the intensity of natural disasters and make communities more vulnerable to their effects. Climate change can also increase the risk of disasters by reducing the availability of water and food.

4.Institutional factors

Institutional failures can create or magnify vulnerability through human decisions and actions that exacerbate social and political inequities.

❖ Capacity:

Capacity can be defined as “resources, means and strengths which exist in households and communities and which enable them to cope with, withstand, prepare for, prevent, mitigate or quickly recover from a disaster”.

Capacities could be:

1. Physical capacity
2. Socio-economic capacity

1.Physical Capacity: People whose houses have been destroyed by the cyclone or crops have been destroyed by the flood can salvage things from their homes and from their farms. Some family members have skills, which enable them to find employment if they migrate, either temporarily or permanently.

2.Socio-economic Capacity: In most of the disasters, people suffer their greatest losses in the physical and material realm. Rich people have the capacity to recover soon because of their wealth. In fact, they are seldom hit by disasters because they live in safe areas and their houses are built with stronger materials.

❖ Levels of Capacity:

The three levels of capacity in disaster management are individual, organizational, and enabling environment:

- **Individual level**: The skills, experience, and knowledge of people
- **Organizational level:** The internal structure, policies, systems, and procedures of an organization
- **Enabling environment:** The broader system within which individuals and organizations function

Capacity is the combination of resources, strengths, and attributes available to manage and reduce disaster risks. It can also refer to the ability of people, organizations, and systems to manage adverse conditions, risk, or disasters.

Some principles for effective capacity building include:

- Flexibility and adaptability
- Comprehensive planning
- Ownership and partnership
- Attention to functional capacity
- Integration of actors and scales
- Contribution to disaster risk reduction

❖Global Disaster Risk Trends:

Disaster risk trends are a measure of the sustainability of development. Trend analysis helps us to understand patterns of disaster risk and, consequently, whether disaster risk reduction is being effective.

Global Disaster Risk Trends include:

Increased number of disasters: The number of natural-hazard induced disasters has increased fivefold since the 1970s.

Increased frequency and intensity of climate-related disasters: The number of climate-related disasters and extreme weather events increased from 3,600 in 1980-99 to 6,700 in 2000-19.

Water-related disasters are the most common: Water-related disasters are the most common natural and anthropogenic adversity.

Population growth and infrastructure development increase exposure to natural hazards: The world's exposure to natural hazards is increasing due to population growth and infrastructure development, especially in coastal areas.

Risk of dying in a natural disaster is falling: The global risk of dying in a natural disaster is likely falling.

Financial losses per unit of wealth are rising: Global financial losses per unit of wealth are rising.

Low income countries suffer disproportionately in terms of fatalities: Low income countries disproportionately account for disaster fatalities.

Emerging and developed economies record higher economic losses: Emerging and developed economies record higher economic losses as more people and assets are located in hazard-prone areas.

The United Nations Office for Disaster Risk Reduction **(UNDRR)** works to investigate the state of risk across the globe every two years.
The year 2020 rivaled 2016 as the world's hottest recorded year. Apart from the COVID-19 pandemic, the year was dominated by climate-related disasters. These were largely responsible for the 389 recorded events which resulted in 15,080 deaths, 98.4 million people affected, and economic losses of at least US$ 171.3 billion.
The statistics used in this report are drawn from the latest updates in the emergency events database, EM-DAT, maintained by the Centre for Research on the Epidemiology of Disasters (CRED, UClouvain).
In comparison to the previous two decades(2000-2019), **2020** was higher than the annual average in terms of number of recorded events and the annual average of economic losses, which is US$ 151.6 billion1. There were considerably fewer deaths compared to the annual average of 61,709 and fewer people directly affected compared to the annual average of 201.3 million people. This decrease in impacts is due to the absence of mass casualty events, such as the **2004 Indian Ocean Tsunami (227,000 deaths)** and the **2010 Haiti Earthquake (222,500 deaths)** or high impact events, such as the 2015/2016 drought in India(330 million people affected). However, in 2020 there were 26% more storms than the annual average of 102 events, 23% more floods than the annual average of 163 events, and 18% more flood deaths than the annual average of 5,233 deaths.

The impacts of the events were not equally shared: Asia experienced 41% of disaster events and 64% of total people affected. Heat waves in Europe accounted for 42% of total reported deaths2 . In a year of record-breaking storms and wildfires the Americas suffered 53% of total economic losses, largely in the USA which experienced the bulk of the year's most costly climate-related disasters.

Indonesia had the highest number of disasters (29 total events), including 25 floods. However, India and China suffered the largest human impacts with 19.6 million people and 14.9 million people affected, respectively. Floods were the most common disasters worldwide (201 events), while storms affected the highest number of people (45.5 million) and caused the most economic losses (US$92.7 billion). Extreme temperatures were the deadliest type of disasters accounting for 42% of total deaths2, followed closely by floods which accounted for 41% of total deaths.

Summer heat waves in Europe were the deadliest events for the 2nd year in a row. Heat waves in France, Belgium, the Netherlands, and the UK caused a total of 6,340 deaths,2 more than double the figures for heat waves in 2019.

The impact of floods was felt heavily throughout Africa and Asia. In Africa, floods affected seven million people and caused 1,273 deaths.

In India, flooding was responsible for the 3rd deadliest event of the year costing 1,922 lives. China also faced significant flooding as a series of four summer floods across the country killed a total of 397 people, affected 14.3 million people, and caused US$ 21.8 billion in economic losses.

❖ Costs and Frequencies of Disaster Trends:

Frequency:

Frequency is the recurrence interval of the disaster. The number of weather, climate, and water-related disasters has increased fivefold over the past 50 years, with one disaster occurring every day on average.

The frequency, complexity and severity of their impacts are likely to increase in the future due to factors such as climate change, displacement, conflict, rapid and unplanned urbanization, technological hazards and public health emergencies.

Different regions have experienced different impacts from disasters, including:

North America, Central America, and the Caribbean: This region accounted for 46% of reported economic losses worldwide between 1970 and 2021.

Europe: Extreme temperatures were the leading cause of reported deaths, and floods were the leading cause of economic losses.

South America: Floods accounted for 61% of the reported disasters.

Cost:

The economic cost of these disasters has also been increasing, reaching $4.3 trillion between 1970 and 2021.

The global cost of climate change damage is estimated to be between $1.7 trillion and $3.1 trillion per year by 2050. This includes the cost of damage to infrastructure, property, agriculture, and human health. This cost is expected to increase over time as the impacts of climate change become more severe.

❖ Historical Review of Disaster Trends:

Here are some historical trends in disasters:

Natural disasters

In the past decade, earthquakes have caused the most deaths globally. Over the same period, natural disasters have killed nearly half a million people worldwide.

Climate and weather-related disasters

Over the past 50 years, the number of climate and weather-related disasters has increased five-fold.

Pakistan's floods

Pakistan has experienced 28 super riverine floods in its 75-year history. The worst flood in the country's history occurred in 2010. Major floods occurred in 2010, 2011, 2014,2020 and 2022, affecting millions of people and causing extensive damage to infrastructure, crops, and livelihoods. Pakistan's most recent natural disaster was the 2022 floods, which were caused by heavy monsoon rains.

Causes:

The floods were caused by a series of intense monsoon rains from early July to late August. The rains were linked to climate change.

Impact:

The floods killed at least 1,739 people, injured nearly 13,000, and displaced an estimated 8 million people. They also caused Rs 3.2 trillion ($14.8 billion) of damage and Rs 3.3 trillion ($15.2 billion) of economic losses.

Effects:

The floods damaged most of the water systems in the affected areas, forcing people to rely on contaminated water. Unsafe water and poor sanitation led to malnutrition and diseases like diarrhea.

Response:

Pakistan declared a state of emergency on August 25, 2022. Medical camps were established, and international, national, and provincial organizations provided medical assistance.

Pakistan is one of the countries most vulnerable to the effects of climate change. Natural hazards in Pakistan are likely to increase, and communities need to be prepared to cope.

Some Bigger Disasters in world:

Deadliest natural disasters by highest estimated death toll excluding epidemics and famines. This list takes into account only the highest estimated death toll for each disaster and lists them accordingly.

Estimated Deaths	Events	Location
4million	1931 China floods	China
2million	1887 Yellow River flood	China
655,000	1976 Tangshan earthquake	China
500,000	1970 Bhola cyclone	East Pakistan (now Bangladesh)
316,000	2010 Haiti earthquake	Haiti
3Lac	1839 Coringa cyclone	Andhra Pradesh, India
3Lac	1737 Calcutta cyclone	Bengal, India
273,000	1920 Haiyuan earthquake	China

Some Bigger Disaster in Pakistan:

Disaster	Occurrence	Deaths
Earthquake	May 31, 1935	60,000
Earthquake	Nov 27, 1945	4,000
Flood	1950	2,900
Wind storm	Karachi, 1965	10,000
Earthquake	Dec 28, 1974	5,300
Flood	Sep 1992	1,334
Wind storm	Nov 14, 1993	609
Flood	Mar 3, 1998	1,000
Earthquake	Oct 8, 2005	87,351
Flood	Jul/Aug 2010	1700

❖ Economic Impacts of Disaster:

Economic losses from natural disasters have been increasing in recent decades. This has been attributed mainly to population and economic growth in disaster-prone areas. Future natural disaster losses are expected to increase due to a continued increase in economic exposure and climate change. This highlights the importance of designing policies that can mitigate the impacts of these disasters on the economy and society.

The Economic Impacts of Natural Disasters: This focuses on the direct and indirect economic effects of natural disasters. It discusses how direct impacts, such as damage to property, can lead to indirect impacts, such as changes in economic activity.

The economic impact of a disaster can include:

Direct impacts: Damage to assets, such as property, infrastructure, crops, and livestock

Indirect impacts: Changes in economic activity, such as loss of revenues, unemployment, and market destabilization.

Nearly every study of natural disasters finds short-term declines in either income or employment. A study of major hurricane strikes in US coastal counties finds that hurricanes cause county-level personal income growth to fall by 0.45 percentage points in the year of the impact, which represents over 25% of the mean growth rate. A global study of 53 major floods, each of which displaced at least 100,000 people and affected primarily poor countries, finds that the floods reduced economic activity in cities.

❖ Social Impacts of Disasters:

“Social impact means looking at how natural disasters affect individuals in the community, and it goes way beyond just dealing with casualties and property damage. It's about working directly with the people.”

Disasters can have many social impacts, including:

Displacement:

Disasters can disrupt social arrangements and cultural practices, and may require the establishment of new settlements. Resettlement can be a complex process that involves political, economic, social, and cultural issues.

Health impacts:

Disasters can cause short-term deaths from infectious, parasitic, or respiratory diseases. In the medium term, disasters can lead to deaths from deteriorating living conditions, poverty, and malnutrition.

Household impacts:

Disasters can impact households' well-being by affecting their income, productivity, dwelling units, assets, health, and education. Disasters can also impact access to utilities like electricity, water, and sanitation.

Loss of life and property:

Disasters can lead to loss of life, property damage, crop destruction, and livestock loss.

❖ Environmental Impact of Disaster:

Disasters can have many environmental impacts, including:

Ecosystem disruption:

Disasters can disrupt the natural ecosystem, affecting the habitats of fish, shellfish, birds, insects, and mammals.

Water quality:

Disasters can impact water quality when sewage treatment facilities flood, or when debris enters waterways and reservoirs.

Infrastructure damage:

Disasters can damage infrastructure like bridges, roads, transmission lines, and oil and gas pipelines.

Wildlife impact:

Disasters can kill wildlife directly, or impact them indirectly by changing their food availability and habitat.

Endangered species vulnerability:

Endangered species are especially vulnerable when their habitat is destroyed.

❖ Impacts of Disaster on Infrastructure:

Disasters can have a significant impact on infrastructure, causing physical damage and operational failures. The consequences of this damage can be far-reaching, affecting the economy, society, and the environment.

The consequences of infrastructure failure can be significant - disruption to households and businesses and may result in evacuations, business closures, economic loss and clean-up costs, potential health hazards and environmental impacts.

- Damaged infrastructure may reduce access to certain resources or income-generating activities, making them less resilient to new and emerging risks.
- To help reduce the impact of disasters on infrastructure, governments can:
- Invest in building more resilient infrastructure.
- Identify climate change-related risks in the procurement process.
- Prohibit construction in flood or landslide prone areas .
- Define strict construction standards
- Improve early-warning systems .
- Provide better public information about evacuation plans.

❖ Climate Change:

Definition:

Climate change is a long-term shift in a region's average weather conditions, such as temperature, rainfall, and windiness.

Causes:

Human activities are the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil, and gas. These activities generate greenhouse gases that trap the sun's heat and raise temperatures.

Effects:

Climate change can cause many effects, including:

- Changes in rainfall, droughts, increasing floods, and heat waves
- The ocean becoming more acidic
- The ice caps melting
- Sea levels rising

Impacts:

Climate change can have immediate or indirect effects on human systems, such as food and agricultural, human health and well-being, and the built environment

❖ MAJOR DISASTERS:

❑ EARTHQUAKES

Definition:

Earthquake can be defined as the sudden shaking of the earth crust. It is one of the most destructive natural hazards. They may occur at any time of the year, day or night, with sudden impact and little warning.

Causes of Earthquake:

The earth's crust is a rocky layer of varying thickness ranging from a depth of about 10 kilometers under the sea to 65 kilometers under the continents. The crust is not one piece but consists of portions called 'plates' which vary in size from a few hundred to thousands of kilometers.

An earthquake happens when two blocks of the earth suddenly slip past one another. The surface where they slip is called fault plane. The location below the earth's surface where the earthquake starts is called the **hypocenter,** and the location directly above it on the surface of the earth is called **the epicenter**.

Earthquakes are primarily caused by the movement of tectonic plates, which make up the Earth's outer shell. When these plates interact, they can either collide, move apart, or slide past each other. This movement creates stress along faults, and when this stress exceeds the strength of the rocks, it is released in the form of **seismic energy.**

These stresses can be classified according to the type of movement along the plate's boundaries:

a) Pulling away from each other,

b) Pushing against one another and

c) Sliding sideways relative to each other.

All these movements are associated with earthquakes.

Earthquakes are recorded by instruments called **seismographs**. The recording they make is called a **seismogram.** Earthquake magnitude or amount of energy released is determined by the use of a seismograph' which is an instrument that continuously records ground vibration. . An earthquake with a magnitude 7.5 on the Richter scale releases 30 times the energy than one with 6.5 magnitudes. An earthquake of magnitude 3 is the smallest normally felt by humans.

The largest earthquake that has been recorded with this system is 9.25 (Alaska, 1969 and Chile, 1960).

Types of Earthquakes:

Earthquakes can be of three types based on the focal depth:

(i)Deep:- 300 to 700 kms from the earth surface

(ii)Medium:- 60 to 300 kms

(iii)Shallow: less than 60 kms

The deep focus earthquakes are rarely destructive because by the time the waves reach the surface the impact reduces. Shallow focus earthquakes are more common and are extremely damaging because of their proximity to the surface.

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Effects of Earthquakes:

- Damage occurs to human settlement, buildings, structures and infrastructure,
- especially bridges, elevated roads, railways, water towers, pipelines, electrical
- generating facilities.
- Aftershocks of an earthquake can cause much greater damage to already weakened
- structures.
- Secondary effects include fires, dam failure and landslides which may block water
- ways and also cause flooding.
- Damage may occur to facilities using or manufacturing dangerous materials resulting in possible chemical spills.
- There may also be a breakdown of communication facilities.
- There are large number of casualties because of the poor engineering design of the buildings and close proximity of the people. About 95 per cent of the people who are killed or who are affected by the earthquake is because of the building collapse.
- There is also a huge loss to the public health system, transport and communication and water supply in the affected areas.

Possible risk reduction measures:

Community preparedness: Community preparedness is vital for mitigating earthquake impact. The most effective way to save you even in a slightest shaking is 'DROP, COVER and HOLD'.

Public education: Public education is educating the public on causes and characteristics of an earthquake and preparedness measures. It can be created through sensitization and training programm for community, architects, engineers, builders, masons, teachers, government functionaries teachers and students.

Engineered structures:

Buildings need to be designed and constructed as per the building by laws to withstand ground shaking. Architectural and engineering inputs need to be put together to improve building design and construction practices. The soil type needs to be analyzed before construction. Building structures on soft soil should be avoided. Buildings on soft soil are more likely to get damaged even if the magnitude of the earthquake is not strong. Similar problems persist in the buildings constructed on the river banks which have alluvial soil.

❑ FLOODS

Definition:

Flood is a state of high water level along a river channel or on the coast that leads to inundation of land, which is not usually submerged. Floods may happen gradually and also may take hours or even happen suddenly without any warning due to breach in the embankment, spill over, heavy rains etc.

Types of Floods:

Riverine Floods: These occur when rivers overflow their banks due to excessive rainfall or snowmelt. Riverine floods typically develop more slowly and can be predicted in advance to some extent.

Flash Floods: Flash floods due to heavy rainfall, dam breaks, or sudden stormwater runoff. They can be extremely dangerous due to their sudden and unpredictable nature.

Coastal Flooding: Coastal flood due to storms, hurricanes, or high tides. It can lead to significant damage.

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Causes of Floods:

- Heavy rainfall
- Heavy siltation of the river bed reduces the water carrying capacity of the rivers/stream.
- Blockages in the drains lead to flooding of the area.
- Landslides blocking the flow of the stream.
- Construction of dams and reservoirs
- In areas prone to cyclone, strong winds accompanied by heavy down pour along with storm surge leads to flooding.

With the advancement of technology such as satellite and remote-sensing equipments flood waves can be tracked as the water level rises.

Heavy precipitation will give sufficient warning of the coming river flood.

High tides with high winds may indicate flooding in the coastal areas.

Effects of Floods:

- The most important consequence of floods is the loss of life and property.
- Structures like houses, bridges; roads etc. get damaged by the gushing water, landslides triggered on account of water getting saturated, boats and fishing nets get damaged. There is huge loss to life and livestock caused by drowning.
- Lack of proper drinking water facilities, contamination of water (well, ground water, piped water supply) leads to outbreak of epidemics, diarrhoea, viral infection, malaria and many other infectious diseases.
- Flooding also leads to a large area of agricultural land getting inundated as a result there is a huge crop loss. This results in shortage of food, and animal fodder.

- Floods may also affect the soil characteristics. The land may be rendered infertile due to erosion of top layer or may turn saline if sea water floods the area.

Possible Risk Reduction Measures:

Mapping of the flood prone areas is a primary step involved in reducing the risk of the region. Historical records give the indication of the flood inundation areas and the period of occurrence and the extent of the coverage. Warning can be issued looking into the earlier marked heights of the water levels in case of potential threat. In the coastal areas the tide levels and the land characteristics will determine the submergence areas. Flood hazard mapping will give the proper indication of water flow during floods.

Land use control will reduce danger of life and property when waters inundate the flood plains and the coastal areas. The number of casualties is related to the population in the area at risk.No major development should be permitted in the areas which are subjected to high flooding. Important facilities like hospitals, schools should be built in safe areas

Construction of engineered structures in the flood plains and strengthening of structures to withstand flood forces and seepage. The buildings should be constructed on an elevated area. If necessary build on stilts or platform.

Flood Control aims to reduce flood damage. This can be done by decreasing the amount of runoff with the help of reforestation, protection of vegetation, clearing of debris from streams and other water holding areas, conservation of ponds and lakes etcDams can store water and can release water at a manageable rate. Flood Proofing reduces the risk of damage. Measures include use of sand bags to keep flood water away, blocking or sealing of doors and windows of houses etc. Houses may be elevated by building on raised land. Buildings should be constructed away from water bodies.

❖ CYCLONES

Definition:

Cyclone is a region of low atmospheric pressure surrounded by high atmospheric pressure resulting in swirling atmospheric disturbance accompanied by powerful winds blowing in anticlockwise direction in the Northern Hemisphere and in the clockwise direction in the Southern Hemisphere. They occur mainly in the tropical and temperate regions of the world.

The development of a cyclone covers three stages namely

(a) Formation and initial development state

(b) Fully matured

(c) Weakening or decay

Low pressure and the development can be detected hours or days before it causes damage. The satellites track the movement of these cyclones based on which the people are evacuated from areas lively to be affected. It is difficult to predict the accuracy.

Effects of Cyclones:

High winds cause major damage to infrastructure and housing, in particular fragile constructions. They are generally followed by heavy rains and floods and, in flat coastal areas by storm surge riding on tidal waves and inundating the land over long distances of even up to 15 kilometers inland.

Physical damage: structures will be damaged or destroyed by the wind force, flooding and storm surge. Light pitched roofs of most structures especially the ones fitted on to industrial buildings will suffer severe damage.

Casualties and public health: caused by flooding and flying elements, contamination of water supplies may lead to viral outbreaks and malaria.
Communication: severe disruption in the communication links as the wind may bring down the electricity and communication towers, telephone poles, telephone lines, antennas and satellite disk and broadcasting services. Transport lines (road and rail) may be curtailed, Lack of proper communication affects effective distribution of relief materials.
Possible Risk Reduction Measures:
Coastal belt plantation - Green belt plantation along the coastal line in a scientific interweaving pattern can reduce the effect of the hazard. Providing a cover through green belt sustains less damage. Forests act as a wide buffer zone against strong winds and flash floods. Without the forest the cyclone travel freely inland. The lack of protective forest cover allows water to inundate large areas and cause destruction. With the loss of the forest cover each consecutive cyclone can penetrate further inland.
Hazard mapping – Meteorological records of the wind speed and the directions give the probability of the winds in the region. Cyclones can be predicted several days in advance. The onset is extensive and often very destructive. Past records and paths can give the pattern of occurrence for particular wind speeds. A hazard map will illustrate the areas vulnerable to cyclone in any given year. It will be useful to estimate the severity of the cyclone and various damage intensities in the region..
Engineered structures – structures need to be built to withstand wind forces. Good site selection is also important. Majority of the buildings in coastal areas are built with locally available materials and have no engineering inputs. Good construction practice should be Adopted.

❑ TSUNAMI

Definition:

The term Tsunami has been derived from a Japanese term Tsu meaning 'harbor' and nami meaning 'waves'. Tsunamis are popularly called tidal waves but they actually have nothing to do with the tides. These waves which often affect distant shores, originate by rapid displacement of water from the lake or the sea either by seismic activity, landslides, volcanic eruptions or large meteoroid impacts. Whatever the cause may be sea water is displaced with a violent motion and swells up, ultimately surging over land with great destructive power.

Causes of Tsunami:

The geological movements that cause tsunamis are produced in three major ways.

Earthquake: The most common of these are fault movements on the sea floor, accompanied by an earth-quake. They release huge amount of energy and have the capacity to cross oceans. The degree of movement depends on how fast the earthquake occurs and how much water is displaced.

Landslide: The second most common cause of the tsunami is a landslide either occurring under water or originating above the sea and then plunging into the water. The largest tsunami ever produced by a landslide was in Lituya Bay, Alaska 1958. The massive rock slide produced a wave that reached a high water mark of 50 - 150 meters above the shoreline.

Volcano: The third major cause of tsunami is volcanic activity. The flank of a volcano located near the shore or under water may be uplifted or depressed similar to the action of a fault, or, the volcano may actually explode.

In 1883, the violent explosion of the famous volcano, Krakotoa in Indonesia, produced tsunami measuring 40 meters which crushed upon Java and Sumatra. Over 36,000 people lost their lives in this tyrant waves.

Effects of Tsunami:

- Local tsunami events or those less than 30 minutes from the source cause the majority of damage. The force of the water can raze everything in its path.
- Damage to ports and airports may prevent importation of needed food and medical supplies.
- Apart from the physical damage, there is a huge impact on the public health system.
- Deaths mainly occur because of drowning as water inundates homes. Many people get washed away or crushed by the giant waves and some are crushed by the debris, causes.
- Availability of drinking water has always been a major problem in areas affected by a disaster.
- Sewage pipes may be damaged causing major sewage disposal problems.
- Open wells and other ground water may be contaminated by salt water and debris and sewage.
- Flooding in the locality may lead to crop loss, loss of livelihood like boats and nets, environmental degradation etc.

Possible risk reduction measures:

Site Planning and Land Management:

Engineering structures

Flood management

❑ DROUGHTS

Definition:

Drought is either absence or deficiency of rainfall from its normal pattern in a region for an extended period of time leading to general suffering in the society. It is interplay between demand that people place on natural supply of water and natural event that provides the water in a given geographical region.

It is a slow on-set disaster and it is difficult to demarcate the time of its onset and the end. Any unusual dry period which results in a shortage of useful water.

Drought is a normal, recurrent feature of climate. Climate is expected to show some aberrations and drought is just a part of it.

Drought can occur by improper distribution of rain in time and space, and not just by its amount.

Causes of Droughts:

- Deficit rainfall
- Over population
- Deforestation
- Soil erosion
- Excessive use of ground and surface water for growing crops
- Loss of biodiversity

Types of droughts:

Meteorological drought is simple absence or deficit of rainfall from the normal.

Hydrological drought:

Hydrological drought often leads to reduction of natural stream flows or ground water levels, plus stored water supplies.

Agricultural drought:

This form of drought occurs when moisture level in soil is insufficient to maintain average crop yields. An extreme agricultural drought can lead to a famine, which is a prolonged shortage of food in a restricted region causing widespread disease and death from starvation.

Effects of Droughts:

Typical adverse effects:

- As the meteorological drought turns into hydrological drought, the impacts start appearing first in agriculture which is most dependants on the soil moisture.
- Irrigated areas are affected much later than the rain fed areas.
- However, regions surrounding perennial rivers tend to continue normal life even when drought conditions are prevailing around. The impacts slowly spread into social fabric as the availability of drinking water diminishes, reduction in energy production, ground water depletion, food shortage, health reduction and loss of life, increased poverty, reduced quality of life and social unrest leading to migration.

Possible Risk Reduction Measures:

There are various mitigation strategies to cope up with drought.

Public Awareness and education: This includes awareness on the availability of safe drinking water, water conservation techniques, agricultural drought management strategies like crop contingency plans.

Drought Monitoring: It is continuous observation of the rainfall situation, availability of water in the reservoirs, lakes, rivers etc .

Water supply augmentation and conservation through rainwater harvesting in houses and farmers' fields increases the content of water available.

Expansion of irrigation facilities reduces the drought vulnerability.

Land use based on its capability helps in optimum use of land and water and can avoid the undue demand created due to their misuse.

❑ LANDSLIDES

Definition :

The term 'landslide' includes all varieties of mass movements of hill slopes and can be defined as the downward and outward movement of slope forming materials composed of rocks, soils, artificial fills or combination of all these materials along surfaces of separation by falling, sliding and flowing, either slowly or quickly from one place to another.

Causes of Landslides:

There are several causes of landslide. Some of the major causes are as follows:

Geological Weak material: Weakness in the composition and structure of rock or soil may also cause landslides.

Erosion: Erosion of slope toe due to cutting down of vegetation, construction of roads might increase the vulnerability of the terrain to slide down.

Intense rainfall: Storms that produce intense rainfall for periods as short as several hours or have a more moderate intensity lasting several days have triggered abundant landslides. Heavy melting of snow in the hilly terrains also results in landslide.

Human Excavation of slope and its toe, loading of slope/toe, draw down in reservoir, mining, deforestation, irrigation, vibration/blast, Water leakage from services.

Earthquake shaking has triggered landslides in many different topographic and geologic settings. Rock falls, soil slides and rockslides from steep slopes involving relatively thin or shallow disaggregated soils or rock, or both have been the most abundant types of landslides triggered by historical earthquakes.

Effects of Landslides:

- The most common elements at risk are the settlements built on the steep slopes, built at the toe and those built at the mouth of the streams emerging from the mountain valley.
- All those buildings constructed without appropriate foundation for a given soil and in sloppy areas are also at risk.
- Roads, communication lines are vulnerable.

Possible risk reduction measures:

Hazard mapping locates areas prone to slope failures. This will help to avoid building settlements in such areas. These maps will also serve as a tool for mitigation planning.

Land use practices such as:

- Areas covered by degraded natural vegetation in upper slopes are to be afforested with suitable species. Existing patches of natural vegetation (forest and natural grass land) in good condition, should be preserved
- In construction of roads, irrigation canals etc. proper care is to be taken to avoid blockage of natural drainage

- Total avoidance of settlement in the risk zone should be made mandatory.
- Relocate settlements and infrastructure that fall in the possible path of the landslide
- No construction of buildings in areas beyond a certain degree of slope

Retaining Walls can be built to stop land from slipping (these walls are commonly seen along roads in hill stations). These are constructed to prevent smaller sized and secondary landslides that often occur along the toe portion of the larger landslides.

Engineered structures with strong foundations can withstand or take the ground movement forces. Underground installations (pipes, cables, etc.) should be made flexible to move in order to withstand forces caused by the landslide.

❑ FOREST FIRES

Definition:

The most common hazard in forests is forests fire. Forests fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark.

Causes of Forest Fires:

Natural causes- Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) offer favorable circumstance for a fire to start.

Man made causes- Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material.

Effects of Forest Fires:

Fires are a major cause of forest degradation and have wide ranging adverse ecological, economic and social impacts, including:

- Loss of valuable timber resources
- Degradation of catchment areas
- Loss of biodiversity and extinction of plants and animals
- Loss of wildlife habitat and depletion of wildlife
- Loss of natural regeneration and reduction in forest cover
- Global warming
- Loss of carbon sink resource and increase in percentage of CO2 in atmosphere
- Change in the microclimate of the area with unhealthy living conditions
- Soil erosion affecting productivity of soils and production
- Ozone layer depletion
- Health problems leading to diseases
- Loss of livelihood for tribal people and the rural poor, as approximately 300 million people are directly dependent upon collection of non-timber forest products from forest areas for their livelihood.

Possible risk reduction measures:

- Prevention of human-caused fires through education and environmental modification.

It will include cultural activities, engineering works, people participation, and education and enforcement. It is proposed that more emphasis be given to people participation through Joint Forest Fire Management for fire prevention.

- Prompt detection of fires through a well coordinated network of observation points, efficient ground patrolling, and communication networks. Remote sensing technology is to be given due importance in fire detection. For successful fire management and administration, a National Fire Danger Rating System (NFDRS) and Fire Forecasting System are to be developed in the country.
- Fast initial attack measures.
- Vigorous follow up action.
- Introducing a forest fuel modification system at strategic points.
- Fire fighting resources.

❑ HEAT WAVES

Definition:

Heat-wave is a condition of atmospheric temperature that leads to physiological stress, which sometimes can claim human life.

Heat-wave is defined as the condition where maximum temperature at a grid point is 3˚C or more than the normal temperature, consecutively for 3 days or more.

World Meteorological Organization defines a heat wave as five or more consecutive days during which the daily maximum temperature exceeds the average maximum temperature by five degrees Celsius. If the maximum temperature of any place continues to be more than 45° C consecutively for two days, it is called a heat wave condition. There will be no harm to the human body if the environmental temperature remains at 37° C. Whenever the environmental temperature increases above 37° C, the human body starts gaining heat from the atmosphere. If humidity is high, a person can suffer from heat stress disorders even with the temperature at 37°C or 38°C.

Causes of Heat waves:

A heat wave occurs when a system of high atmospheric pressure moves into an area. In such a high-pressure system, air from upper levels of our atmosphere is pulled toward the ground, where it becomes compressed and increases in temperature. This high concentration of pressure makes it difficult for other weather systems to move into the area, which is why a heat wave can last for several days or weeks. The longer the system stays in an area, the hotter the area becomes. The high-pressure inhibits winds, making them faint to-nonexistent. Because the high-pressure system also prevents clouds from entering the region, sunlight can become punishing, heating up the system even more. The combination of all of these factors come together to create the exceptionally hot temperatures we call a heat wave.

Effects of Heat waves:

- Heat waves causes serious health risks like dehydration, heat rash, heat cramps, sunburn, heat exhaustion, heat stroke etc.
- Excessive heat causes psychological stress
- Abnormally hot temperatures cause electricity demand to increase during the peak summertime hours which leads to electricity spikes due to increased air conditioning use, which can create power outages. As a result, available electricity supplies are challenged during a higher, wider, peak electricity consumption period.
- If a heat wave occurs during a drought, which dries out vegetation, it can contribute to bushfires and wildfires.
- Heat waves can cause roads and highways to buckle and melt water lines to burst, and power transformers to detonate, causing fires.

Possible risk reduction measures:

Establish Early Warning System and Inter-Agency Coordination to alert residents on predicted high and extreme temperatures. Who will do what, when, and how is made clear to individuals and units of key departments, especially for health.

Capacity building / training program for health care professionals at local level to recognize and respond to heat-related illnesses, particularly during extreme heat events. These training programs should focus on medical officers, paramedical staff and community health staff to reduce mortality and morbidity.

Public Awareness and community outreach Disseminating public awareness messages on how to protect against the extreme heat-wave through print, electronic and social media and Information, Education and Communication (IEC) materials such as pamphlets, posters and advertisements and Television Commercials (TVCs) on Do's and Don'ts and treatment measures for heat related illnesses.

Collaboration with non government and civil society: Collaboration with nongovernmental organizations and civil society organizations to improve bus stands, building temporary shelters, wherever necessary, improved water delivery systems in public areas.