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Basics of Disaster

1.1. Understanding the concept and meaning of disaster

Disaster means any occurrence, mishap or calamity, in an area that causes damage to property and loss of human lives (or any other significant loss). This can be considered an odd event that results in extensive losses in terms of people, property and the environment. It can also be defined as a catastrophe, either natural or human-induced, that results in substantial loss of life or human suffering, causalities damage and destruction of the environment; and is of a nature or extent that exceeds the ability of the affected areas' community to cope, for example, an earthquake is a disaster only when it affects the people and their assets. The French word "Disastre", which combines the words "des", which means bad, and "astre" which means a "star" is where the word "disaster" originates. In earlier days, a disaster was considered due to some unfavorable star or misfortune. Nowadays, the term *disaster* is commonly used to denote any odd event which either natural or human-induced; this brings about immense misery to a region that is highly vulnerable to multiple disasters, and it becomes difficult to cope with the situation through local resources. In this situation, the community needs basic necessities such as shelter, food, clothing, medical assistance and social care. Disaster can be caused by a variety of factors, including environmental degradation, climate change and human activities. It can have wide-ranging and severe impacts on individuals, communities and societies, and results in ecological disruption, damage to buildings, roads, bridges and environmental loss. It can also affect health services and disrupt other essential services. The impacts of disasters can be both immediate and long term, affecting people and the environment. Communities can lessen the effects of catastrophes and improve their

protection by being informed of the different kinds of disasters. Disasters are events that cause widespread destruction, loss of life and disruption of the normal life system. Understanding the concept and root causes of disasters, we can together work toward preventing and effectively responding to these catastrophic events by reducing their impact on vulnerable populations to mitigate their impact. While some disasters are unavoidable, many can be prevented or mitigated through effective planning, early warning systems and community preparedness. By understanding the risks and vulnerabilities in a specific area, we can take steps to minimize the impact of disasters and protect the people at risk; therefore, by working together at different levels to support one another, we can better navigate the challenges presented by these disasters.

1.2. Classification of disasters

Disasters are sudden events that strike at any time and can have devastating effects on communities. It is important to understand the different types of disasters and how they are classified to better prepare and effectively respond to them to mitigate their impact. Disasters can be classified into several categories based on their cause and impact. These categories include natural disasters, man-made disasters, technological disasters and environmental disasters.

1) *Natural disasters*: these are the disasters that are caused by natural activities (processes) or natural phenomena, which means they are under the control of nature. These disasters are caused by natural forces, for example, droughts, tsunamis, floods, hurricanes, wildfires volcanic activities and earthquakes are exclusively of natural origin. These disasters can cause widespread damage to property and loss of life.

2) *Human-induced disasters*: these are the events that are triggered by human activities or result from human negligence or error. They are also called man-induced or anthropogenic disasters and are associated with human actions, such as industrial accidents, dam failure terrorist attacks, explosions, leakage of toxic or poisonous substances and oil spills. These disasters can also have serious impacts on humans and require immediate action to mitigate their impact. Human interaction with the environment has also resulted in some of the most major accidents.

1.2.1. *Other categories of disasters*

1) *Minor disaster*: a minor disaster is an event that causes limited damage and has a relatively low impact on the affected population, for example, small-scale localized incidents such as a minor fire, a small-scale industrial accident or a localized flood that affects a small community.

2) *Moderate disaster*: a moderate disaster is an event that causes a higher level of damage and has a more significant impact on the affected population, compared to a minor disaster. These may include larger scale incidents such as a moderate earthquake, a significant industrial accident affecting a larger area or a flood that affects several communities.

3) *Major disaster*: a major disaster is an event that results in extensive damage, poses a severe threat to human life and requires a substantial and coordinated response from local, regional or national authorities. These may include large-scale natural disasters such as tsunamis and earthquakes, or man-induced disasters such as a major industrial accident, large-scale transportation accidents and wars.

4) *Sudden or rapid onset disasters*: these include earthquakes, tsunami, floods, tropical storms, volcanic eruptions and landslides (mostly geological and climatic disasters).

5) *Slow onset disasters*: these include drought, famine, climate change, desertification, deforestation and pest infestation.

Natural disasters	Human-induced disasters
Cyclones	Accidents (road, rail, sea, air)
Cloudburst	Biological disasters, epidemics, health hazards
Drought	Fires (building, coal, mines, oil), urban fires
Earthquakes	Industrial mishaps, gas leak, explosion, sabotage
Floods, flashflood, excessive rains	Nuclear disasters, nuclear weapons, bomb threats, warfare
Landslides	Chemical disasters, oil spills, toxic wastes
Snow avalanches	Electrical/power-related accidents, technical faults, urban heat
Storm surges, tornadoes	Terrorist activities, atom/nuclear bombs, civil strife
Volcanic eruptions	Technological disaster
Wildfires (forest fires)	Dam failure, waterlogging
Tsunamis	Pollution (air, water, soil, noise)
Wind storm, snow storm	Environmental challenges, global warming, sea level rise

Table 1.1. *An overview of natural and human-induced disasters*

1.3. Aggravating factors of disasters

Numerous elements can intensify disasters, leading to increasing their impact and severity in terms of deaths, damage and destruction to the affected population. The following are some typical aggravating factors:

1) *Population growth and rapid urbanization*: if a disaster strikes in a region with a dense population, especially in developing countries, there will be more impact in terms of loss of lives, damage and destruction to structures. Furthermore, if people from rural regions relocate to cities in pursuit of job prospects and safety, there are fewer safe and appealing locations for these migrated people to build their homes. Once more, societal conflicts might result from competing for limited resources.

2) *Poverty and inequality*: poor sections of the population are more vulnerable to disasters compared to wealthy people, as they are able to recover quickly. Economically disadvantaged communities are often forced to live in more vulnerable areas such as flood plains, across borders and other disaster-prone areas; they face greater challenges both in terms of preparing for and recovering from disasters.

3) *Climate change and environmental degradation*: the increasing frequency and intensity of extreme weather events due to climate change can amplify the impact of disasters, leading to more widespread devastation and destruction to people and the environment, which leads to environmental degradation through activities such as deforestation, soil erosion, desertification and poor conservation techniques; these can increase the susceptibility to natural disasters such as floods, landslides and droughts.

4) *Lack of awareness and information*: this is related to inadequate information to people and some people are unaware about safety measures and procedures to be implemented before and after disasters, and may not know about risk reduction measures and steps to take during emergencies.

5) *Inadequate disaster preparedness and infrastructure*: lack of disaster preparedness, early warning systems, evacuation plans and emergency supplies can worsen the impact of disasters, leading to increased vulnerability during disasters. The effects of disasters can be worsened by inadequate infrastructure, such as poorly constructed buildings, roads and bridges, particularly in seismically active zones and cyclone or hurricane-prone locations.

6) *Political instability and conflict*: disasters that strike in the areas impacted by armed conflict or political instability make it more difficult to respond and aggravate the humanitarian situation.

7) *Healthcare system*: inadequacies in healthcare infrastructure and capacity can increase the impact of disasters, particularly in the case of pandemics or during public health emergencies.

1.4. Impact of disasters

Both natural and human-induced disasters have a significant impact on people, economies and the environment, leading to the loss of human lives and causing injuries, often requiring immediate medical attention and emergency response. At times, people may be forced to evacuate their homes due to disasters, leading to temporary or long-term displacement of individuals and families. This can result in homelessness, loss of possessions and challenges to recover again. Physical infrastructure such as buildings, roads, bridges and utilities may be damaged or destroyed during a disaster, hindering normal functioning and requiring extensive reconstruction efforts. The functioning of essential services such as water supply, electricity, communication and transportation can be disrupted. Disasters can result in significant economic losses, including damage to businesses, agriculture and other economic activities. The cost of recovery and rebuilding can be substantial. With regard to natural disasters, such as hurricanes and earthquakes, to man-made disasters, such as oil spills and industrial accidents, the impact can be severe and long lasting, and can cause environmental degradation, such as deforestation, soil erosion, air pollution and contamination of water sources. This can have long-term effects on ecosystems and biodiversity. Other significant impacts of disasters are the disruption of essential services such as healthcare and communications, leading to profound social, health and psychological effects on individuals and communities. Trauma, stress and grief may be experienced due to disruption of social structures. Certain disasters can contribute to the spread of diseases, injuries and mental health issues. Access to healthcare may be compromised, and existing health conditions may worsen. Innovative methods and techniques such as building disaster-resistant buildings and implementing early warning systems have been proven to help effectively mitigate the impact of disasters. By utilizing technologies such as drones and satellite imagery, geoinformatics and

remote sensing emergency responders can quickly assess the extent of damage and coordinate rescue efforts more efficiently. Novel research is also being conducted to develop more sustainable and environmentally friendly methods for disaster response, preparation and recovery. For example, scientists are exploring the use of biodegradable materials in temporary shelters and clean-up efforts to minimize the long-term environmental impact of disasters. Additionally, ongoing research used can also improve predictive modeling and risk assessment, allowing communities to better prepare for future disasters to effectively mitigate their impact. By adopting these strategies, communities can become more resilient and better equipped to tackle the challenges of future disasters.

1.5. Hazard meaning and concept

A hazard can be defined as a potential threat or danger that can cause harm to individuals, communities or the environment. It may also be defined as any dangerous physical event, condition, or phenomenon that may cause or has the potential to cause loss of life, injury and damage to property. It can be regarded as an unexpected threat to humans and their property. Also, it is a pre-disaster situation in which some risk of disaster exists, and to be more specific, a hazard is just an event but loss due to this is a disaster. The word "hazard" is derived from old French "*Hasard*" and "*az-har*" in Arabic, which means chance luck. It is a situation where there may be a chance of damage and destruction. Hazard refers to the potential occurrence, in a specific period, and geographic area of a natural phenomenon that may adversely affect human life, property or activity to the extent of causing a disaster. Hazards can arise from a wide range of sources, including natural phenomena, human activities and technological processes. Understanding hazards is crucial for identifying and managing risks to ensure the safety and well-being of individuals and the surrounding environment. To have a clear understanding of hazards, it is essential to grasp the concept and recognize the potential risks they pose. Hazards can be found in various forms and environments, and identifying them is crucial for ensuring safety and minimizing the impact. A hazard becomes a disaster when it affects an area, resulting in loss of life, displacements and homelessness, and damage to infrastructure and property. Understanding hazards involves a comprehensive assessment of their nature, potential impact and the means to control or mitigate their effects. This understanding is achieved through

various processes such as hazard identification and risk assessment, taking into account the exposure and vulnerability of individuals or assets.

In conclusion, a hazard represents a potential threat to the well-being of individuals, the environment or property. To gain a better understanding of hazards, it is helpful to explore the concept of hazards with the help of some examples: if a hazard like a cyclone hits an unpopulated area, say an unpopulated coast, it need not be considered a disaster; however; it will be a disaster only if life and property are seriously damaged. Flood is a hazard and is only a disaster when it affects the people and assets. So, we can say that every disaster is a hazard, but it is not necessary that every hazard can be a disaster.

Having a deep understanding of the concept of hazards and being able to identify them is vital for reducing damage and maintaining a safe environment. By recognizing different types of hazards and taking appropriate precautions, individuals can minimize harmful damage and prevent potential risks.

1.6. Types of hazards

There are several different types of hazards, including natural disasters such as earthquakes, floods and hurricanes, as well as man-made hazards such as chemical spills, fires and industrial accidents, biological or behavioral factors that may lead to adverse consequences. Understanding different types of hazards is essential for implementing appropriate safety measures. Each type of hazard presents its own unique set of challenges and risks. These can be grouped into two major categories:

1) *Natural hazards*: natural hazards are caused because of natural phenomena and they are of meteorological, geological and even biological origin, for example, cyclones, tsunamis, earthquakes and volcanic eruptions are exclusively of natural origin.

2) *Man-induced hazards*: man-induced hazards are human caused and are of technological origin, which occur due to human negligence. These are associated with industries or energy generation facilities and include explosions, leakage of toxic waste, pollution, dam failure, wars or civil strife.

1.6.1. *Other types of hazards*

1) *Physical hazards*: these are hazards that arise from the environment and can cause harm to humans or property. Examples include extreme temperatures, sharp objects, noise and radiation.

2) *Chemical hazards*: these hazards involve exposure to chemicals that can be toxic, flammable or corrosive. Examples include cleaning agents, pesticides and industrial chemicals.

3) *Biological hazards*: biological hazards stem from exposure to organisms or substances produced by living organisms. Examples include bacteria, viruses, fungi and allergens.

4) *Behavioral hazards*: these hazards are related to human behavior and can include factors such as negligence, lack of training or disregard for safety protocols, for example, using a mobile phone while driving is a behavioral hazard that increases the risk of accidents.

1.7. Characteristic features of hazard/disaster

Some common characteristics of hazards include the following:

1) *Unpredictability*: hazards often arise unexpectedly or are difficult to predict with certainty; without adequate risk assessment and monitoring, they can appear unexpectedly or build gradually over time, making it difficult to predict when they might occur. Most hazards are difficult to predict and occur suddenly.

2) *Nature*: hazards can be natural, human-induced or a combination of both that may cause damage and destruction.

3) *Location*: the specific physical place or a particular area where a hazard persists and usually occurs in highly vulnerable or disaster-prone areas.

4) *Onset*: hazards/disasters can be sudden, for example, earthquakes, or they can have slow onset, for example, drought.

5) *Intensity*: disasters with great magnitude are more severe and can have more potential to cause damage and disruption.

6) *Frequency*: they can occur at any time; some disasters occur frequently and some are seasonal, causing huge damage in an affected area or a region.

7) *Duration*: this refers to the length of time during which a hazard or dangerous condition exists. The duration of a disaster depends upon the type and effectiveness of a disaster in a particular area.

1.8. Disaster management terminology

– *Capacity*: in disaster management, capacity refers to the ability of individuals, communities, organizations and systems to effectively prepare for, respond to, recover from and mitigate the impact of disasters. It encompasses various elements that contribute to the overall resilience and effectiveness of a community or system in dealing with disasters, involving human resources, skill, education, infrastructure, proper training, etc., to deal with disasters.

– *Capacity development*: capacity development in the context of disasters refers to the process of enhancing the knowledge, skills, resources and capabilities of individuals, communities, organizations and institutions to effectively prepare for, respond to, recover from and mitigate the impacts of disasters. The aim is to strengthen the overall resilience of a community or society to better cope with the challenges posed by natural or human-made disasters.

– *Capacity building*: the process of developing the skills, knowledge, resources and organizational structures required to enhance an individual's or community's ability to effectively address challenges and achieve sustainable development.

– *Coping capacity*: the capacity of individuals, groups and structures to deal with and handle unfavorable circumstances, crises or natural calamities, by utilizing knowledge, available skills and resources to manage adverse conditions of the disasters.

– *Capacity assessment*: evaluation of the existing capacity and resources available to cope with and respond to disasters. This includes assessing the capabilities of emergency services, infrastructure and healthcare systems.

– *Retrofitting*: the process of modifying or upgrading existing structures and infrastructure to make them more resistant to the impacts of disasters, particularly natural hazards like earthquakes, floods, hurricanes or tornadoes.

The goal of retrofitting is to enhance the resilience of buildings and infrastructure, reducing the risk of damage or failure during a disaster event. This is especially important in regions that are prone to specific types of hazards.

– *Resilience*: the capacity of a community, system or society exposed to risks to withstand, resist, adapt and recover from the impacts in a timely and effective way, especially by maintaining and restoring its fundamental structures and functions.

– *Hazard*: a dangerous phenomenon or a condition that may cause loss of life, damage to property, social and economic disruption or environmental damage.

– *Hazard identification*: this is the process of identifying and characterizing the various hazards that could pose a threat to the area. This includes both natural hazards (such as earthquakes, floods and hurricanes) and human-made hazards (such as industrial accidents and chemical spills).

– *Exposure*: exposure refers to the elements (people, houses and infrastructure) and other human assets and property at risk from a natural hazard or human-induced hazard. Exposure is also defined as the state, or situation, of being in contact with something that can develop a potential loss. It may be possible to be exposed but not vulnerable, for example, by living in a floodplain area, but having sufficient means to modify building structure or cope up to mitigate potential loss. To be vulnerable to an extreme event means you are also exposed to a particular hazard.

– *Exposure analysis*: this includes determining the extent to which people, assets and the environment are exposed to the identified hazards. This involves mapping and quantifying the distribution of elements at risk.

– *Vulnerability*: this includes the characteristics and circumstances of a community or a system that makes it susceptible to the damaging effects of a hazard.

– *Vulnerability assessment*: this evaluates the vulnerability of the exposed elements, such as people, buildings, infrastructure and the environment, to the identified hazards. It also assesses the susceptibility and resilience of these elements to potential impacts.

– *Risk*: risk or disaster risk refers to the potential for adverse effects, such as loss of life, damage to infrastructure, economic disruption and environmental degradation, resulting from the interaction between hazards and vulnerable elements. It is a combination of the likelihood of a hazardous event occurring and the potential consequences it may have. It is the probability of quantifiable damage in terms of loss, injury, deaths or any other negative consequences. It means when a community or locality is exposed to a hazard and is likely to be affected by its impact. Risk is the function or product of hazard, exposure and vulnerability.

– *Disaster risk assessment*: this is a systematic process that involves identifying, analyzing and evaluating the potential risks and vulnerabilities associated with natural or human-made hazards. The goal is to understand the potential impact of disasters on a community, region or system and to inform decision-making in disaster risk reduction (DRR) and management.

– *Risk analysis*: this combines information on hazards, vulnerabilities and exposures to assess the overall risk. This often involves the calculation of risk levels, taking into account the probability of a hazard occurring and the potential consequences.

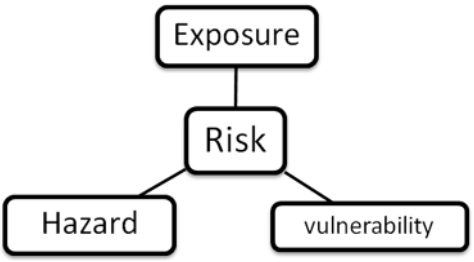

Figure 1.1. *Risk = Hazard × exposure × vulnerability*

1.9. Vulnerability

In disaster management, vulnerability refers to the susceptibility of individuals, communities or systems to the impacts of a disaster. The degree to which a community's infrastructure, services or physical location is likely to be harmed or disturbed by the effects of a certain hazard due to its design, construction or proximity to hazardous terrain or a disaster-prone area can be perceived as their vulnerability. Earthquakes are more likely to affect structures and infrastructure that are vulnerable; therefore, it is important to

build structures strong enough to withstand the greatest force that any event might exert. A society's susceptibility is also determined by its social and economic circumstances like poverty, population growth and lack of knowledge about how to effectively resist the effects of disasters. Therefore, this is the extent to which a community, structure, service or geographic area is likely to be damaged or disrupted by the impact of a particular hazard or disaster on the account of their nature, construction or other factors like closeness to dangerous terrain or a location where disasters are likely to occur. Also, vulnerability of humans is the relative incapacity of an individual or community to prepare for, manage, resist and recover from the impact of a disaster. Vulnerability is related to a disaster and a disaster can result only when a hazardous event – such as an earthquake, flood, or cyclone – occurs in a vulnerable situation in any hazard-prone region. This definition consists of two primary elements, vulnerability and hazard. There can be no disaster if there is no vulnerability or danger. When vulnerability and hazard interact, a catastrophe or disaster happens.

1.10. Types of vulnerability

There are different types of vulnerabilities, including physical, social, economic and institutional vulnerabilities.

– *Physical vulnerability*: this is the extent to which a structure is likely to be damaged or disrupted by a hazard event. It relates to the exposure of people and infrastructure to natural hazards. For example, communities located in flood-prone areas or regions prone to earthquakes are more physically vulnerable to those specific hazards.

– *Social vulnerability*: this encompasses the characteristics and dynamics of a community that can affect its ability to prepare for, respond to and recover from a disaster. Factors such as poverty, inequality, lack of access to resources, limited social networks and marginalized populations can increase social vulnerability.

– *Economic vulnerability*: this is the extent to which economic activities such as employment generation in services, trade, industrial and agricultural production are disrupted or likely to be damaged by disasters. Areas with high levels of poverty, limited economic diversity and dependence on specific industries may be more economically vulnerable to disasters.

– *Institutional vulnerability*: this relates to the capacity and effectiveness of institutions, including government agencies, emergency management organizations and community-based organizations, in responding to and managing disasters. Weak governance, inadequate policies and limited resources can contribute to institutional vulnerability.

– *Environmental vulnerability*: natural resource depletion and resource degradation are the key aspects of environmental vulnerability due to pollution from stormwater runoff containing agricultural chemicals like pesticides and other toxic substances.

1.11. Disaster management: meaning and concept

Disaster management is defined as a discipline or approach that includes all such measures or operational activities that are taken to reduce the harmful effects or damage caused by disasters through proper management with the aim to minimize the loss of life and causalities. It is an integrated and continuous process of planning, organizing, coordinating, responding and implementing measures that are necessary for the prevention of the threat of any disaster in the future. Disaster management is a complex multi-disciplinary approach to tackle before and aftereffects of a disaster that occurs in a particular area or a region, and to restore the normal life of the people therein. In addition, disaster management includes planned steps taken by an organization, a society or a country to lessen the adverse effects of disasters and to bring back the business continuity of the people or to restore the normal routine work of a society. Management of disaster events involves a range of actions aimed at minimizing the impact of disasters on communities and infrastructure. It encompasses preparedness, response, recovery and mitigation efforts to address various types of disasters, including natural calamities, technological accidents and public health emergencies. In simple terms, disaster management means all such measures that are taken so that hazards cannot take the form of a disaster. Also, conducting risk assessments to identify the potential hazards and vulnerabilities contributes to developing comprehensive disaster management plans related to the specific risks faced by a region or community. Effective disaster management requires collaboration among government agencies, non-governmental organizations, community groups and international partners to mitigate the impact of disasters and build resilient communities capable of responding to (and recovering from)

adverse disaster events. Disaster management adopts a holistic and multi-sectoral approach, recognizing the interconnectedness of various factors that contribute to disaster risk. The ultimate goal of disaster management is to save lives, reduce suffering and protect livelihoods in the face of adversity. Disaster management aims to build resilient communities and reduce the impact of disasters on individuals and societies.

1.12. Role of different agencies in disaster management

Management of disasters is the responsibility of everyone facing the challenges related to disasters. All the levels of government, whether state, central, NGO, Local people and community play a vital role in the process of management of disaster. It is the responsibility of people, society, communities and local people to manage disasters. By working together, the impact of disasters can be managed effectively to support affected communities in their recovery and rebuilding efforts. Since we cannot completely prevent the upcoming of many disasters, we can reduce their harmful effects by proper management and by being prepared for them before they strike to minimize the loss of life and property. Disasters can be typically managed through a collaborative effort involving various organizations at different levels. The key stakeholders involved in disaster management include:

1) *Government agencies*: national and local government agencies play a crucial role in disaster management, including disaster preparedness, response and recovery. This can involve agencies responsible for emergency management, public safety, healthcare and infrastructure.

2) *Non-governmental organizations (NGOs)*: NGOs often provide vital support in disaster management, offering resources, expertise and ground assistance in the affected areas such as shelter, healthcare and logistics.

3) *International organizations*: organizations such as the United Nations, the World Health Organization and the Red Cross play a vital role in providing global coordination and resources for disaster response and recovery efforts.

4) *Community and civil society groups*: local community organizations and civil society groups play a critical role in disaster management by promoting preparedness, providing support to affected populations and contributing to long-term recovery efforts.

5) *Private sector*: the private sector, including businesses and industry, often contributes resources, logistical support and expertise to disaster management efforts.

1.13. Modern management of disasters

Modern management goes beyond the post-disaster assistance. It now includes both the pre- and post-disaster activities to tackle the particular event of a disaster involving pre-disaster planning, empowering communities through education, awareness, training and participatory approaches to enhance their preparedness, response capabilities, resilience and many other fields. Modern management of disasters involves a holistic and proactive approach that integrates various strategies and technologies to mitigate risks, enhance preparedness and facilitate effective response and recovery. Key components of modern disaster management include:

1) *Risk assessment and mitigation*: this includes utilizing advanced technologies such as geographic information systems (GIS) and remote sensing for comprehensive risk assessment, hazard mapping and identification of vulnerable areas. This information is used to develop and implement targeted mitigation measures.

2) *Early warning systems*: this includes implementing sophisticated early warning systems that leverage real-time data, weather forecasting, seismic monitoring and other technologies to provide timely alerts for impending natural disasters, enabling authorities to take proactive measures and evacuate at-risk populations.

3) *Information and communication technologies (ICT)*: ICT tools help in efficient communication, coordination and data management during disasters, including the use of social media, mobile apps and emergency response platforms to disseminate information, coordinate rescue operations and mobilize resources.

4) *Inclusive and sustainable recovery*: IT includes emphasizing inclusive and sustainable recovery efforts that prioritize the needs of vulnerable groups, promote infrastructure resilience and integrate long-term planning for rebuilding communities more effectively.

1.14. Disaster risk reduction

Disaster risk reduction (DRR) refers to the actions taken to reduce the adverse impacts of natural hazards through systematic efforts to analyze and manage the causes of disaster, including through avoidance of hazards, reduced social and economic vulnerability to hazards and improved preparedness for adverse events. In simple terms, DRR refers to the systematic process of identifying, assessing and reducing the risks of disasters to lessen their adverse impacts on individuals, communities and countries. The goal of DRR is to enhance resilience and minimize the vulnerability of people and their livelihoods to the potential negative consequences of natural and human-made hazards. By implementing comprehensive DRR measures, communities and nations can enhance their ability to anticipate, prepare for, respond to and recover from disasters. DRR can be done through risk assessment by identifying and analyzing potential hazards, vulnerabilities and exposure to determine the level of potential risk to people, infrastructure and the environment. These measures will ultimately reduce the likelihood and overall impact of future disaster events on people. Communities also play a major role in the DRR process through their active participation and empowerment by conducting educational programs to raise awareness about risks and promote preparedness measures. Supporting developing countries and collaborating at the regional and international levels to share knowledge, expertise and resources also helps in building their capacity for DRR. In addition, by designing resilient buildings and structures, promoting insurance schemes and financial mechanisms can also help to withstand or recover quickly from disasters. This will lead to strengthening the capacity of individuals, communities and institutions to effectively manage and respond to both natural and human-induced disasters. DRR considers the probability of harmful consequences or expected losses (deaths, injuries, property, livelihood, economic activity disruption or environmental damage) resulting from interactions between natural or human-induced hazards and vulnerable conditions. Risk can be calculated using the given equation:

$$\text{Risk} = \text{Probability of hazard} \times \text{degree of vulnerability}$$

Management disaster risk involves certain activities:

1) *Prevention*: this includes activities and preventive measures taken to avoid existing and new disaster risks, for example, relocating exposed people and assets away from a hazard-prone region.

2) *Mitigation*: this involves steps to be taken to reduce the harmful impacts of hazards and related disasters, for example, constructing flood defense, planting more trees to stabilize slopes and implementing strict land use policies and construction codes.

3) *Transfer*: The process of formally or informally shifting the financial consequences of a particular hazard from one party to another, whereby a household communities, people or state authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that party, for example, insurance.

4) *Preparedness*: this includes set of necessary measures taken in advance by people or government. The use of knowledge and capacity of communities and individuals to respond to and recover from the impacts of future hazard or disaster events, for example, disaster preparedness, planning installing early warning systems, identifying evacuation routes and preparing emergency kits and supplies.

1.15. Applications of information technology in DRR

Information technology (IT) has revolutionized communication, bringing within the ambit of connectivity, remote and far-flung and marginalized regions. This helps us in effectively managing disasters.

1) *Decision support and public awareness*: the World Wide Web and the Internet have opened up possibilities of department-specific websites, which provide valuable information in specialized branches of disaster management. There are specialized websites on natural hazards such as earthquakes and cyclones that provide comprehensive information regarding specific natural hazards. Such websites would present all information on the hazard and ways to deal with it. These form important decision support tools (DCS) that facilitate knowledge transfer during critical times.

2) *Information sharing*: the integration of IT with telecommunication interfaces has made possible facilities like video teleconferencing that provide for direct interface between aid givers and official agencies at the emergency site, rendering relief and rescue process in a highly efficient manner.

3) *Policy planning*: IT has greatly aided planning for disaster response and preparedness for DRR. Even generally, policy-making for traffic, transport, forest conservation, urban congestion, etc., is facilitated by spatial imagery through remote sensing.

1.16. Application of GIS in DRR

Another significant development has been the geographical information system (GIS), by which detailed spatial analysis of areas "at risk" is accomplished through satellite imagery. Comprehensive information is collected about the area, which is displayed graphically on a map, highlighting critical facilities and communities at risk, available communication infrastructure, etc., which guides immediate disaster response in the short run, and over the long run, facilitates risk mapping, risk assessment, dissemination of information, public awareness, etc., which aid long-term policy planning for disaster mitigation. The GIS has greatly facilitated response efforts as strategies can be devised based on scientific simulation studies and scenario analysis using information made available through remote sensing. It plays a crucial role in DRR by providing valuable tools and techniques for understanding, analyzing and managing geospatial data related to natural (as well as human-induced) disasters and their potential impact on human populations and infrastructure.

1) *Risk assessment and analysis*: GIS enables the identification and mapping of areas vulnerable to natural disasters such as floods, earthquakes and landslides. It helps in assessing the potential impact of these disasters on communities and infrastructure by analyzing various layers of geospatial data such as elevation, land use and population density.

2) *Early warning systems*: GIS is used to develop early warning systems for natural disasters. By integrating real-time data such as weather patterns, seismic activity and hydrological conditions into GIS platforms, authorities can identify and alert areas at risk, allowing for timely evacuation and disaster response.

3) *Resource management*: GIS assists in the efficient allocation of resources during disaster response and recovery efforts by mapping critical infrastructure, evacuation routes and emergency shelters. This helps in coordinating rescue operations and providing aid to affected areas.

4) *Post-disaster recovery and reconstruction*: GIS also helps in post-disaster assessment and recovery planning by mapping the extent of damage, identifying areas in need of reconstruction and evaluating the effectiveness of recovery interventions.

5) *Policy formulation*: GIS aids in evidence-based decision-making for DRR policies and land use planning by providing spatial analysis and visualization of vulnerability and exposure to natural hazards.

1.17. Disaster management cycle

The disaster management cycle, also known as the disaster management continuum, is a conceptual framework that outlines the various phases of dealing with disasters, from preparedness to recovery. This cycle helps emergency management professionals and organizations to plan, coordinate and implement strategies for disaster mitigation and response. The typical phases of the disaster management cycle include the following:

1) *Preparedness*: this phase includes planning, training, drills, public awareness campaigns, infrastructure development and resource allocation. Preparedness enhances the capacity of communities and organizations to respond effectively to disasters.

2) *Mitigation*: this includes implementing measures to reduce or eliminate the impact of hazards, such as building codes, land-use planning and infrastructure improvements to minimize the impact of disasters on people and property.

3) *Response*: this includes immediate actions that are taken to save lives and prevent further damage during and after a particular disaster. It also includes search and rescue, medical care, evacuation and emergency shelter to protect lives and property, meet basic human needs and stabilize the situation.

4) *Recovery*: long-term efforts to restore the affected community to normal or improved conditions. This involves rebuilding infrastructure, providing financial assistance and addressing social and economic issues to restore the community to a state of normalcy or improved resilience.

Figure 1.2. *Disaster management cycle*

1.18. Disaster Management Act

The Disaster Management Act, 2005 was enacted on December 23, 2005 and extends to the whole of India. It received the assent of the President of India on the same date. It serves as a crucial legal framework for managing disasters and providing support to those affected in India, and consists of all the definitions of disaster and Disaster Management concepts. The Disaster Management Act of 2005 has provided the legal and institutional framework for Disaster Management in India at national, state and district levels that focus on providing effective management of disasters and related matters. The main objective of this act is to build a safe and disaster-resilient India through prevention/mitigation, preparedness and response to provide technical and financial activities support and other commercial activities. The Act consists of 11 chapters and 79 sections, outlining various measures for disaster management and related issues. Its main focus is to assist people affected by disasters, helping them regain their lives to prevent, mitigate and prepare for future disasters.

1.18.1. *Chapters of Disaster Management Act, 2005*

The chapters of Disaster Management Act, 2005, include the following:

1) Preliminary chapter.

2) The National Disaster Management Authority (NDMA).

3) State Disaster Management Authority (SDMA).

4) District Disaster Management Authority (DDMA).

5) Measures by the Government for Disaster Management.

6) Local authorities.

7) National Institute of Disaster Management (NIDM).

8) National Disaster Response Force (NDRF).

9) Finance.

10) Offences and penalties.

11) Miscellaneous.

1.18.2. *Disaster Management Act, 2005 framework*

The National Disaster Management Act of 2005 in India establishes a framework for disaster management at the national, state and district levels. The act outlines the roles and responsibilities of various bodies at different levels involved in disaster management. Here are some of the key bodies mentioned in the National Disaster Management Act, 2005:

1) *National Disaster Management Authority (NDMA)*: NDMA is the apex body responsible for formulating policies, plans and guidelines for disaster management in India. It is headed by the Prime Minister of India. The NDMA coordinates disaster response and mitigation efforts at the national level. The NDMA is also mandated to recommend guidelines for minimum standards of relief to be provided to persons affected by the disaster for proper allocation of funds.

2) *State Disaster Management Authority (SDMA)*: each state in India has its own State Disaster Management Authority, headed by the chief minister. In the case of union territory with no assembly, for example, Delhi and Puducherry, the LG or Administrator is the chairman of SDMA. The

state-level implementation of the plans and policies established by the NDMA is the responsibility of the SDMA. It creates the State Disaster Management Plan and organizes disaster response efforts.

3) *District Disaster Management Authority (DDMA)*: at the district level, the DDMA is responsible for implementing disaster management plans and coordinating response activities. It is headed by the District Magistrate (Deputy Commissioner) or Collector.

4) *National Executive Committee (NEC)*: the NEC is responsible for coordinating the implementation of policies and plans for disaster management. It is chaired by the Union Home Secretary.

5) *State Executive Committee (SEC)*: similar to the NEC, the SEC at the state level coordinates the implementation of disaster management plans within the state. It is chaired by the Chief Secretary of the state.

6) *Local authorities*: municipalities, panchayats and other local bodies are involved in disaster management at the grassroots level. They work under the guidance of the DDMA and play a significant role in coordinating local-level response efforts.

1.19. Disaster preparedness plan

Disasters can disrupt the normal functioning of a community, resulting in significant damage to property and lives, causing a breakdown in social and economic systems. Individuals and authorities are often caught off guard, lacking the initiative and direction needed to respond effectively to such crises. This can lead to delays in relief efforts, further exacerbating the situation. However, having a well-developed and tested disaster preparedness plan in place can significantly mitigate the impact of disasters and enhance disaster resilience through effective preparedness planning. A comprehensive disaster preparedness plan equips officials with a set of clear instructions to follow and enables them to issue directives to their teams and the affected population. This streamlined approach not only expedites rescue and relief operations but also boosts morale among those affected. Moreover, such plans are invaluable in pre-disaster situations, guiding officials when warnings are issued and eliminating the need for time-consuming consultations with senior officers for approval. The importance of having a disaster preparedness plan is evident from national and international experiences, where inadequate planning or the absence of a

plan has led to more severe consequences from disasters. A well-structured plan includes measures to be implemented before, during and after a disaster strikes. It outlines the inventory of available resources, assigns responsibilities, establishes coordination mechanisms among government bodies and provides guidelines for collaboration with NGOs, social workers and international organizations. A well-designed disaster preparedness plan not only enhances the resilience of communities but also ensures a coordinated and efficient response to disasters, minimizing loss of life and property.

By creating awareness and empowering communities to anticipate and respond to disasters, a preparedness plan aims to minimize the impact of emergencies. Long-term measures such as constructing river embankments, retrofitting buildings, establishing communication systems, setting up relief centers and implementing land use regulations are also included in the plan. Regular review and revisions ensure the plan's practicality and effectiveness based on lessons learned from past experiences.

Key characteristics of an effective preparedness plan are as follows:

1) *Clarity of aim*: the plan should have a clearly defined objective that aligns with the overall goal of disaster preparedness.

2) *Realism*: it should be based on a realistic assessment of potential disaster threats, community vulnerability and available resources to counter such threats.

3) *Level of the plan*: the plan should be tailored to the specific level of operation, whether at the local village, district or regional level.

4) *Flexibility*: given the unpredictable nature of disasters, the plan should be adaptable and able to respond to varying scenarios swiftly.

1.20. Questions

1) Define the following terms:

a) Disaster and risk

b) Resilience and exposure

c) Capacity and capacity development

2) Define Vulnerability; also discuss its types.

3) Distinguish between hazard and disaster.

4) Explain in detail the characteristic features of hazards.

5) What are the two major types of disasters? Name three examples in each category.

6) Write in detail about disaster risk reduction (DRR).

7) Describe the disaster management cycle and its all phases.

8) Write a detailed note on the Disaster Management Act.

9) Explain the concept of risk assessment in disaster management and discuss its importance in proactive planning.

10) Describe the principles of disaster risk reduction and explain how they contribute to sustainable development.

11) Explain the role of technology in disaster management, highlighting both its benefits and limitations.

12) Discuss the applications of GIS and remote sensing in disaster risk reduction.

13) What are the aggravating factors of disasters?

14) Discuss the importance of preparedness in disaster management.

15) Describe the concept of disaster management and its scope.

16) What do you understand by a disaster preparedness plan?

17) What is the importance and significance of a disaster preparedness plan?

18) What are the main characteristics of a disaster preparedness plan?

19) Discuss the role of government agencies at the local, national and international levels in disaster management.

20) Describe the role of non-governmental organizations (NGOs) and volunteer groups in disaster management.

1.21. Multiple-choice questions (MCQs)

1) What is the primary goal of disaster management?

a) Recovery

b) Preparedness

c) **Mitigation**

d) Response

2) What is the main purpose of a disaster response plan?

a) Reduce the risk of disasters

b) Minimize the impact of disasters

c) **Coordinate actions during and after a disaster**

d) Implement long-term recovery efforts

3) The process of identifying potential hazards and assessing their impacts is known as:

a) Response planning

b) **Risk assessment**

c) Emergency preparedness

d) Disaster recovery

4) Which organization plays a crucial role in coordinating disaster response efforts at the national level in many countries?

a) **United Nations**

b) World Health Organization

c) Red Cross

d) Federal Emergency Management Agency (FEMA)

5) What does the term “Shelter in Place” mean in disaster management?

a) Evacuating to a designated shelter

b) Taking cover in a safe location

c) **Staying indoors and taking refuge**

d) Moving to higher ground

6) The “Incident Command System” (ICS) is a standardized approach for:

a) Disaster recovery

b) Communication during disasters

c) **Incident management and coordination**

d) Risk assessment

7) What is the purpose of conducting drills and exercises in disaster management?

a) Assessing the damage after a disaster

b) **Testing the effectiveness of response plans**

c) Providing immediate relief to affected populations

d) Identifying potential hazards

8) The “Golden Hour” in disaster management refers to:

a) The first hour after a disaster occurs

b) **The critical period for decision-making and action**

c) The time when recovery efforts begin

d) The hour of maximum impact during a disaster

9) What is the purpose of a Community Emergency Response Team (CERT)?

a) **Search and rescue operations**

b) Conducting risk assessments

c) Managing recovery efforts

d) Providing medical care during disasters

10) Which disaster management phase involves restoring the community to normal or improved conditions?

a) Preparedness

b) Response

c) **Recovery**

d) Mitigation

11) What is the primary role of the National Disaster Response Force (NDRF)?

a) Providing financial assistance to disaster victims

b) Researching disaster management

c) **Undertaking specialized response and rescue operations**

d) Coordinating international disaster relief efforts

12) The "Triage" process in disaster management is related to:

a) **Sorting and prioritizing casualties for medical treatment**

b) Assessing the structural damage after a disaster

c) Evacuating people from affected areas

d) Distributing relief supplies

13) What is the purpose of a Hazard Vulnerability Assessment (HVA)?

a) **Assessing the risk of hazards to a community**

b) Providing immediate relief to disaster victims

c) Coordinating international disaster response efforts

d) Evaluating the effectiveness of recovery plans

14) The "Chain of Command" in disaster management refers to:

a) A series of interconnected emergency shelters

b) **The hierarchy of authority and communication within response teams**

c) The distribution of relief supplies to affected areas

d) A network of international disaster relief organizations

15) The term "disaster risk reduction" (DRR) is closely associated with:

a) **Minimizing the impact of disasters on vulnerable populations**

b) Providing immediate relief to disaster victims

c) Conducting post-disaster damage assessments

d) Coordinating international disaster response efforts

16) What is a “safe zone” in disaster management?

a) A designated area for emergency drills

b) A location for storing relief supplies

c) **A secure area for affected populations during a disaster**

d) A zone with reduced risk of natural disasters

17) The term “Crisis Communication” in disaster management refers to:

a) Communicating during the recovery phase

b) Providing immediate relief to disaster victims

c) **Communicating information during and after a disaster**

d) Coordinating international disaster response efforts

18) The “Sendai Framework for disaster risk reduction” was adopted by:

a) United Nations Security Council

b) **United Nations General Assembly**

c) World Health Organization (WHO)

d) International Red Cross

19) Which phase of disaster management involves educating the public and raising awareness about potential risks?

a) **Preparedness**

b) Response

c) Mitigation

d) Recovery

20) The term “evacuation route” in disaster management refers to:

a) A designated path for emergency drills

b) The route taken by relief supplies to affected areas

c) **The path used by people to leave an area during a disaster**

d) A route for transporting injured individuals to medical facilities

21) What is the purpose of the “Hyogo Framework for Action”?

a) Addressing climate change issues

b) **Enhancing disaster risk reduction efforts**

c) Coordinating international humanitarian aid

d) Conducting research on disaster management

22) The term “FEMA” stands for:

a) **Federal Emergency Management Agency**

b) Foreign Emergency Medical Assistance

c) Fund for Emergency Humanitarian Aid

d) Federation of Emergency Management Associations

23) Widespread loss of life and property due to natural or manmade causes is termed a:

a) **Disaster**

b) Hazard

c) Extreme loss

d) Vulnerability

24) The Disaster Management Act was made in:

a) 2006

b) 2003

c) **2005**

d) 2009

25) The level of risk of a disaster depends on:

a) Nature of the hazard

b) Vulnerability of the elements which are affected

c) The economic value of the element which is affected

d) **All of the above**

26) Any natural process with the potential to cause harm is termed a natural hazard.

a) **True**

b) False

27) A physical, social, economic and environmental condition that make a society susceptible to the adverse effects of hazard is known as:

a) Resilience

b) Capacity

c) **Vulnerability**

d) Mitigation

28) Disaster risk is a function of:

a) Hazard

b) Vulnerability

c) Exposure

d) **All of above**

29) The word disaster comes from the:

a) Greek word

b) Latin word

c) **French word**

d) German word

30) Where is NIDM located?

a) Kanpur

b) Bengaluru

c) **New Delhi**

d) Mumbai

31) J&K is exposed to various hazards mainly due to what?

a) Location

b) Geomorphology

c) Climate

d) **All of above**

32) Who should be the first responders in a disaster management situation?

a) Central government

b) **Community**

c) Local government

d) State government

33) Disaster management includes:

a) Mitigation

b) Reconstruction

c) Rehabilitation

d) **All of above**

34) Which of the following groups of people are more vulnerable in the event of disaster?

a) Men, women, boys

b) Men, boys, old people

c) **Women, children, old people**

d) None of the above

35) What are the consequences of disaster on a society?

a) Loss of life

b) Damage to property

c) Environmental degradation

d) **All of above**

36) When do we celebrate International Day for Natural Disaster Reduction?

a) March 1

b) April 15

c) September 12

d) **October 13**

37) What are the major hazard /disaster management-related activities?

a) Preparedness

b) Response

c) Recovery

d) **All of the above**

38) What is a disaster an occurrence of?

a) Disrupting the normal conditions of existence

b) Causing a level of suffering

c) Damage to infrastructure

d) **All of the above**

39) What are hazards and disasters mainly classified as?

a) Physical and chemical

b) **Natural and human-induced**

c) Physical and human

d) Social and cultural

40) A hazard is a situation where there is:

a) The threat of natural calamity

b) **The threat to property and lives from calamities**

c) The threat for consequences of the disaster

d) All of the above

41) Disaster is an event arising out of:

a) **Result of hazard event**

b) Causes of hazard event

c) Causes of disaster event

d) All of the above

42) Typical examples of man-made disasters are:

a) Chemical explosion

b) Leakage of toxic waste

c) War and civil strife

d) **All of the above**

43) The role of which agency is important in disaster prevention?

a) **Media**

b) Police

c) Government officials

d) Public

44) What are the important measures to be taken at the community level of disaster preparedness?

a) Increased awareness

b) Provision of early and timely warning

c) Land use planning

d) **All of the above**

45) Which of the following agencies are the national disaster risk reduction stakeholders?

a) Central government

b) National disaster offices

c) Private sector

d) **All of the above**

46) Structural and nonstructural measures are the elements of which category of risk reduction measures?

a) Socioeconomic measures

b) **Physical measures**

c) Environmental measures

d) Post-disaster measures

47) What are the major types oriented to mitigation measures of hazards and disasters?

a) Public mitigation measures

b) Community mitigation measures

c) **Both a and b**

d) None of the above

48) What are the main prescribed procedures for standard operating?

a) Search and rescue

b) Medical assistant

c) Casualty management

d) **All of the above**

49) Which phase of disaster management involves measures taken to minimize the impact of a disaster?

a) Preparedness

b) Response

c) Recovery

d) **Mitigation**

50) The steps needed to be taken for any risk of natural or man-made disaster are:

a) Proper building construction

b) Better planning

c) Awareness among the stakeholders

d) **All of the above**

51) Disaster management is aimed at:

a) Resettling people in the closest unaffected urban area

b) Collection of valuable data for future management objectives

c) Strengthening sewage and drinking water treatment facilities to resist the impact of a future disaster

d) **Restoring a community's services, facilities and residences to pre-disaster levels**

52) What are the roles of NGOs in the disaster-related preparedness stage?

a) Public awareness and education

b) Vulnerability and risk assessment

c) Forming and training DNTs, introducing alternative technologies

d) **All of the above**

53) Mock drills and exercise to create awareness among people are conducted at:

a) State level

b) District level

c) GP/Village level

d) **All of the above**

54) Disaster management covers:

a) Maintaining control over disasters

b) Reducing the effects of disasters

c) Briefing of government officials about disasters

d) **All the above**

55) The primary goal of a disaster preparedness plan is:

a) **To protect the population**

b) To protect valuable resources

c) To keep communication lines open

d) To protect environmental health personnel

56) For coordinating disaster management activities for all natural hazards, the nodal agency at the central government is the:

a) **Ministry of Home Affairs**

b) Ministry of Rural Development

c) Ministry of Communication

d) Ministry of Urban Ministry

57) What are the three phases of disaster management planning?

a) Evacuating, rebuilding and re-branding

b) Preparation, planning and perception

c) Planning, evacuating and recovery

d) **Preparation, response and recovery**

58) Full form of DDMA is:

a) **District Disaster Management Authority**

b) District Disease Management Authority

c) District Dam Management Authority

d) District Duck Management Authority

59) Which of the following best defines “risk” in the context of a system or environment?

a) **The probability of a specific hazard or threat occurring**

b) The potential consequences or impacts of an event

c) The level of exposure to potential harm or loss

d) The ability of a system to adapt and recover from disturbances

60) What is the full form of NEC?

a) National Eternal Committee

b) **National Executive Committee**

c) National Election Commission

d) National Engineering Course