Disaster Management: Preparedness, Response and Recovery

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ABSTRACT:
In order to lessen the effects of catastrophes on people's lives, infrastructure, and the environment, a key area called disaster management has developed. The main ideas and strategies used in disaster management are summarized in this chapter. In order to lessen the negative consequences of natural and man-made catastrophes, it emphasises the significance of preparation, response, and recovery. In order to properly manage and lessen the effects of catastrophes, the chapter also emphasises the need of cooperation among diverse stakeholders, including governmental organisations, non-governmental organisations, and local populations. Societies may improve their resilience and capacity to react to calamities by putting comprehensive disaster management plans and strategies into place, which will ultimately save lives and protect livelihoods.

KEYWORDS:

Earthquakes, Flood, Seismic, Significant, Surface, Water.

I. INTRODUCTION

Natural catastrophes including tropical cyclones, floods, droughts, tornadoes, earthquakes, volcanic eruptions, etc. cause enormous loss of life and property. Fortunately, warning systems are now accessible, and damage to lives and property may be reduced by taking mitigation measures. Worldwide National Meteorological Services to provide public warnings for various weather-related natural calamities [1]–[3]. It is impossible to predict exactly when and where a harmful natural occurrence will occur over an extended period of time. Even if they cannot be stopped, natural catastrophes may be lessened by implementing the appropriate long- and short-term disaster mitigation measures. Floods are described as a relatively high-water discharge rate from a network of rivers and streams that causes the riverbank margins to overflow and submerges low-lying regions next to the riverbed. It mostly manifests as a physical phenomenon. Floods are caused by unusually strong rainfall, collapsed dams, snowmelt, and river jams. In terms of how many people are impacted globally, droughts and flood catastrophes are tied for second place.

Types of Floods

Floods may be divided into three groups, as follows:

(i) River floods

Especially in mountainous locations, rivers are charged by melting snow or by severe rainfall that cover extensive catchment areas. The flooding occurs in river systems with tributaries that may drain over wide regions and include several distinct river basins. The amount of flooding is influenced by soil moisture, plant cover, snow depth, and catchment basin size.

(ii) Coastal floods

Tropical cyclones and ferocious winds that develop at the ocean's surface are linked to coastal flooding. Storm surges along the shore caused by wind can make coastal flooding worse [4]–[6]. The inland shores are inundated by sea and ocean water, impacting miles of tracts. Tides, storm surges, and tsunamis all have an impact. Extreme flooding occurs in coastal river basins as a consequence of persistent and endless rain throughout the rainy season, which is defined as June through September.

(iii) Flash floods

Rising clouds, thunderstorms, and tropical cyclones are characteristics of these floods, which happen six hours after the start of the rain. These are caused by runoff during a heavy rain, especially if the slope of the catchment is inadequate to absorb and store a significant portion of water. The abrupt breakup of glaciers, dam collapse, and other factors are additional sources of flash floods. These provide possible risks in locations with a high likelihood of heavy rainstorms, steep terrain, significant surface runoff, and water flowing through canyons.

General Characteristics of Floods

- **i.** Forest plants and man-made buildings both show varying degrees of tolerance to the impacts of flooding.
- **ii.** The length of time that floods remain in place determines how much damage is done.
- **iii.** Building foundations may be uprooted or weakened by fast-moving water.
- **iv.** A river's rate of rise and discharge serves as a foundation for flood management.
- **v.** The kind of actions that should be carried out in the flood plain will depend on the frequency of occurrence anticipated over a long period of time.
- **vi.** Typically, floods during the rainy season do significant damage to the agricultural industry.

Effects of Floods

- **i.** The residential and commercial buildings are damaged by rising water, erosion, and force.
- **ii.** They pose a threat to coastal settlements because they wash away everything that is in their way. It is the main reason for landslides in hilly places.
- **iii.** There is a significant loss of life and property among fishermen, locals, livestock, animals, and plants. The majority of fatalities are said to be caused by drowning.
- **iv.** All sources of fresh water are almost completely damaged and polluted, which increases the danger of water-borne infections in the affected communities.
- **v.** There is a severe food crisis as a consequence of the damage of food and fodder crops.
- **vi.** Floods also render land unproductive because erosion causes the topsoil to be lost.
- **vii.** Floods are also known to replenish ground water and protect wetlands.

Flood Control

- **i.** As the riverbed's ability to handle heavier loads multiplies, its depth and breadth might be enhanced, which would decrease the extent of the flood plain.
- **ii.** The establishment of a network of canals from river systems often results in flooding. Additionally, this would help the sector or economy of agriculture. The design and construction must be done with care due to the potential environmental effect and essential safety measures.
- **iii.** To store floodwater and release it at reasonable rates, reservoirs should be built. That would need very meticulous engineering. Additional resource production would be facilitated by dams and reservoirs.
- **iv.** Both newly built residential and commercial structures should have strong enough foundations to withstand flood conditions.
- **v.** The banks of rivers and streams need to be stabilised with stone, masonry, or vegetation. In areas where rivers flow through cities, especially close to bridges, this should be closely adhered to.

II. DISCUSSION

Post Disaster Requirements

Authorities and the community's early reaction to floods should include:

- **i.** Search and Rescue operations.
- **ii.** Water Provision.
- **iii.** Medical assistance.
- **iv.** Disaster epidemiological surveillance assessment.
- **v.** Food and Temporary Shelter.
- **vi.** Reconstruction of houses.
- **vii.** Equipment and tools.
- **viii.** Creation of employment.
- **ix.** Supply of animals.
- **x.** Assist with recovery of small business.
- **xi.** Assistance to farmers.
- **xii.** Distribution of farm and fisheries.

Flood Problem in India

From one river system to another, the flood issue may take many different forms. Below, two major river systems are reviewed in light of India's flooding issues:

Brahmputra River

The Brahmaputra and its tributaries are the primary cause of floods in the northeastern area. During the monsoon season, the river exceeds its banks and severely damages both property and human lives. It has impacted the Kaziranga wildlife sanctuary many times, when the increasing floodwaters caused the death of the rhinoceros' population. The erosion along the Brahmputra's banks has been much worse in recent years. The rivers also carry a lot of silt and are prone to changing their route**.**

Ganga River System

The Rapti, Sharada, Ghaghra, and Gandak, four northern Ganga tributaries in this area, generate significant flooding along their banks. Only the northwest of Uttar Pradesh has drainage congestion, with Meerut, Mathura, and Agra suffering the worst. The flooding of the Burhi Gandak, the Baghirati, the Kamla Balan, the Kosi, and the Mahananda causes significant damage to Bihar. Along with the crop submersion, the region also sees traffic disruption. The Baghirati, Ajoy, and Damodar rivers create significant floods in the Bengal area. Here, flooding is also influenced by the Bay of Bengal's tidal action. The Yamuna, the largest tributary of the Ganga, is the source of some minor floods in Delhi and Haryana. The majority of these flood-prone areas have insufficient channel capacity and river water flow management in these waterways.

Earthquakes and Seismology

An earthquake is a significant example of the strength of the tectonic forces generated by the endogenetic heat conditions of the earth's core. An earthquake is a movement of the ground that may range from a little tremor to a violent motion that can toss buildings into the air and leave gaping fractures in the earth. The magnitude or intensity of the energy produced by an earthquake is measured using the Richter scale, which Charles F. Richter developed in 1935. One of the largest earthquakes in the world ever recorded was the Good Friday Earthquake that occurred in Alaska (USA) on March 27, 1964, measuring 8.4 to 8.6 on the Richter scale [7], [8]. Seismology is the branch of science that examines the behaviour and patterns of seismic waves. The centre, or epicentre, of an earthquake is always deep below the ground, although its depth varies from place to place. An earthquake's focus is the location of its genesis, which is always concealed under the ground. The epicentre of the deepest earthquake may be 700 kilometres below the surface of the earth. The focal depth of large Himalayan tremors, like the August 2, 1988 Bihar-Nepal earthquake, is between 20 and 30 km. The epicentre is the location on the ground's surface that is perpendicular to the underground focus or hypocenter where seismic waves are first recorded. 'Seismic waves' are the waves produced by an earthquake and are captured by a seismograph. Oseismallines are the lines connecting the locations on a map where seismic waves are present in equal amounts.

Causes of Earthquakes

Disequilibrium in any area of the earth's crust is the major cause of earthquakes. Disequilibrium in the earth's crust has been attributed to a variety of factors, including volcanic eruptions, faulting and folding, internal gas expansion and contraction, hydrostatic pressure from man-made water bodies like reservoirs and lakes, and plate movements.

(1) Vulcan City

Considered to be one of the primary causes of earthquakes is volcanic activity. Seismic activity and Vulcan City are so closely linked that they act as a cause and effect for one another. Each volcanic eruption is followed by an earthquake, and many of the more powerful earthquakes start volcanic eruptions. When building the Vulcan metropolis, the explosive and violent gases tried to escape higher. As a result, they pushed the crystal's surface upward with immense force, which generated powerful earth earthquakes.

(2) Elastic Rebound Theory and Faulting

End-genetic forces that cause horizontal and vertical movement lead to the formation of faults and folds, which in turn cause isocratic disequilibria in the crystal rocks and, ultimately, earthquakes of varying magnitudes depending on the type and extent of rock block displacement brought on by faulting and folding. It was thought that disequilibria in crystal rocks produced the Assam earthquake of 1950;

(3) Hydrostatic Pressure and Anthropogenic Causes

The storage of large volumes of water in large reservoirs, the pumping of ground water and oil, deep underground mining, dynamite blasting of rocks for building, and other human activities may also result in earth tremors with catastrophic repercussions.

The building of gigantic dams and the storage of massive amounts of water in vast reservoirs behind the dams result in the disequilibrium of adjusted rocks underneath the reservoirs.

(4) Plate Tectonic Theory

The crust of the planet is made up of solid, movable plates that may be either continental, oceanic, or perhaps both. Six main plates the Eurasian, American, African, Indian, Pacific, and Antarctic plates as well as 20 smaller plates make up the crust of the globe. Due to thermal convection currents that originate deep inside the earth, these plates are continually shifting in respect to one another. Different forms of plate motion result in a variety of disequilibria, which in turn leads to earthquakes of differing magnitudes [9], [10].

(1) Classification on the Basis of Causative Factors

- **i.** Natural earthquakes are ones that are brought on by endogenous forces, or by natural processes. These are separated into four further subcategories.
- **ii.** Explosive volcanic eruptions are the primary source of volcanic earthquakes and fissure kinds, which only occur in volcanic locations. severe earthquake brought on by the Etna volcano's explosive eruptions in 1968.
- **iii.** Rock chunks that are moved during faulting activity are what produce tectonic earthquakes. Such an earthquake, like the 1906 earthquake in California (USA), is very dangerous and devastating.
- **iv.** Due to an imbalance in the geological processes, isostatic earthquakes are caused by an abrupt disruption in the isostatic equilibrium at the regional scale.
- **v.** Deep focus earthquakes, which happen at higher depths, are what Plutonic Earthquakes really are.
- **vi.** Human activities including the extraction of water and crude oil from subterranean aquifers are the main source of anthropogenic earthquakes. and oil reserves, deep underground mining, rock blasting with dynamite for building reasons, such as the 1967 Koyna earthquake in Maharashtra caused by the Koyna reservoir, etc.

(2) Classification on the Basis of Focus

They have been split into three groups based on the depths of their foci.

(i) Moderate Earthquake: Foci are situated between 0 and 50 km deep.

(ii) Intermediate Earthquake: Foci between 50 and 250 km below the surface.

(iii) Deep Focus Earthquake: Foci between 250 and 700 kilometers below the surface.

Using human casualties as a foundation for classification.

(i) Moderately Hazardous Earthquakes: If the number of fatalities from seismic shocks is below 50,000, for example, the Tabas earthquake in Iran in 1978 (death toll: 25,000).

(ii) Highly Hazardous Earthquakes: If there are between 51,000 and 100,000 human fatalities as a result of seismic disturbances, such as in 1935 in Quetta, Baluchistan (60,000 fatalities).

(iii) Most Hazardous Earthquakes: The most dangerous earthquakes occur when the number of fatalities exceeds a million, such as the Tang-Shan earthquake in China in 1976, which claimed 7,50,000 lives.

World Distribution of Earthquakes

In reality, weaker and more statically scattered regions of the planet are linked to earthquakes. The zones of young folded mountains, the zones of faulting and fracturing, the intersection of continental and oceanic margins, the zones of active volcanoes, and along the various plate borders are where the majority of earthquakes in the globe occur. The following belts are where earthquakes are most likely to occur, according to a seismologists' map of earthquake distribution throughout the globe.

(i) Circum-Pacific Belt

Surrounding the Pacific Ocean.

(ii) Mid-Continental Belt:

This region includes the epicenters of East African Fault Zones as well as Alpine-Himalayan Chain epicenters in northern Africa and Eurasia.

(iii)The Mid Atlantic Belt:

Which represents earthquakes along the mid-Atlantic Ridge and its outlying fault lines.

Effects of Earthquakes Hazards

Earthquakes and their risks are assessed based on the Richter scale's measurement of seismic strength, but they are also evaluated based on the extent of the harm an earthquake does to both human lives and property.

(i) Landslides

Landslides and debris falls are caused by weaker land masses and tectonically sensitive land borders, which harm communities and transportation infrastructure on the lower slope segments.

(ii) Damage to Life and property

Buildings, roads, trains, industries, dams, and bridges all sustain severe damage, resulting in significant losses in both human life and property. In contrast to buildings made of consolidated materials and bedrock, earthquake vibrations remain longer and seismic wave amplitudes are artificially higher in filled and levelled depressions, marsh deposits, etc. The effects of earthquake catastrophes on human buildings and life are explained by two significant earthquakes along the Bihar-Nepal border in 1934 and 1988. The Bihar earthquake of 15 January 1934, measuring 8.4 on the Richter scale, resulted in 10,700 fatalities, 250 km of landslides and 60 km of slumping, as well as ground surface ruptures and faults.

(iii) Damages to Government Infrastructure

Due to the high concentration of people, business structures, and residential areas, cities and towns are hardest impacted. Large building collapses result in higher loss of lives and property. Building collapse causes damage to ground water pipelines, which disrupts water supply, uproots telephone and electric poles, and completely shuts off electricity and communication. Sewer systems that fail may also have negative side effects like diseases and traffic jams.

(iv) Fire Hazard

Because of the overturning of cooking gas cylinders, contact with live electric wires, churning of blast furnaces and relocation of other electric and fire-related equipment, significant earthquakes create major fires in homes, mines and factories.

(v) **Landmass Deformation**

Because of crusts and troughs in the ground surface and faulting activity, intense earth tremors and the subsequent vibrations brought on by severe earthquakes cause the ground surface to deform.

(vi) Flash floods

Dams are damaged by powerful seismic occurrences, which also trigger catastrophic flash floods. Strong earthquakes that create rock blocks and other debris on the hill slopes facing the river valley also contribute to heavy floods by obstructing the flow of rivers.

III. CONCLUSION

Disaster management is essential for preserving lives, reducing losses, and fostering long-term recovery following catastrophes. Preparedness, response, and recovery are only a few of the important areas of disaster management that have been covered in this essay. Communities may increase their resilience and lessen susceptibility to different hazards via efficient planning, risk assessment, and the implementation of strong early warning systems.In order to guarantee a quick and effective reaction to catastrophes, preparation is essential and includes actions like developing emergency response plans, training employees, and holding exercises. Effective disaster management also depends on cooperation between many parties, including governmental organisations, humanitarian organisations, and local populations. Coordination may enhance response and recovery operations overall by streamlining communication, allocating resources more efficiently, and improving reaction.

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