Geography of Disaster Management

Madhu Prakash Srivastava
Yukti Khajanchi

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GEOGRAPHY OF DISASTER MANAGEMENT

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CHAPTER 1

A BRIEF INTRODUCTION TO DISASTER MANAGEMENT

Madhu Prakash Srivastava, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: madhu.srivastava@muit.in

ABSTRACT:

Disaster management plays a crucial role in safeguarding communities and minimizing the devastating impacts of natural and man-made disasters. This introduction aims to provide a comprehensive overview of the fundamental principles and key components of disaster management. It begins by defining disasters and highlighting their unpredictable nature and potential to disrupt societal systems. The significance of disaster preparedness, mitigation, response, and recovery phases is emphasized, along with the importance of effective coordination and collaboration among various stakeholders involved in disaster management. Furthermore, the chapter explores the multidisciplinary nature of disaster management, drawing upon fields such as emergency management, risk assessment, humanitarian aid, and community resilience. The role of technology and innovation in enhancing disaster management capabilities is also addressed. By understanding the core concepts and principles presented in this introduction, individuals and organizations can develop a solid foundation to actively contribute to the field of disaster management and contribute to building more resilient and sustainable communities.

KEYWORDS:

Calamity, Disaster, Environment, Management, Susceptibility.

INTRODUCTION

The duties of a disaster manager are those of a disaster relief assistant both during and after a catastrophe emergency. Disaster management is a relatively recent profession that may be identified. It is not always a full-time endeavor. In reality, the majority of those working in the sector only have a small portion of their overall duties related to catastrophe challenges. In recent years, there has been a growing understanding that all of these disaster management operations really make up the disaster management process. However, those working in the catastrophe area need to play a consistent and unified role [1]–[3]. This covers a wide range of tasks, from management through project execution. Additionally, this area includes disaster preparation, mitigation, prevention, and response. The only way to successfully handle calamities is to eradicate their underlying causes. This would once again help to reduce the population's susceptibility to calamity. Positive emergency responses will have a significant influence on how dangerous catastrophe events are now. To accomplish their mission, disaster managers will need a variety of technology and abilities, and they must undergo rigorous training. The whole range of catastrophe-related operations is referred to as disaster management. In general, people want to conceive of disaster management in terms of the post-disaster measures conducted by authorities responsible for relief and rebuilding. However, it has been noted that disaster management has a considerably wider range of applications and that many contemporary disaster managers are far more engaged in pre-disaster operations than in post-disaster response.

Disaster Definition

A catastrophe may be defined in many ways. According to each organization's responsibilities, prejudices, and capacities, definitions differ across aid groups. Disasters are defined as abrupt events like accidents or natural disasters that result in significant property damage or fatalities. It is a scenario brought on by a natural phenomenon or an armed war that causes significant economic disruption, stress, and bodily and emotional harm. Although catastrophes are often described in terms of the event that produced them, it is crucial to remember that a disaster is not the event itself. You may use an earthquake as an example to illustrate this. It is a result of nature. However, it is unlikely to cause a catastrophe if it does not hit a densely populated region with flimsy structures. Exactly which situation will be considered a catastrophe depends largely on who is describing it? An oil refinery explosion, for instance, would be considered a big catastrophe by the government, but the United Nations or volunteer organizations (VOLAGS) are unlikely to launch a large reaction unless hundreds of low-income families are also injured. On the other hand, long-term environmental degradation-related crises often get attention from VOLAGS before governments make use of their resources [4]–[6].

There are distinctions between accidents and catastrophes. By the scope of the need and the number of people affected, a catastrophe may be distinguished from an accident or incident. Although an airplane catastrophe is both tragic and expensive, the number of victims is really rather low. Disasters should be distinguished from individual, mild, or localized suffering. For instance, hunger is a global issue that is becoming worse. Being endemic, it is often handled using a variety of strategies. The only time that a situation qualifies as a disaster is when hunger becomes severe and pervasive or manifests as a famine. This difference is crucial because it not only provides a beginning point for analyzing and comprehending disasters' significance, effect, and required solutions, but also helps designate them as a different group of occurrences.

Three Categories of Disasters Exist

Natural Catastrophes

Disasters that are brought on by natural events like earthquakes, cyclones, floods, etc. are referred to as natural disasters. Technically speaking, they are still considered natural risks. The phrase natural disaster may be deceptive since it suggests that disasters only occur as a consequence of natural dangers, but in reality, human activities have a significant role in disaster creation. For instance, tragedies would not be caused by floods if towns or farms were not situated in flood plains. If homes were constructed to earthquake- and cyclone-resistant standards, these risks would only be of interest to scientists and would not cause natural catastrophes. Recent years have seen an increase in the frequency of environmental disasters. It usually happens as a consequence of subpar agricultural, grazing, or settlement methods, or as a result of wood fuel demand. Deforestation, desertification, erosion, siltation, and floods are often the results of poor land use or excessive exploitation of natural resources, which upsets the ecological balance. Examples include increasing desertification brought on by overgrazing or incorrect use of water resources, as well as increased floods caused by bad agricultural practices or overgrazing in a watershed's higher reaches. This kind of calamity is causing many people to worry since it may cause significant human displacement in addition to negative environmental effects. The ensuing social upheaval might lead to serious issues.

Invented Disasters

The phrase man-made disasters often refer to catastrophes brought on by man-made risks. Armed conflict, technology disasters, and disasters that don't result from natural hazards but happen in populated areas make up the three main types of man-made catastrophes.

Technology-Related Mistakes

When dangerous things like gasoline, chemicals, explosives, or radioactive materials are manufactured, transported, or distributed, accidents or incidents often arise. An example is the disastrous gas leak that occurred in 1984 at the pesticide facility in Bhopal, India. According to environmentalists, such catastrophes are frequent in industrializing and developing nations because they lack the skilled personnel and government authorities to identify and address dangers in more complicated and large-scale industries. Additionally, employees in industrialized nations have higher levels of technical proficiency than those in developing nations. A common misconception in poor nations is that environmental protections are too expensive, which leads to unhealthy working conditions. For instance, it would be difficult to mandate steel-toed safety boots at a facility where most of the employees lack shoes.

Although the kind of accidents that occur in both affluent and developing nations are similar, the chance that they will happen and the potential harm they might do are significantly larger. Due to the fact that Third World enterprises are often surrounded by shantytowns and slums populated by migrants from the nearby countryside, the mortality tolls from the ensuing accidents may be increased. Disasters caused by technology may sometimes be more economically than physically devastating. For instance, massive refineries have detonated with no human casualties, but the expense of repairing such facilities may be a tremendous burden that severely impacts a tiny country's economy.

DISCUSSION

Hazards, Calamity, and Disaster Distinctions

Disasters and Risks are Different

Hazard is a term used to describe a condition that is very harmful for both human and animal life and constitutes a threat to life, health, property, or the environment. A theoretical danger of injury exists for the majority of risks, which are latent or prospective. An emergency arises when a risk is active. Risk is a result of the interaction between possibility and hazard. On the other side, a danger, which might be either natural or man-made, is what causes a tragedy. Natural hazards are events that occur in the natural world and cause damage. The term natural is used to denote that nature is to blame for the calamity. Natural disasters include things like earthquakes, hurricanes, sinkholes, hailstorms, wildfires, and others. Remembering that one natural danger might lead to another may also be beneficial. A tsunami, for instance, may result from an earthquake. Disasters caused by nature are somewhat different. They are the consequences of natural disasters on people. For instance, the tsunami in Indonesia resulted in significant property destruction and, more crucially, human life loss. Along with property damage and human casualties, the earthquake and tsunami in Japan also resulted in nuclear fallout [7], [8].

A catastrophe is an occurrence that totally upends a community's regular ways of life, whereas a hazard is a scenario where there is a danger to life, health, the environment, or property. The

community suffers losses as a result of it that are too great for it to handle on its own in terms of people, money, and the environment. Hazards are phenomena that occur on our planet, whether they are created by nature or by humans, and cannot be avoided. While catastrophes are the end outcome of a hazard, which may be natural or man-made, hazards only present a danger to life and property in their latent stage. When these dangers result in significant loss of life and property, they are referred to be disasters. A danger turns into a catastrophe when it becomes active and is no longer merely a threat. Disasters and risks are both man-made and natural. If we learn to live in tune with nature and take precautions, we can stop dangers from turning into catastrophes. Disaster is an unanticipated natural or man-made calamity of considerable scope that causes severe physical damage or destruction, loss of life, or sometimes irreversible alteration to the natural environment. Calamity is an occurrence that causes tremendous loss.

Vulnerability, Potential, and Risk

As a result of their design or location near dangerous terrain, human communities, structures, crops, or human health are vulnerable to disasters.

Capacity

A community, society, or organization's capacity is the sum of all its assets, strengths, and resources that may be employed to carry out predetermined objectives. The process of building individuals, organizations, and society's capabilities over time to accomplish social and economic objectives, including through enhancing knowledge, skills, processes, and institutions, is known as capacity development. A combination of all the strengths and resources available within a community, society, or organization that can reduce the level of risk or the effects of a disaster is what capacity is defined as in the definition of capacity. This encompasses management and leadership, as well as material and human resources. The United Nations Development Programme (UNDP) sees capacity building as a locally driven, social change and acknowledges that competent people, organizations, and communities are essential to the effective lowering and managing of catastrophe risks. If capacity is the ability to plan and accomplish goals, then capacity development is the path leading to those goals. Commonly, the term capacity development refers to a procedure that is internally motivated and begins with already-existing capacity assets.

However, the term capacity building refers to a procedure that only aids in the early phases of developing or establishing capabilities, often by outsiders, and is predicated on the notion that no current capacities exist from which to begin. As a result, it is less extensive than capacity development. The following presumptions serve as the foundation for UNDP's work in creating sustainable DRR (Disaster Risk Reduction) capacity at the national and local levels. Any DRR company must have locally developed, owned, and maintained capacity to succeed. Rather than being the responsibility of a particular organization, field of study, or stakeholder group, the development of DRR (Disaster Risk Reduction) capability is the issue of a whole society. The advancement of leadership, other managerial skills, and performance-improving techniques must be combined with the technical capacity development associated with professional disciplines or functions like environmental management or land-use management. Transforming capacity into performance requires an enabling environment, which includes strong political ownership and commitment at the highest levels of power, wide engagement, openness, and obvious public responsibility. In order to be able to cope, one must maintain awareness, have access to resources, and practice excellent management in both good and bad times. Disaster risks are reduced in part due to coping mechanisms.

Risk

Risk is the relative likelihood that a dangerous occurrence will take place. For instance, a high-risk location might be near an active fault zone. catastrophe risk, or the potential for a catastrophe in a location, results from the interaction of vulnerability and hazard. Risk thus has the potential to be harmful. Hazard and vulnerability divided by capacity for convenience produce disaster risk. Traditionally, the notation is used to denote danger. Therefore, risk rises with rising risks and vulnerabilities and falls with rising capacity. The ability of a community to handle a risk and lessen its possible effects is referred to as capacity. Reduced dangers, increased capacity, and reduced susceptibility are all necessary to lower risk. But we are aware that in most situations, the level of risk is predetermined and cannot be altered.

Cycle for Disaster Management

Every action that may be performed before, during, or after a catastrophe with the intention of preventing it, lessening its effect, or recovering from its losses is included in disaster risk management. The following are the three main phases of actions involved in disaster risk reduction.

The Period Just Before to a Calamity

Pre-disaster measures are those that have been implemented to lessen the harm that a possible danger may bring to people and property. such as launching awareness campaigns, bolstering the weak systems already in place, creating strategies for crisis management at the family and community levels, etc. These risk reduction actions are referred to as mitigation and preparation activities during this stage. These are actions taken to guarantee that victims' needs and necessities are satisfied and suffering is kept to a minimum. Emergency response actions are those undertaken at this time.

After a Catastrophe (Post-Disaster)

Immediately after a catastrophe happens, actions are performed in reaction to it with the aim of achieving early recovery and rehabilitation of impacted populations. Response and recovery efforts are what they are known as. The Disaster Risk Management Cycle Diagram (DRMC) broadens the scope of efforts that typically take place throughout a disaster's Emergency response and Recovery periods. Some of them overlap across both phases such things as coordination and the provision of continuous help, however some tasks are exclusive to each stage e.g. Early Warning, Evacuation, and Reconstruction during Emergency Response, as well as Economic and 48 Social Recovery during Recovery. The DRMC also emphasizes the media's function, where there is a direct correlation between it and financing possibilities. This diagram is most effective for disasters with relatively rapid onset, such as floods, earthquakes, bushfires, tsunamis, cyclones, etc., but it is less accurate for disasters with slow onset, such as drought, where there is no single, easily identifiable event that initiates the transition into the Emergency Response stage. catastrophe management, according to Warfield (2008), attempts to minimize or prevent possible losses from hazards, provide fast and appropriate aid to catastrophe victims, and accomplish speedy and efficient recovery.

The disaster management cycle exemplifies the continual process by which organizations in the public, private, and nonprofit sectors prepare for and lessen the effects of catastrophes, respond during and immediately after a disaster, and take action to recover. At every stage of the cycle, the

right decisions increase readiness, improve warnings, minimize vulnerability, or prevent catastrophes from occurring in the next cycle iteration. In order to fully manage a catastrophe, governmental policies and strategies must be developed that either change the causes of disasters or lessen their consequences on infrastructure, people, and property. As disaster management is strengthened in advance of a catastrophic occurrence, the mitigation and readiness stages take place. Developmental concerns are essential to the prevention of disasters and to a community's efficient catastrophe response. catastrophe management professionals, in particular humanitarian organizations, are engaged in the immediate response and long-term recovery stages as soon as a catastrophe strikes. The four stages of disaster management described below do not necessarily, or even often, take place one after the other or in this specific sequence. The duration of each phase is significantly influenced by the intensity of the catastrophe, and parts of the cycle often overlap.

1. **Mitigation:** Reducing the consequences of a tragedy. Examples include zoning laws and construction rules, vulnerability assessments, and public education. Being prepared means figuring out how to react. Examples include emergency preparations, drills, and warning systems.
2. **Response:** Attempts to reduce the dangers a catastrophe creates. Examples include search and rescue and disaster aid.
3. **Recovery:** Getting the neighborhood back to normal. Examples include grants, short-term housing, and health treatment.

Indian Disaster Management

With over 6 billion inhabitants, India is the second most populous nation in the world and the biggest democracy. India is a very varied nation that is integrated. India is located in South Asia and is bordered by the Arabian Sea, Indian Ocean, and Bay of Bengal on three sides. There are mountain ranges in the Himalayas to the north. India has a 3.4 million square kilometer landmass and a 7,500-kilometer-long coastline. Prior to the Mughals' invasion for plundering, India was the wealthiest nation in the world economically. All of the magnificent diamonds originated in India, which also knew how to mine and manufacture diamonds. According to the Human Development Index, India's per capita GDP in 2005 was just $736, and the country ranked 128th overall (UNDP 2007). Poverty is the primary contributing factor to catastrophes in India.

India stands out as one of the nation’s most vulnerable to natural catastrophes, including some of the world's worst cyclones, earthquakes, chemical disasters, mid-air head-on air crashes, rail accidents, and road accidents. India is among the nation’s most vulnerable to terrorist attacks. Up until recently, India was a reactive nation that only offered assistance in the wake of catastrophes. It was a disaster management method that was focused on aid. India also boasts the oldest famine relief laws in the world. There has been a paradigm change in recent years. With a focus on disaster preparation, mitigation, and prevention, India has become more proactive or is doing so. India has a history of accepting aid from other countries during emergencies. While India initially refused to accept aid from other nations in the wake of the 2004 tsunami in the Indian Ocean, it nonetheless sent defense personnel, medical teams, disaster experts, ships, helicopters, and other types of humans, material, and equipment resources to aid Sri Lanka, Mauritius, and Indonesia.

It should be highlighted that India saw the tsunami firsthand and was simultaneously reacting to it domestically. National geographic borders are not respected or recognized by disasters. The tsunami event provides a striking illustration. As the globe becomes more globalized, there will be an increase in regional catastrophes that affect many different nations. On the basis of previous

catastrophic catastrophes, several adjustments have been made to disaster policy and new organizations have been formed. The Disaster Management Act of 2005 was passed, and the national disaster management response structure was created. The promotion of a culture of disaster resilience is a major goal of the National Disaster Management Authority. Disaster management training is offered by the National Institute of Disaster Management as well as Disaster Management Cells in the states [9], [10].

Disaster Planning

Indian disaster strategy now emphasizes catastrophe prevention, planning, and mitigation rather than reaction and disaster assistance. Moving from government to public-private partnerships and community catastrophe management is another key trend in disaster management. Significant progress has been achieved in this area, but the primary roadblock is the government officials' dictatorial demeanor. The kind of catastrophe response by the Indian government is described in the India catastrophe Report. The lack of a cogent disaster preparation and response strategy, the necessity for immediate steps, and the quality and availability of disaster-related information are identified as the main problems. It demonstrates how important advancements in social, economic, and health progress have often been halted or reversed by catastrophes. The strategy underlined the reality that without mitigation being included into the development process, no growth would be sustainable.

The development strategy incorporated disaster mitigation and prevention as a key element. The development process must take disaster mitigation, preparation, and prevention into consideration. As a result, disaster management has become a top concern for the nation. Beyond the traditional emphasis on post-event assistance and recovery, there is a need to look forward and plan for disaster preparation and mitigation in order to reduce the impact of recurring shocks to our development efforts. The 2001 Gujarat earthquake had a significant effect. Along with the victims, their relatives, and the general populace, it had a very devastating impact on the government and those who set policy. The Gujarat Disaster Management Act, 2003 was passed by the Gujarati government in India for the first time. Prior to it, neither the federal nor state levels had any laws in place to address the holistic management of different types of catastrophes. The relief code, the rules and regulations, and the government directives made throughout the years that were not merged were substantially followed by the state and federal governments.

Group for Disaster Management

Local government is in charge of disaster management, which is supervised by the State Government and supported by the Government of India. There are around 600 districts in the 35 states and union territories. A Collector and District Magistrate oversee the administration of each district. There is a disaster management cell in every state, which is often housed at the state administrative training institutions. The Central Government provides the majority of financing for the Disaster Management Cell's faculties. Each cell is expected to get disaster management training and to create plans and papers. Because of the many droughts and famines, the government gained a great deal of experience in disaster relief efforts. The NDMA is responsible for directing relief in loan repayment or granting new loans on such concessional terms as may be deemed appropriate. It also coordinates the enforcement and implementation of disaster management policies and plans, arranges and supervises the funding of mitigation measures, preparedness and response, and establishes guidelines for the minimum standards of relief to be provided to those affected by disasters. The NDMA may take these steps to avert calamity. A multidisciplinary,

multiskilled, high-tech National Disaster Response Force (NDRF) with eight battalions has been established to confront nuclear, biological, and chemical calamities. This covers all calamities that may occur on land, at sea, or in the air.

Infrastructure and other capital asset repair expenses should be paid for first from plan funds, with the exception of those that are directly related to relief efforts and communication with the impacted region and people. The responsible Ministries of the Government of India, the State Governments, and the Planning Commission formulate medium- and long-term strategies to lessen and, if feasible, completely eradicate the recurrence of these catastrophes. The Planning Commission should be able to pinpoint capital projects to stop the recurrence of certain disasters after consulting with the State Governments and relevant Ministries. The Plan may provide funding for these projects. Development initiatives should be considerate of disaster mitigation in order to advance toward safer development. Economically speaking, it makes more sense to spend a little bit more now, in a planned manner, on measures and components that can help in disaster prevention and mitigation, rather than being forced to spend much more recently on restoration and rehabilitation, given the kind of economic losses and developmental setbacks the country has been experiencing year after year. Development projects and processes should be planned with the prevention and mitigation of disasters in mind; otherwise, the development will no longer be sustainable and will ultimately result in more suffering and loss for the country.

NGOs' (Non-Governmental Organizations) Role in Development

On staff at many nongovernmental development organizations (NGOs) are experts in disaster relief. This proves that catastrophes often strike areas where development organizations run regular programs, and that they are unable to stay out of and participate in post-disaster operations. Specialized personnel oversee post-disaster activities and assist in creating catastrophe plans for their companies. Outside of these mechanisms that are expressly designed for disaster management or relief, disaster management experts are also present. Major departments or important persons are often allocated to disaster management or mitigation tasks in government ministries including agriculture, forestry, public health, defense, and public works. For instance, it is typical to encounter a public works department employee who is responsible for carrying out flood control measures. That individual must take responsibility for inland usage, settlement planning, evacuation, and flood mitigation in order to be successful. As a result, the good disaster manager has to be involved in many different operations.

Community-Based Organizations' Function

Disaster management refers to a deliberate and methodical approach to comprehending and resolving issues following disasters, which includes systematic observation and analysis of actions related to disaster prevention, mitigation, preparedness, emergency response, rehabilitation, and reconstruction. In other words, community preparation plays a role in disaster management. Depending on how much damage and loss of life it causes to society's infrastructure, a natural hazard may develop into a natural catastrophe. A robust safety plan is very necessary to improve community readiness. All pre-disaster preparation is included in the community preparedness plan in order to minimize loss due to a natural catastrophe. It is essentially a synthesis of numerous detailed strategies to achieve a single goal. In each emergency event, the local community is the first to act. Therefore, community-based activities are crucial for disaster management. Initiatives conducted by numerous entities, including the state, must thus be focused on individuals.

Additionally, the community's involvement in planning and decision-making should be used to determine the degree of community engagement.

The local economy must become stronger so that local residents can stop relying on outside aid. In recent decades, the volunteer sector has been in the forefront of organizing communities to help them deal with calamities. With the assistance of the state, their actions and experiences have been amplified and displayed on a bigger scale. Communities and the development organizations that operate there get along well. As a result, the state has been able to carry out its plans more successfully. Plans made at the village level in Orissa after the Super Cyclone are one such example. The development community has learned from its extensive experience around the world that community-based disaster risk reduction (CBDRR) initiatives that are approached from a social and behavior change perspective ensure that the poorest, most vulnerable, and marginalized communities are aware of the straightforward steps that must be taken to protect people's lives and personal property in the event of natural disasters. The ability of CBDRR to alter mindsets in both communities and other stakeholders may be the most important lesson learned.

Disaster Risk Management at the Community Level (CBDRM)

The only technique of disaster management that has been proved effective is community-based, and it is anticipated that India would be a global leader in this field. In order to lessen their vulnerabilities and strengthen their capabilities, the risk communities the first respondersare actively involved in the identification, analysis, treatment, monitoring, and assessment of catastrophe risks. Given the severity and frequency of natural catastrophes in India, it has been determined that the country would benefit greatly from the institutionalization of CBDRM in government policymaking and programs. When Mumbai, Pune, and other regions were devastated by unheard-of floods, Maharashtra provided the best example of community-based disaster management. This state also suffered significant losses in terms of human life and both public and private property. In order to meet the needs of those who were affected, the development sector undertook a process of relief, rehabilitation, and livelihood restoration. The world's development industry is home to a sizable body of knowledge and skill.

The employees of governmental disaster preparation organizations, national emergency or relief organizations, national rebuilding organizations, and emergency service organizations, departments, or ministries are the most notable disaster managers. All call for catastrophe management experts. Disaster managers are often employed by municipal or provincial governments. A director of emergency services works in a big metropolis. There are other people working there in the public works, police, or health agencies. They could be given more duties related to emergency management. A large number of nonprofit organizations, including the National Red Cross and Red Crescent Societies, the League of Red Cross and Red Crescent Societies, and the International Committee of the Red Cross, are designed particularly to provide emergency assistance. They operate on both a national and international scale. Additionally, there are millions of smaller private aid groups worldwide. These have been set up to provide specialized aid to catastrophe victims.

The function of Communication and The Media in Disaster Management

The prevention of disasters depends critically on communication. It is true that they often cross over. However, these responsibilities may be broken down into five major groups. Technical communication systems, such satellites, computer networks, and remote sensing equipment, as

well as other technology-based communication systems, conduct research on, anticipate the course of, monitor, and offer early warning of natural catastrophes. Disaster site communications keep in touch with emergency relief supply providers, the government, impacted communities, and disaster response personnel. The efficient, reliable functioning and interaction of private, governmental, and international catastrophe prevention and relief groups relies on organizational communications.

Our understanding of natural hazards and how to prevent them from becoming catastrophes is developed via communication between scientists, engineers, government officials, other disaster response authorities, insurers, the media, and the general public. Public education and communication are used to inform the public about natural hazards and disaster prevention, warn of impending dangers, and encourage participation in public discussions about disaster preparedness and response through electronic and print media, wired and mobile phones, and alternative media. Scientists, representatives of the disaster relief community, and communications experts have all taken an interest in each of these communications-related catastrophe responses. Many of the studies and conversations that have been the focus of current worldwide discussions about technical communications systems, communications at catastrophe sites, and organizational communications are published elsewhere in this collection.

Geography and GIS's Function in Disaster Management

Geography has a long history of study and use in disaster management and hazard understanding. It looks at some of the early theories of geography's interest in interactions between people and their environments and talks about how our knowledge of hazards has changed over time, particularly the contemporary focus on vulnerability. Global Positioning Systems (GPS), Geographic Information Systems (GIS), and Remote Sensing (RS) have drawn a lot of attention for their uses in disaster management and are being used more often as a decision-supporting tool across the whole disaster management cycle. Using digital video and mobile GIS to collect geodata from an urban catastrophe management viewpoint.

Program Accessibility

There were two distinct software package kinds examined. One group underwent testing with the aim of analyzing the capability to import GPS-tracked points and export them to a GIS. The second group underwent testing with the aim of analyzing still picture capture from digital video. ArcPad has proven to be the best program for processing GPS data; it is user-friendly and enables you to essentially skip many stages since it is a scaled-down version of ArcView with the ability to connect in real-time to GPS devices. Additionally, it is adaptable using the ArcPad Application Builder. The Scandalize Live program was the only one of those evaluated that could automatically store a series of photographs using the time-code as their filename for the automated creation of still images based on video.

CONCLUSION

After reading the chapter, we may draw the conclusion that natural catastrophes play a significant role in the natural cycles. The importance of public perception in the management of natural disasters is reasonably evident. Existing technologies are capable of giving disaster management crucial and novel information that might save lives, limit property damage, and diminish the environmental effects of natural catastrophes. Despite all of this, there are many flaws that prevent

the best decision-making for catastrophe management. Natural disasters, man-made catastrophes, and technical disasters are the three different categories of disasters. Effective preparation before a crisis occurs may often be the best reaction to natural or man-made catastrophes. If the managers themselves are aware of what to do in a crisis and how to prepare for one, disaster management will be successful. India has always been susceptible to natural calamities such floods, droughts, cyclones, earthquakes, and landslides due to her unique geo-climatic circumstances. The amount of individual, communal, and public assets lost has been enormous. Disasters have the greatest impact on the underprivileged and the destitute. Therefore, disaster management plays a significant role in Indian policy. Additionally, a crucial stage in the process of lessening the effects of catastrophes is the identification of hazards and the evaluation of risks impacting the state.

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CHAPTER 2

NATURAL DISASTER: FLOODS AND DROUGHTS

Ramakant, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: ramakant@muit.in

ABSTRACT:

Floods and droughts are two significant natural disasters that have far-reaching impacts on human populations and the environment. This study provides an overview of floods and droughts, examining their causes, characteristics, and the consequences they impose on affected regions. The discussion begins by exploring the factors that contribute to floods, such as heavy rainfall, snowmelt, or dam failures, and the subsequent inundation of land areas. Similarly, the chapter delves into the causes of droughts, including prolonged periods of low precipitation and high evaporation rates, leading to water scarcity and agricultural losses. The unique characteristics and patterns of floods and droughts are examined, ranging from flash floods with rapid onset to prolonged droughts spanning multiple seasons or years. The study also highlights the various impacts of these disasters, encompassing loss of life, displacement, damage to infrastructure, agricultural failures, and ecological disturbances. Additionally, the importance of effective preparedness, early warning systems, and adaptive strategies in mitigating the adverse effects of floods and droughts is emphasized. Understanding the nature and dynamics of these natural disasters is essential for policymakers, emergency responders, and communities to develop robust strategies and resilience plans that aim to reduce vulnerability and enhance adaptive capacities in the face of future flood and drought events.

KEYWORDS:

Environment, Floods, Management, Natural Disaster, Susceptibility.

INTRODUCTION

As a consequence, natural catastrophes cause significant devastation and a high fatality rate. Disasters do not include incidents that take place in sparsely populated regions. Therefore, although a flood in a city is considered a natural catastrophe, one on an uninhabited island would not qualify. Some of the main natural catastrophes that often and progressively afflict India are floods, droughts, cyclones, earthquakes, landslides, and avalanches [1]–[3]. Disasters that are brought on by natural events like earthquakes, cyclones, floods, etc. are referred to as natural disasters. Technically speaking, they are still considered natural risks. The phrase natural disaster may be deceptive since it suggests that disasters are only caused by natural dangers, but in reality, human activities have a significant role in disaster creation. For instance, tragedies would not be caused by floods if towns or farms were not situated in flood plains. If homes were constructed to earthquake- and cyclone-resistant standards, these risks would only be of interest to scientists and would not cause natural catastrophes. Recent years have seen an increase in the frequency of environmental disasters. It usually happens as a consequence of subpar agricultural, grazing, or settlement methods, or as a result of wood fuel demand. Deforestation, desertification, erosion, siltation, and floods are often the results of poor land use or excessive exploitation of natural resources, which upsets the ecological balance. Examples include increasing desertification

brought on by overgrazing or incorrect use of water resources, as well as increased floods caused by bad agricultural practices or overgrazing in a watershed's higher reaches. This kind of calamity is causing many people to worry since it may cause significant human displacement in addition to negative environmental effects. The ensuing social upheaval might lead to serious issues [4]–[6].

Natural Disasters in India, Types

The climate in India contributed to a number of natural catastrophes there. Massive losses of Indian lives and property have resulted from this. The worst dangers are droughts, floods, flash floods, cyclones, avalanches, landslides caused by heavy rainfall, and snowstorms. These occurrences need to have significant negative effects on the environment and/or cause human casualties in order to be considered disasters. These usually suffer monetary losses as well. In steep locations, excessive rain during the monsoon triggered landslides, greatly disrupting life there and even in the adjacent villages. Frequent summer dust storms, which typically move from north to south and inflict significant property damage in North India, are another threat. They also drop a lot of dust from dry areas. In certain areas of India, hail is also frequent and seriously damages standing crops like wheat and rice. The following are a few of India's natural disasters.

India's Landslides

Because the lower Himalayan hills in India are still forming and are not old enough, landslides continue to occur there often. Deforestation, which has resulted in massive tree removal, is another factor contributing to the prevalence of landslides in these areas. In addition to the lower Himalayas, several parts of the Western Ghats also sometimes suffer landslides, but not as often. Avalanches occur often in significant areas of Sikkim, Kashmir, and Himachal Pradesh.

India's Floods

The most frequent natural disaster that affects practically all of India's areas is flooding. Heavy rains raise the flood levels of large rivers like the Brahmaputra, which causes widespread devastation across that area. Crops are severely impacted. Global warming is a big factor in this catastrophe as well. Massive ice formations are rapidly melting, raising the water levels even further. Floods have largely been happening in Central India during the last several decades. Floods are the most frequent environmental problem caused by the imbalance in the environmental cycle.

Swift Floods

The 2013 flash floods in the Ganga River were yet another devastation caused by nature that struck the nation. Many of the hundreds of people that perished in Uttarakhand as a result of the region's disastrous landslides were pilgrims to Badrinath and Kedarnath, and many more are still unaccounted for.

India's Drought

Tens of millions of people have died as a result of drought in India over the 18th, 19th, and 20th centuries. Indian agriculture is mainly reliant on the summer monsoon in the southwest. The failure of the monsoons causes water shortages and below-average agricultural harvests in several areas of India.

Cyclones that Wreaked Havoc in India

The most destructive kind of natural catastrophe is a cyclone. Cyclones strike coastal areas in the Intertropical Convergence Zone, including the Bay of Bengal, and are characterized by stormy rains that cause total blackouts and shut off access to all forms of connection, even for essential supplies. Mild cyclones infrequently occur along India's western coast, which is bordered by the Arabian Sea; they mostly affect Gujarat and, less commonly, Kerala. In the Bay of Bengal area, coastal regions like Andhra Pradesh, Orissa, Tamil Nadu, and West Bengal are most affected by strong cyclones. Aside from these significant natural disasters, there are several other problems that have been significantly interfering with living in India, such as drought, heat waves, and wildfires. Although some steps have been made to limit the damage, there is still much that needs to be done.

DISCUSSION

Resulting from Disasters

India is one of the most disaster-prone countries in the world since so much of it is vulnerable to natural disasters. Disasters have resulted from them, resulting in human and material damage. Natural disasters including storms, landslides, volcanic eruptions, floods, and earthquakes have disastrous effects. In recent years, these dangers have claimed hundreds of lives and caused enormous property damage. These have had a negative impact on the crucial areas for the growth of the nation, including agriculture, communication, irrigation, power projects, and rural and urban settlements. No matter how long a catastrophe lasts, the devastation in terms of lives lost, injuries sustained, and property lost is immeasurable. The fact that several million people have been murdered by floods, earthquakes, landslides, cyclones, etc. in only the last two decades may be used to gauge the severity of the catastrophes. Following is a discussion of some typical natural catastrophes and how they affect the environment:

Earthquake Effects on the Environment

One of the most devastating natural catastrophes is an earthquake. An earthquake's size, length, and quantity of shaking all affect the amount of damage it does. There are areas in the earth's crust that are unstable and are prone to tectonic activity. Affected areas in India include the whole Himalayan region, sections of the Gangetic Plain, Kutch, and the Andaman and Nicobar Islands. Earthquakes have killed millions of people worldwide during the last 500 years. Building collapse results in significant loss of lives and property. In addition, there is major damage to the roads, bridges, canals, electric poles, etc. Earthquakes seem to occur more often in certain areas. The following are India's most significant earthquakes:

Ground Tremor and Surface Rupture

i. This is the primary reason why houses, bridges, roads, canals, and other things are destroyed.
ii. Earthquakes cause sands and silts to liquefy, changing their condition from one of solid to liquid. As a consequence, buildings also collapse.
iii. Landslides in hilly areas, strong earthquakes can cause many landslides.
iv. Fires are a significant risk that is related to earthquakes. The gas pipelines and electrical wires that start fires are often broken by earth tremors and structural damage.

v. Following an earthquake, a region's groundwater conditions and surface topography are affected.

Flood's Impact on the Environment

Floods may result in fewer fatalities than earthquakes or cyclones, but they nevertheless do a great deal of environmental harm. If the floods continue for a longer period of time, the issue becomes worse. Massive losses in life and property result from floods in the impacted area. Both cattle and crops have suffered significant losses. Floods have repercussions beyond property destruction and human and animal deaths. These are what they are:

1. Many epidemic illnesses, including diarrhea, gastroenteritis, jaundice, malaria, etc., spread as a result of floods.
2. Soil erosion is a result of rapid runoff.
3. Forests and wildlife habitat are often damaged.
4. Buildings, bridges, roads, sewage lines, electricity lines, and other man-made infrastructure are harmed.
5. Floods ruin agricultural soil and inflict extensive harm to standing crops.
6. Food and drinking water are severely in short supply in flood-affected communities.

Adverse Consequences of Drought

Drought has several effects on a nation's geography since it has an influence on all facets of our civilization, including the political, social, and economic ones. Agriculture is the sector of the Indian economy that is directly impacted by drought. A weak monsoon will lead to crop failure, which will have an impact on hundreds of millions of small farmers, agricultural laborers, and their families. The farmer will be forced to borrow money from predatory lenders as a result of their severe circumstances, which will keep them trapped in a cycle of debt and poverty. In the worst cases, suicide would be the only option for these farming families during a drought. School dropouts and starvation would also be defining characteristics. We are aware of the farmer suicides that occurred in the Maharashtra area of Vidarbha in 2009 due to the drought.

Rainwater is very necessary for agriculture since irrigation systems are the mainstay of Indian agriculture. The Kharif crops are impacted by drought, which also negatively impacts India's rice output and the economy of our paddy-growing nation. A drought would have a negative impact on agricultural productivity by diminishing the yield and would increase food insecurity throughout the country. As a consequence, there would be a lack of food and food insecurity, which would cause significant inflation and a sharp increase in the cost of food grains, making it impossible for the poor to survive. Due to a lack of agricultural raw materials, agro-based sectors would likewise see a decline in output and suffer significant losses [7], [8].

One of the fundamental issues that everyone encounters is a difficulty with their source of drinking water. Due to the deterioration of green pasture areas and the lack of feed, the animal husbandry industry would be severely impacted. In addition, drought affects the amount of forest cover in India, which is a significant source of its economic resources. Forest fires, which destroy trees and other resources, are more likely to occur when there is a lack of precipitation. A drop in output during the monsoon season raises the price of agricultural products and has an impact on consumer demand. Farmers would profit from higher prices in a free market, but consumers would suffer, which would lead to a decline in demand. The bulk of farmers, particularly smallholders, do not

get the benefits of rising prices; instead, intermediaries or dealers take advantage of the situation. A drought so has an impact on both smallholder farmers and low-income consumers.

Effects of Snow Avalanches and Landslides

Landslides happen in isolated mountainous regions with challenging topography and unfavorable weather, where the villages and hamlets are tiny communities with shoddy houses, improvised constructions, and inadequate resources. In most situations, landslides and snow avalanches occur with little to no warning, dumping massive amounts of rock, soil, or snow on often unprepared populations. Given these details, it is reasonable to conclude that landslides have catastrophic impacts. The following are the direct and indirect impacts of landslides and avalanches:

Direct Consequences Result in Harm to the Body

Any object at the top of a landslide, along its route, or at its base will sustain significant damage. The impact of a slab type snow avalanche, in which enormous slabs of frozen snow crash to the ground, is very severe and destructive. In contrast, a loose snow snow avalanche may envelop and cover a broader region. The immediate repercussions of landslides and snow avalanches include damage to power and communication lines, closures of highways, mountain passes, and streams, in addition to injuries and deaths to people and livestock. Flash floods, which may be devastating, are caused by the blocking of streams and subsequent release of the impounded water. Flash floods may occur when enormous amounts of debris from landslides or snow avalanches fall into alpine lakes. Due to the freezing impact brought on by the exceptionally low temperatures, snow avalanches cause further agony. Even if there are survivors among the victims, they could have hypothermia and frostbite prior to rescue [9], [10].

Impacts Throughout Time and Indirect Effects

The indirect effects and long-term effects of landslides and snow avalanches cause further loss of productivity agriculture, poultry, small-scale cottage industry, forest produce in an already low productivity scenario, in addition to the loss of homes, destruction of property, and disruption of family life due to death or injury to relatives.

Disaster Mitigation Efforts

Mitigation is a process used to lessen both human suffering and property damage brought on by harsh natural occurrences. This includes actions like better farming methods, enhanced disaster-resistant construction systems, and land use planning. Disaster prevention and/or mitigation should be the main objectives of disaster management. Four sets of tools are typically available to disaster managers. As follows:

1. Reducing susceptibility and managing risks.
2. Economic rebalancing.
3. Political involvement.
4. Public perception.

Only natural catastrophes are addressed by risk management, vulnerability reduction, and economic diversification, while upcoming refugee crises are addressed by political action and public awareness. Programs for hazard management are often carried out by the government and intergovernmental organizations. Because many of the hazard management actions cover broad regions and demand a lot of resources, the bigger VOLAGS also fulfill the same job as these two.

Small organizations and local communities may carry out a range of tasks at the community level with minimal help from outside sources. Such actions include planting windbreaks and constructing flood embankments.

Planning Techniques

Through routine planning, many solutions that might lessen the effects of risks can be used. One of these is:

1. Normal development programs must be adjusted in order to minimize losses. For instance, in locations prone to floods or cyclones, crops that are more wind- or flood-resistant may be planted.
2. In the economic sphere, when economies are built on a single cash crop, diversification is crucial. The economy will be better protected by diversification from both natural calamities and unforeseen price changes on the global market. Small island nations that rely on exporting palm oil, bananas, or other tropical agricultural items are particularly susceptible to severe cyclone damage. These nations might expand their industries to include fishing, light manufacturing, or other ventures.
3. Creating within an area disaster resistant economic activity. Certain sorts of calamities have comparatively little impact on certain economic activity. For instance, warehousing is a better industry to locate near flood plains than manufacturing. In cyclone-prone coastal locations, coconut palms are a better choice than citrus or other fruit plants. It is important to look for and promote the growth of businesses that are less susceptible to risks.

The purpose, density, and placement of activities, as well as the pace of development and growth limitations, are all regulated by conventional land-use rules. The term zoning may be used to describe the grouping of land into districts or land-use zones. Ordinances governing zoning are often broken down into broad land-use classifications, such as commercial, residential, industrial, and/or agricultural applications. Reforestation areas, range-land management zones, and watershed management zones are a few examples of sub-zone classifications. Building regulations are used to regulate the built environment within a region. Hazardous areas may be permanently designated for agricultural or recreational use, reducing population or built environment concentrations on this location. Considering that enforcement is challenging and the majority of expansion is uncontrolled, building regulations and land-use zoning are often condemned as ineffectual in less developed nations.

Investment in or Development of Strategy

Planning professionals often promote growth away from risky locations. They make investments or work to improve the environment in less susceptible areas or communities to achieve this. The majority of risks are not site- or area-specific; they may endanger large regions, making it challenging to use this method in regional development. It might be argued that earthquake zones sometimes cover thousands of kilometers, making it difficult or impossible to relocate affected communities or businesses. In addition, risks that happen seldom are often not taken into account while planning economic growth. Despite all of these, agricultural sectors have benefited from strategic investment. Indian efforts to expand irrigation, land reclamation projects, and local farm-to-market highways into coastal plains have proven effective.

Economic Motivators

Governments provide a variety of financial incentives to individuals and groups in order to promote growth away from dangerous locations. The supply of land, loans, grants, preferential credit, preferential taxes, technical help, or a combination of these are examples of such incentives. The government of Bangladesh has a special responsibility to play in reducing agricultural and human losses. They started a program to provide landless peasants tiny irrigated parcels of land, and via participating private sector organizations, low-cost loans for early land development were made accessible. Government agricultural extortionists gave technical farming advice once they arrived in the new locations. A well-informed public, particularly those at risk, is necessary for effective hazard management. Public awareness is the term used in hazard management for this. Public awareness programs spread knowledge about the many sorts of hazards, their impacts, the steps that may be taken to lessen their effects, and what to do in case a danger arises.

Financial Protection

Economic mitigation lessens the effect of the catastrophe on the economy and on the financial stability of the disaster victims. In order to prevent all of the major businesses from being impacted at once, this is accomplished by strengthening the economic sectors that are most susceptible to disasters, diversifying the economy, introducing or expanding disaster-resistant economic activities, and spreading or relocating economic activities to less vulnerable areas. Economic loss mitigation follows the same process as physical loss mitigation. After hazard mapping is complete, planners pinpoint the economic sectors most susceptible to calamities. The foundational components of the economy and those that are less susceptible to catastrophe are first noted. Every economic activity is investigated to see whether a risk might influence a significant amount of it. Both the macro and micro levels of this study are used. Although insurance and economic diversification are the two main ways to mitigate economic harm, there are presently not enough programs accessible for low-income people in developing nations. Governments and significant economic organisations have sometimes discovered other methods of offering low-income individuals' insurance.

Changing Current Development Activities

Changing ongoing development plans is a significant method of catastrophe mitigation. Numerous development initiatives have the potential to lessen families' and communities' financial or physical vulnerability. For instance, housing plans may combine a range of disaster-resistant building and planning strategies, sometimes at little or no extra expense. Additionally, strengthening community resilience is crucial for reducing a community's susceptibility to floods and droughts. This entails involving neighborhood residents in initiatives to lower their risk of catastrophe, raising awareness, and educating them about preparation and response procedures. Collaboration between government organizations, non-governmental organizations, and local communities is essential for successful disaster management because it enables a planned and effective response to flood and drought occurrences. Understanding and tackling the problems caused by floods and droughts becomes even more important in a changing climatic situation when severe weather events are growing more common and powerful. We may work to create more resilient civilizations that can adapt to and recover from these natural calamities by fusing scientific knowledge, technological breakthroughs, and community involvement. Ultimately, we can lessen the destructive effects of floods and droughts, safeguard human lives and livelihoods, and maintain the integrity of our ecosystems by emphasizing preventative measures, sustainable land and water management practices, and comprehensive disaster risk reduction initiatives.

CONCLUSION

In conclusion, floods and droughts are two examples of natural catastrophes that provide serious problems for both the environment and human society. For efficient catastrophe management and the creation of resilient communities, a knowledge of their origins, traits, and effects is essential. Floods occur in the flooding of land regions and may cause significant damage to infrastructure, fatalities, and population relocation. They are often brought on by excessive rainfall, snowmelt, or dam collapses. Contrarily, droughts, which are characterized by protracted periods of little precipitation and high rates of evaporation, cause water shortages, failed agriculture, and ecological disruptions. Both catastrophes have extensive effects that go beyond the surrounding areas and have an impact on wider socioeconomic and environmental systems. Investment in preparation measures, including as early warning systems, infrastructure planning, and land use management, is essential to reducing the effects of floods and droughts. These tactics allow prompt reaction and evacuation, minimizing casualties and infrastructure damage. Additionally, effective irrigation methods, drought-resistant crops, and adaptation tactics that emphasize water conservation are essential for dealing with drought conditions.

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CHAPTER 3

FLOODS AND DROUGHTS WITH REFERENCE TO NATURE

Madhu Prakash Srivastava, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: madhu.srivastava@muit.in

ABSTRACT:

Floods and droughts are natural phenomena that have profound implications for the environment. This study provides an overview of floods and droughts, focusing on their connection to nature and the ecological consequences they entail. The discussion begins by examining the natural processes and climatic factors that contribute to floods, such as intense rainfall, snowmelt, or river channel dynamics. Similarly, the study explores the natural factors that cause droughts, including variations in precipitation patterns, soil moisture, and evaporation rates. Furthermore, the study delves into the ecological impacts of floods and droughts. Floods can play a vital role in shaping ecosystems by redistributing sediment, creating new habitats, and promoting biodiversity. However, excessive flooding can lead to erosion, loss of vegetation, and habitat destruction. In contrast, droughts pose significant challenges to plant and animal life by causing water stress, reducing food availability, and disrupting the delicate balance of ecosystems. Moreover, the study highlights the interconnections between floods, droughts, and climate change. It emphasizes that climate change can influence the frequency and intensity of these events, exacerbating their impacts on nature. Changes in rainfall patterns, rising temperatures, and altered hydrological cycles contribute to the increased occurrence of extreme floods and prolonged droughts, affecting ecosystems at various scales.

KEYWORDS:

Environment, Floods, Management, Natural Disaster, Susceptibility.

INTRODUCTION

Flooding occurs when the water level is high in a river channel or on the shore and causes land that is not typically submerged to be flooded. Since flood is a characteristic of the physical environment, it plays a significant role in the hydrological cycle of a drainage basin. Flooding is a natural occurrence that happens in reaction to a lot of rain, but it turns into a danger when it threatens people's lives and property. Low-lying coastal regions and river floodplains are the most susceptible to flooding. Every time the water level rises, any bare low-lying land next to a river, lagoon, or lake is more prone to experience flooding. As saltwater may readily be washed inland by high winds, tides, and tsunamis, this encompasses coastal regions and shorelines [1], [2].

India's Flood-Prone Regions

West Bengal, Orissa, Andhra Pradesh, Kerala, Assam, Bihar, Gujarat, Uttar Pradesh, Haryana, and Punjab are the states that lie on the fringe of the India Flood Prone Areas. The severe southwest monsoon rains force the banks of rivers like the Brahmaputra, Ganga, and Yamuna to expand, which in turn floods the nearby regions. Central India has gotten used to precipitation events like flash floods and intense rain during the last several decades. Floods in coastal locations are mostly caused by cyclones. In particular, the coasts of Andhra Pradesh, Orissa, and Gujarat in the east and

west of our wide coastline are particularly vulnerable to the assault of cyclonic storms that form and intensify over warm waters. Huge tidal surges and torrential rain are also present during these powerful storms. The coastal areas are extensively flooded by the tidal waves. Floods will inevitably occur in the cyclone-affected area due to the heavy rain that follows them. Cyclones caused 27 dams in Saurashtra to flood, some by more than 2 meters, in November 1982 and 1983. Although floods brought on by cyclonic storms are a natural disaster, we must take some preventative actions to lessen their effects.

Physical Circumstances

Substantial Catchment Area

Even when rainfall conditions are not very strong, a big catchment area gathers water from a greater region, increasing the likelihood of flooding in the resulting stream simply because the amount of water gathered from such a vast area becomes quite significant. The catchment regions for the Ganga and the Godavari are enormous, as is the amount of water that these rivers transport.

Insufficient Drainage Setup

Flooding happens regardless of how small the catchment area is or how much rain falls there because if the water does not drain fast, it builds up and causes flooding. The following are the causes of the inadequate drainage systems seen in various parts of the nation. Inadequately built drainage channels. Punjab and Rajasthan in particular have poorly developed drainage channels. When there is a lot of rain in these areas, the rivers cannot handle the volume of water, which causes flash floods. Additionally, the region's unconsolidated soil obstructs natural drainage, causing floods. Rivers reduced carrying capacity. The buildup of sediments from severe erosion in the catchment regions reduces the capacity of channels that convey water. The channel's carrying capacity is decreased as a result of the silt being deposited on the beds, which hinders water flow. This causes the flood water to spread out into the nearby plain. The Narayani and Kosi rivers, in particular, have caused extensive flooding in eastern Uttar Pradesh and northern Bihar. This flooding is primarily the result of the rivers' reduced carrying capacity as a result of being clogged with sediments from accelerated erosion in the Himalayan region and inadequate slope in flood plains. Landslides that block natural flow.

Landslides result in the impoundment of water and a subsequent rise in water level, which causes bank full circumstances. In the event that the natural dam breaches, there will be catastrophic floods downstream. The Himalayan area is where this often occurs. When a landslide led to the creation of a dam across the Bhagirathi River in 1978, this incident occurred. 14 hours later, this dam broke, wreaking destruction up to Uttarkashi and eradicating the hamlets of Gangnani and Dabrani on the Gangotri pilgrimage path. Rivers with sinuous and meandering courses hinder the normal discharge of water, slowing the velocity, delaying the flow of water and causing stagnation. Take the Brahmaputra's meandering loops as an example. Sand bar formation is a typical coastal phenomenon, especially close to estuaries. The mouths of estuaries and deltas are choked by long coast drift that results in the creation of sand bars. This prevents natural drainage, especially when there has been a lot of rain and the river is carrying more water. The impact of sea tides, which deposit silt on the mouths of rivers and also in the drainage systems, has made the issue worse in the delta regions of West Bengal and Orissa. This causes the river's ability to release water to continuously decline.

The Impact of Humans and Anthropogenic Factors

Flood is a natural occurrence that occurs when certain climatic and physical conditions exist. But in recent years, certain flooding incidents have been substantially brought on by human interference with the natural environment. The quantity of run-off or the groundwater of precipitation determines the flood discharge of a stream. The quantity of water infiltration, which is influenced by the kind and amount of vegetation, the soil's texture, the slope's length and steepness, and other factors, determines run-off. All of these elements have changed as a result of human influence. The loss of forest cover is the most significant of all [3]–[6].

Deforestation

Runoff is strongly influenced by vegetation because it serves two crucial purposes by facilitating infiltration and so reducing runoff. Raindrops are deflected by the forest canopy and take a longer time to travel through the leaves, branches, and stems of trees to the ground. On the ground, the grass and lead litter permit soil penetration and so lessen runoff. On the other side, a lack of flora leaves the surface vulnerable to heavy rainfall. Since there is little infiltration, most of the water flows as surface runoff, causing flooding downstream. Floods have therefore become the norm in the downstream regions wherever man has turned to uncontrolled destruction, like in the Sewali's, Lower Himalayas, Chhota Nagpur plateau, Western Ghats, and elsewhere.

Siltation

Deforestation increases surface runoff, which has the added effect of speeding up erosion and adding more silt to streams. Increased sediment load lowers the river valleys' ability to hold water by causing siltation of the riverbeds and filling of the valleys. The river beds in the Bhabhar area in south-eastern Nepal are rising at a pace of 15 to 30 centimeters each year. Because the river flows inside significantly elevated levees, the Kosi's bed in Bihar is now higher than the flood plain. Floods in the Gangetic plain and the Brahmaputra plain have also been caused, in part or in whole, by the rise of the channel.

Agricultural malpractice

In India, the river valley side slopes are plowed parallel to the channel down to the bottom. This is done to remove any remaining moisture from the wetrabi season. The summer heat bakes the plowed fields after the crops are harvested, leaving the loose soils of the fields in a state of severe aridity. The loose soils get water-soaked with the first rains of the next rainy season and fall into the river bed after an overland f low. As a result, the river beds progressively become quiet. The cultivation of valley side slopes simultaneously lowers the gradient of the river banks, ultimately flattening the valley. The river's ability to accommodate more water steadily reduces as the flattening progresses, and it takes the river much less time to reach bank-full conditions. The low-lying flood plains are subsequently submerged as the water flows over the valley walls.

Ineffective Irrigation Techniques

An extensive network of canals may be found in the alluvial deposit in the Punjab, Haryana, and western Uttar Pradesh. The waterin the surrounding regions is raised by the continuous seepage of water from the canals. As more water is used for irrigation, a phenomenon known as water logging develops in these areas with poor drainage. Because the earth cannot absorb the water, even during severe downpours, only a portion of the rainfall results in flooding as surface runoff.

Urbanization is growing

Urbanization growth contributes to an increase in surface runoff, which in turn increases flood size and impact. The capacity for infiltration is decreased and the surface runoff is increased by the development of buildings, pavements, roads, etc. Locally, the volume and size of floods rise as a result of increased surface runoff that travels via the drains and into the surrounding stream. The dumping of waste from adjacent cities, the expansion of human population in low-lying regions, the clogging of nallas, the building of bridges, highways, embankments, etc. have all contributed to the siltation of river bottoms. As a result, the river's ability to drain has been diminished. Floods may have a variety of causes, and although any one of these factors may result in a flood, in reality, floods are the consequence of a combination of these causes. For instance, while there has not been a change in the general pattern of rainfall, two elements, namely excessive precipitation and deforestation, have been the most significant causes of floods. Deforestation has increased surface runoff and therefore incidence of floods.

Effects of Flooding

As floods occur more often, more intensely, and with greater scale, their damage increases over time. The loss of lives and property is the main consequence of floods. The failure of communication, the interruption of train and road traffic, and other crucial services result in indirect losses, the restoration of which might cost billions of rupees. During the rainy season, India's Assam, Bihar, and portions of Gangetic Uttar Pradesh are particularly vulnerable to flooding. Floods are more likely to occur in the tributaries of the Ganga and Brahmaputra rivers. However, Tamil Nadu, Gujarat, Maharashtra, and Karnataka sometimes experience flooding due to severe rainfall.

DISCUSSION

Flood Monitoring, Warning, and Forecasting

National geographic borders are not respected or recognized by disasters. As the globe becomes more globalized, there will be an increase in regional catastrophes that affect many different nations. India has provided other nations with a model on how to simultaneously address problems at home and in its neighbors. Currently, warnings for earthquakes, cyclones, large-scale fires, volcanoes, famines, and other extreme weather occurrences are all feasible.

Flood Prediction

Specialists keep an eye on events for clues that might indicate when, where, and how big a catastrophe could be. Prediction or forecasting is the term for this. The ability to prevent flooding is greatly aided by early flood information. Flood forecasting and early warning to the affected regions may significantly decrease losses due to flooding, particularly those of human life and animals. A flood peak often passes from a place downstream down a river in a few hours to a few days. Therefore, if the water level is continuously monitored, forecasts of floods downstream may be made far in advance so that local authorities can take preventative measures to reduce the loss of life and property. The best method of managing floods is flood forecasting.

Warning Period

The goal of the warning phase is to offer catastrophe (in this example, flood) management enough information so they can give those at risk enough time to prepare for the disaster and, if necessary,

evacuate. Additionally, efforts are being made to create early warning systems that will alert aid organizations to anticipated refugee disasters.

Early Warning

There are no building rules that protect against storm surge flooding. Today, evacuating people to safer locations as soon as possible after receiving warnings is the recommended method for protecting lives and property against storm surge flooding. There are currently coordinated early warning systems against tropical cyclones in place all over the world, making it feasible to inform the impacted people of the threat from a tropical storm at least 24 to 36 hours in advance. Communities that are well-prepared and aware may now reduce the loss of lives and property by using early warning systems.

Flood Response and Preparation

An integrated strategy to catastrophe reduction must include the creation of a culture of preventive. At the national, state, and district levels, develop Preparedness and Response Plans and keep them in a condition of preparedness. Each vulnerable region should also embrace a policy of self-reliance. Training and education in disaster preparation, mitigation, and prevention to improve capacities at all levels. To increase capacity for disaster prevention, reduction, and mitigation, existing centers of excellence should be identified and strengthened. The term preparedness refers to the steps taken to lessen the effects of natural occurrences by organizing a response and creating a system for a prompt and orderly response. Preparation actions might include stockpiling supplies and gear, creating emergency action plans, manuals, and procedures, creating warning, evacuation, and sheltering plans, and more. They could also involve fortifying or otherwise safeguarding crucial buildings.

Culture of Preparedness

Post-disaster management involves various issues, including law and order, evacuation and warnings, communications, search and rescue, firefighting, medical and mental aid, relief and shelters provision, etc., in order to deal with the consequences of natural catastrophes. The phase of rebuilding and economic, social, and psychological rehabilitation is undertaken by the people themselves as well as the government authorities after the initial shock of the occurrence of the natural catastrophe, such as a flood, has subsided within the first few days or weeks. Experience has shown us that flood damage may be reduced by having an effective warning system in place, together with readiness on the side of the community that is most susceptible. A community that is prepared to deal with catastrophes, who hears and comprehends signs of oncoming dangers, who takes preventative and mitigating actions, will be better equipped to deal with them and return to regular life sooner.

Drought

When rainfall is often insufficient and the potential of the groundwater is lost, biotic life is negatively impacted. The availability of moisture is less crucial to life than its efficacy, making drought a relative condition. Basically, a drought is a bad circumstance brought on by a lack of rain. There are two ways to examine the rains' failure. First, there may not be enough rain; second, there may be enough rain for the whole area but with a large gap between two or more periods of rain. Therefore, both the quantity and the timing of the rainfall are crucial. Drought is thus a relative occurrence. As a result, neither the quantity nor the quality of the rain are very significant [7], [8].

Type and Spread of Drought

Drought type

Depending on climatic, hydrological, and agricultural factors, a drought may be classified into one of three types. Typically, when actual rainfall falls well short of what is climatologically predicted over a large region, we speak about meteorological drought. However, not all observed droughts are caused by the weather. Hydrological drought, surface water drought, ground water drought, and agricultural or soil water drought are the other types of droughts.

Weather-Related Drought

Meteorological drought refers to the unique condition when rainfall do not fall on schedule or in sufficient amounts. As previously said, the efficacy of the rains is more significant than its amount. The average rainfall is more significant than the total amount. In India, there is an annual rainfall of 105 cm. and for a nation of similar size, it is regarded as the greatest anyplace in the world, but it varies greatly. It either starts later or finishes sooner, or there are large intervals in between, or the rainfall is concentrated in one area but totally missing in another.

The Lack of Water

Surface water drought and subterranean water drought are both examples of hydrological drought. It is connected to the disappearance of surface water in places like rivers, streams, lakes, and reservoirs. When meteorological drought lasts long enough, hydrological drought happens.

Drought in the Surface Water

There are several more mechanisms that contribute to water shortage outside meteorological dryness. Rivers and streams in the mountain catchment of rivers might dry up in the post-monsoon season due to deforestation and hydrological instability. Despite the typical rainfall, a surface water drought arises in this circumstance. In Cherrapunji, where it has occurred before, it is now commonplace. When the monsoon is over, the 450 inches (1200 cm) of rainfall immediately evaporates due to the destruction of the catchment's mixed natural forests' hydrological capacity. As a result, water scarcity develops in one of the world's wettest regions during March and April. Even under normal rainfall circumstances, excessive pumping without a corresponding replenishment lowers the ground water table, creating an almost unstoppable ground water drought. Due to the presence of hard, crystallin rocks, the remainder of the nation, particularly in the Peninsula, has relatively little ground-water potential outside of the alluvial regions of the Indo-Genetic plain.

Drought in Agriculture

Agricultural drought, also known as soil water drought, happens when soils lose their ability to effectively conserve moisture via a variety of complicated mechanisms, which causes the aridification of the land. Even when meteorological drought is prevalent, agricultural drought may not be, and vice versa. The causes of the monsoons' early departure and late arrival are unclear. Uncertainty surrounds the physical process that causes this weather state. Knowing the factors that contribute to the early or late beginning of the monsoon will be made easier with increased knowledge of cloud structure.

India hasn't seen any depressions or low pressure systems lately, which is really related to the global weather patterns. One such climatic mechanism that influences the formation of these depressions is the southern oscillation. Naturally, the presence of a low-pressure system over Tahiti in the central Pacific and a high-pressure system over land in southeast Asia hinder the development of cyclones and depressions across Indonesia and the Bay of Bengal. The extended monsoon drought is once again a component of the overall weather dynamics. According to historical rainfall statistics, extended gaps in monsoon rainfall tend to happen in the second part of the season, which is between August and September. 1974, 1979, and 1981 saw occurrences of this kind of phenomenon. The quasi-stationary anti-cyclonic circulation that forms across North West India is connected to these breakdowns. This anti-cyclonic circulation prevents the air from rising, which reduces the circumstances that for rainfall to occur. Once again, it is unclear how meteorological conditions affect this kind of circulation.

The re-establishment of the southern branch of the jet stream is another aspect of the complex global weather dynamics. Convection is suppressed as a result of the jet stream's re-establishment. Suppressed convection prevents the development of clouds, which in turn prevents rainfall. The chilly Somali current pouring across the Arabian Sea causes an upwelling phenomenon that lowers sea surface temperatures by up to 4 degrees. The low surface water temperature reduces evaporation, which lowers the wind's moisture content. Reduced moisture content also results in less rainfall in the lee of Sahyadri and along the western coastal strip. Because the monsoon trough serves as the passageway for lesser depressions, rainfall along its axis is substantial. As a result, the foothills see unusually high precipitation when the monsoon trough is near to the Himalayas. As a result, parts of the plain flood while the remainder dries up and encourages drought.

Drought cannot be defined just as a result of a lack of water. If this were the case, then locations that get a lot of rain, like North-Eastern India and the Western Ghats, would not have been harmed by the drought. However, certain areas do experience drought-like conditions from March through April. Climate and rainfall variability must be acknowledged as an essential component of tropical meteorology. Like many tropical regions, India's weather is marked by brief variations that are not properly explained. Depressions and cyclonic disturbances may generate noticeable spatial differences in rainfall while the monsoons are over India. These disruptions, however, do not exhibit a typical pattern. The lack of rainfall that leads to droughts is a consequence of meteorological variability. Since droughts are a natural occurrence in tropical areas, they will inevitably happen again. There is no region in India that has not experienced drought at some point, with the exception of a few minor areas in the north-east.

Effects of the Drought

Despite the fact that the drought is a transient phenomenon, its effects last for a much longer time. Its negative effects are widely felt in the form of dwindling subsurface water supplies, falling water tables, human and animal deaths, etc., and they are significantly made worse by the cumulative effect of subsequent droughts. Only in the case of a severe drought does this occur. A little drought followed by a prosperous season may not have an impact. Drought has several effects on a country's geography, which may be examined under the following headings.

A Physical Effect

Weather-related drought has an immediate impact on surface runoff, groundwater levels, and soil moisture. To decrease the reservoir levels, the wateris depleted and surface runoff is reduced. The

lack of recharging lowers the and dries out the wells. Irrigation suffers as a result of wells drying up. A meteorological drought also results in less runoff, which during the dry season causes the rivers to dry up. This in turn has an impact on the decrease in reservoir water level.

Result for Agriculture

Indian agriculture is still very heavily influenced by the monsoon. It is reliant on environmental variables like rainfall, the state of the groundwater, and the wetness of the soil. As a result, it is mainly susceptible to agricultural, hydrological, and climatic drought. In drought years, the result is a reduction in agricultural productivity. The most disadvantaged groups in society, who live paycheck to paycheck and have little room for error, are those who are most affected. These people include landless and small-scale farmers as well as workers like weavers, whose entire survival relies on local demand. On the other hand, the wealthier areas profit from food shortages and high prices by selling off their excess supplies. To sum up, it may be claimed that a severe drought followed by a fairly prosperous season causes an economic downturn that is long-term. On the other hand, a milk drought followed by excellent seasons and competent management of the effects could not obstruct the economy's secular upward trend. Some of the long-term effects of drought may be quickly remedied, but the majority have a lasting impact on the economy. If a drought is followed by a good rain, despite certain irrevocable changes like loss of life, property, and riches, it will improve the output of fodder. Additionally, it will restock the reduced food supplies and might perhaps boost job prospects [9]–[11].

Monitoring, Warning, and Drought Forecasting

Meteorological droughts never have a single cause, according to empirical research done over the previous century. It is the product of a variety of factors, many of which work in concert.

Control of Drought

There are two approaches to control drought.

i. Preventing the drought's contributing factors.
ii. Offering drought victims both aid and rehabilitation.

Controlling Weather-Related Drought

Weather-related drought will always be a feature of India's climate as long as it remains a tropical country. As they are a part of a complex atmospheric circulation, meteorological phenomena like the re-establishment of the jet stream, movement of the monsoonal trough close to the Himalayas, El Nino effects and changes in the world's pressure (Walker's Circulation), the upwelling phenomenon in the Arabian Sea, etc., cannot be managed due to their complexity. By somewhat forecasting the fluctuation of changing weather, the meteorological drought may be controlled. Predictions may decrease the effect of climate fluctuations. If it is predicted that there won't be as much rain as usual, the farmer may choose wiser crop selections that use less water. On the other hand, if a crop that requires a lot of water is planted without having access to up-to-date rainfall data, a fake drought scenario can develop.

Controlling Hydrological Drought

Management of the hydrological drought, which is easily caused by human activity, may be accomplished using a variety of approaches and procedures. The goal of managing a hydrological

drought is to stop surface streams from drying up and the decline of the groundwater. This is accomplished by

i. Biological Approaches.
ii. Engineering Procedures.
iii. Involving the community.

Biological Approaches

Utilizing vegetation, or changing the kind of tree cultivated or general design in an integrated way, is a component of biological approaches. Reduced percolation lowers the ground waterin a deforested area. This raises the likelihood of flooding and runoff. Therefore, it's crucial to stop the indiscriminate deforestation that is rapidly expanding in the mountainous area. Treatment of the watershed via agricultural and social forestry by planting appropriate trees. It needs to be a crucial component of watershed management. This will lessen the possibility of flooding in the lower part, which would lead to a drought of surface water, while also recharging the aquifers via its entry into the intake basins. replacing environmentally suited plants in monoculture eucalyptus or pine plantations. This will adequately protect the soil from direct raindrop contact during strong storms, lowering the likelihood of flash floods and preventing surface water shortage. The lower Himalayan area will benefit the most from this technique. Additionally, monoculture eucalyptus plantations that drain a lot of water due to their high evapotranspiration rates should be replaced with forests of trees that provide people both ecological and economic stability. Additionally, by boosting the waterand ending the artificial ground water shortage, this will assist.

Engineering Procedures

Ground water is artificially refilled using a variety of engineering techniques. These are listed as follows:

Recharging of Aquifers

The most efficient and acceptable method of replenishing ground water in a hilly area is to cover the watershed with dense vegetation, including multi-story forests of trees, shrubs, and grasses as well as a thick layer of litter. Rainwater will be able to infiltrate more deeply as a result. on addition to covering the ground with a layer of trees, ground water on flatter areas may be artificially refilled. To do this, floodwater should be allowed to flow over the fields and fill any dug trenches, tanks, ditches, or furrows along the sides of roadways and railroad tracks. The water that has been stocked will finally reach an underground reservoir. In locations where excessive amounts of water have been drained, such as the southern and central portions of Gujarat's Maharana district, injecting water via wells is another method of artificial recharge. This approach will, in large part, aid in reversing the water irreversible decline. In Kurukshetra's Ghaggar basin and in the area of Ahmedabad, siphon pumps were used to inject water from the Sabarmati River. By boosting percolation from surface storage of rainwater, the conventional tank system in peninsular areas provides one such process to replenish ground water.

Controlling Agricultural Drought

India's crop selection has changed as a result of changing climatic and soil conditions. The droughts in India should be examined from the standpoint of the innate resilience of traditional techniques and the increased susceptibility of green revolution agriculture. The Punjab, Haryana,

and Uttar Pradesh wheat monoculture area would experience an artificial drought as a result of the HYVs' increased water needs. Thus, returning to the previous cropping pattern appropriate for that agroclimatic zone would be the first job. Native crops use less water than non-native crops, and the indigenous mixture also helps to prevent soil nutrient deficiencies. In contrast, in drought-prone regions, emphasis should be placed on drought-resistant varieties of crops like sorghum, pearl millet, and sunflower.

Response and Preparation

The effects of drought may be lessened by offering assistance and recovery. To lessen the consequences of drought, the government has started the Drought Prone Area Program. The Rural Works Programme (RWP), which was launched at the start of the nation's Fourth Five Year Plan, served as the forerunner of the Drought Prone Area Programme (DPAP). This was determined based on the fact that a large portion of the money the Central Government spent providing aid to famine-affected areas could have been used to create significant employment in the rural sector, largely linked to a pre-planned program of rural works, in areas that were chronically affected by drought. Soon after the RWP was put into place, it became clear that an area development strategy was necessary since simple rural works would not be useful in reducing drought. The TWP was reconfigured as the DPAP as part of the Fourth Plan's midterm evaluation, and financing on this basis started in 1972–1973. Following many revisions, the DPAP now covers 415 blocks in 95 districts throughout the nation.

The Planning Commission's Minhas Committee had proposed that the DPAP seek for integrated agricultural development with an emphasis on restoring ecological balance. Agronomic techniques, crop pattern restructuring, livestock development, rural communication, and drinking water provision were suggested as key components of the integrated rural development plan in addition to irrigation, forestry, soil, and moisture conservation. Towards the end of 1980, a Task Force led by M reviewed the whole program. S. Swaminathan was the Planning Commission's Member (Agriculture) at the time. The Task Force revised the DPAP and DDP's mission and goals. It reiterated the continuing strategy and approach and placed special emphasis on: The current drought, which is accompanied by corruption, water-intensive agricultural patterns, and a lack of a long-term approach to managing water and drought, is a catastrophe for water management. Government plans for irrigation failed because corruption, delays, and cost overruns affected its plans for prospective projects.

Construction of massive, unprofitable dams, incorrect agricultural practices, water diversion for non-priority purposes, disregard for local water systems, and unaccountable water management by the State government, the Center, and the Maharashtra Water Resources Regulatory Authority are all examples of poor water management. The state's fragile water situation may be attributed to the expansion of sugarcane farming in Maharashtra and water-intensive operations like the operation of wine and sugar mills in drought-affected areas. Real estate developers continue to overuse the land by planning large-scale development projects in regions that are experiencing drought. The rich who love having enormous swimming pools in their backyards are often the target market for these opulent constructions. And to top it all off, Maharashtra will host the Indian Premier League, the nation's most watched cricket competition, this month.

CONCLUSION

We are aware that natural catastrophes play an important role in the cycles of nature. Natural catastrophes may still be prevented, despite their extreme force and suddenness. We now have access to sufficient tools thanks to modern technology to predict natural catastrophes. Natural catastrophes may not be completely prevented, but we may be able to mitigate their consequences to some degree. There shouldn't be any gaps in our understanding of the damages caused by natural disasters since inadequate information makes it difficult to execute emergency response and disaster mitigation programs. People need to be interested in learning as much as they can about the safety precautions. The poorest and most vulnerable people need our support and protection more than anybody. Extremes of water have presented challenges to civilization throughout history, whether via shortage, which causes drought, or oversupply, which causes floods. Although the modern period is highly sophisticated, each year floods and droughts cause enormous losses in terms of both human lives and property. There are several factors that contribute to flooding. Floods are caused by a combination of physical and meteorological factors, including narrow outlets, large catchment areas, a lack of well-developed drainage channels, siltation and channel rise, the presence of unconsolidated soil, the blocking effect of landslides, and meandering.

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CHAPTER 4

RESILIENCE IN CRISIS: MANAGING NATURAL DISASTERS

Sneha Verma, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: sneha.verma@muit.in

ABSTRACT:

Natural disasters are catastrophic events that occur due to natural processes and have significant impacts on human lives, infrastructure, and the environment. This study provides a comprehensive overview of natural disasters, encompassing their causes, types, and consequences. It explores the diverse range of natural hazards, including earthquakes, hurricanes, floods, wildfires, tsunamis, and volcanic eruptions, among others. The study highlights the underlying causes of natural disasters, such as geological activity, weather patterns, and climate phenomena. It delves into the mechanisms that trigger these events, such as tectonic plate movements, atmospheric disturbances, and hydrological processes. Understanding the root causes of natural disasters is crucial for effective mitigation and preparedness efforts. Furthermore, the study discusses the various types of natural disasters, emphasizing their distinct characteristics and impacts. Each disaster type is examined in terms of its spatial extent, duration, magnitude, and the specific risks it poses to human populations and ecosystems. The consequences of natural disasters include loss of life, property damage, displacement of communities, disruption of critical infrastructure, and long-term socio-economic and environmental ramifications.

KEYWORDS:

Environment, Floods, Management, Natural Disaster, Susceptibility.

INTRODUCTION

Disaster is a Latin word that meaning bad star. Disasters are unanticipated, unwelcome events that cause significant harm, loss, destruction, and devastation to both people and property. Disaster damage is immeasurable and varies depending on the location, climate, and kind of the earth's surface. This affects the afflicted area's socioeconomic, political, and cultural conditions. Natural disasters and man-made disasters are both possible. Natural catastrophes include floods, cyclones, droughts, and earthquakes since they result from changes in the environment; man-made disasters include nuclear holocausts and fire mishaps. The everyday routine is totally disrupted by a calamity. Numerous distinct storm forms are referred to as cyclones. A landslide is the movement of rock, rubble, or soil down a slope, while an earthquake is the shaking or trembling of the ground. Now, the geographic distribution of all these natural calamities varies. It would have been simpler for us to decrease damage in terms of both material loss and human life if we had known the source and effects of the natural catastrophe [1], [2].

The research also emphasizes the significance of resilience-building and disaster management measures in reducing the negative consequences of natural catastrophes. It focuses on the need of multidisciplinary cooperation among governmental organizations, emergency responders,

scientists, and community stakeholders as it examines the stages of disaster management, including preparation, mitigation, response, and recovery. The study also discusses how technology and innovation may improve early warning systems, catastrophe prediction, and response capabilities. In order to improve catastrophe risk assessment and management, it examines the use of remote sensing, data analytics, and modeling tools. Stakeholders may create proactive strategies to lower vulnerability and improve resilience by developing a thorough knowledge of natural catastrophes, their causes, and their effects. This summary lays the groundwork for future investigation of certain natural catastrophe types and the creation of successful mitigation and development strategies in disaster-prone areas [3]–[5].

Natural Catastrophe

A natural catastrophe is a significant bad occurrence brought on by Earth's natural processes. Floods, hurricanes, tornadoes, cyclones, volcanic eruptions, earthquakes, tsunamis, and other geologic events are examples of natural disasters. It causes extensive property damage or loss of lives.

Cyclone

A cyclone is a large-scale atmospheric wind and pressure system that moves in a circular fashion, clockwise in the Southern Hemisphere and counterclockwise in the Northern Hemisphere, with a core of low pressure. They are often distinguished by inward spiraling winds that spin in the southern hemisphere clockwise and the northern hemisphere counterclockwise. All major cyclones have their centers in low-pressure regions. When the sea's warm temperature exceeds a threshold and the wind structure is intensifying, a cyclone is generated. In other words, cyclones are powered by warm tropical waters and cannot develop until the sea surface temperature is higher than 26.5 °C. They may, however, endure at lower temperatures after forming and evaporate over land or in cooler waters. The center of the cyclone, where the focus resides, is known as the eye of the cyclone. Due of the high wind, the regions around the eye will be most impacted.

Cyclones' Root Causes

Ocean surface water in tropical waters is heated by incoming sun radiation. Due to the high warmth and humidity of the air above the tropical ocean, air inflation occurs, which is quickly followed by a low density per unit volume of air. Weak breeze near the equator leads the lighter air to rise and experience convection, which further draws inflow of the nearby colder air. An air column with a high temperature, low density, and light weight ultimately arises as a result of the intake air warming up and rising once again. The tropical depression develops in this manner. Only over warm ocean waters close to the equator can cyclones develop. Warm, humid air above the ocean rises from near the surface to generate cyclones. Less air is left around the ocean's surface when this air rises and retreats. A region of low air pressure is created below as the warm air generally rises. The low-pressure area is pushed inward by air from nearby regions with greater air pressure. The fresh cool air then warms up, gets wet, and rises as well. The cycle keeps on. The water in the air condenses into clouds when the moist, warm air rises and cools. The heat from the ocean and water evaporating from the ocean surface fuel the whole system of clouds and wind, which spins and expands. A cyclone is formed in four phases, including:

i. Developing Stage.
ii. Young cyclone.

iii. Seasoned cyclone.
iv. Decay period.

Tropical cyclones need huge warm water bodies to develop. In order for a warm air parcel from the surface to continue rising to a height high enough to produce a cumulonimbus cloud, the environment must also be favorable for convection, which means it must cool fast with height. In order for the Carioles 'force' to be strong enough to support the maintenance of the core low pressure, they must develop at least 500 km from the equator; otherwise, air would come in too rapidly and 'fill' the low pressure, terminating the storm. The storm cannot spontaneously emerge an existing region of disturbance is also necessary to produce some weak spin. Last but not least, the vertical wind shear, or how much the wind changes with height, is less than 10 m/s. The deep convection will be disturbed and the developing storm may be torn apart if shear exceeds this value [6]–[8]. Latent heat, or the energy produced as water cools from water vapour to liquid water, such as in a cloud, provides all of the energy for tropical cyclones. The above-mentioned warm, tropical waters are where this heat first appeared.

Thunderstorms may start to spread out in the warm, humid tropical air if a tropical atmospheric disturbance takes place such a tropical wave departing the west coast of Africa. The weak circulation that caused the thunderstorms is strengthened when more air is entrained into the surface low as it climbs into the thunderstorms. Because there is so much rising air, there is also a high-pressure system above, which causes diverging air above, which accelerates the upward motion of air in thunderstorms. The disturbance is referred to be a tropical depression after the surface winds reach 20–34 knots. The center of the thunderstorm cluster is often where a distinct region of low pressure develops, and the wind is traveling faster inward, increasing the spin much as an ice skater's spin rises when they bring their arms inside. Now because the water is rougher, there is more friction, which causes the winds to condense even more towards the low's center. Now, a feedback mechanism kicks in. The rising air is warmer and more humid due to the rough sea. As a consequence, thunderstorm activity increases and becomes stronger, releasing more latent heat. As a result, the surface pressure drops even lower, resulting in stronger winds, choppier waves, and more surface wind convergence.

DISCUSSION

Effect of the Cyclone

The violent spinning storms known as tropical storms usually develop over the ocean near the tropics. The Coriolis effect, which is caused by the earth's rotation, causes them to move away from the equator as they gain speed. There are various things you would notice if they reached ground.

High Winds: The steep pressure gradients close to the storm center are directly connected to the very high wind speeds of tropical cyclones. With rising wind speed, wind damage rises dramatically. Maximum sustained winds in strong cyclones may reach 200 km/h, with momentary gusts closer to 300 km/h. Even the strongest man-made buildings and natural plants may be destroyed by such high winds.

Storm Surge: A storm surge is a significant rise in sea level that occurs when a tropical cyclone reaches the coast due to the interaction of low pressure near the center and strong onshore winds. This might result in the water crashing into generally unaffected locations, completely destroying

any buildings or other structures. The effects may be devastating in very sensitive locations like Bangladesh's Ganges River Delta, where a sizable population lives in the fertile flats close to sea level. In this region, storm surges have caused more than 100,000 fatalities.

Cyclone Prediction and Cyclone Warning Stages

The science of predicting is tropical cyclone forecasting. It gives the predicted location of a tropical cyclone's center and its consequences in the future. Track forecasting, intensity forecasting, rainfall forecasting, storm surge forecasting, and tornado forecasting are some of the components of tropical cyclone forecasting. While track predicting competence has improved, intensity forecasting skill has remained mostly constant over the previous several years. The propensity for cyclones to be predictable varies widely. Much work has gone into honing the ability to predict location and intensity. Forecasts of cyclone location and severity at 12-, 24-, and 48-hour time-steps are regularly released by the Bureau of Meteorology. The official estimate of the position and strength of a tropical cyclone, the best track, is used to compare all official predictions. For each tropical cyclone, a best course is created utilizing all available information after the event [9]–[11].

Tropical cyclones are unpredictable because some of them show quick fluctuations in strength or alter direction quickly or slowly, mainly in reaction to changes in the environment. For instance, Cyclone Lena was headed west when it abruptly turned around and headed back in the direction it had come from. In contrast to stronger systems that feature a distinct eye, category 1 cyclones are sometimes difficult to find since the center may not be visible from satellite photography. The most difficult systems for forecasters and local decision-makers to predict are those that drastically alter their track or strength near to the shore. When a cyclone forms further offshore before crossing, as opposed to one that does so quickly close the coast, community awareness is substantially greater.

Watching the Cyclone

Over the last two centuries, many methods of tropical cyclone observation have been used. Typhoons, hurricanes, and other tropical storms have been identified by radio broadcasts from ships at sea or word-of-mouth from sailors who have just arrived in port, as well as through silt deposits in estuaries close to the coast and the destruction of coastal communities. In addition, since World War II, the development of technology has led to the use of planes to survey ocean basins, satellites to monitor the world's oceans from space using a variety of techniques, radars to track the movement of the oceans close to the coast, and most recently, the introduction of unmanned aerial vehicles to penetrate storms. Recent research has focused on examining hurricane effects found in nearby lake sediments or rocks, which are subfields of the emerging science of paleotempestology.

Earthquakes in Natural Context

Earthquake

Seismic waves are produced when there is a rapid release of energy in the Earth's crust. The number, kind, and magnitude of earthquakes experienced throughout time are referred to as an area's seismicity, seismism, or seismic activity. Seismometer readings are used to determine the magnitude of earthquakes. As a consequence of changes in the earth's crust, volcanic activity, or an unexpected slide on a fault, there occurs an abrupt, severe shaking of the ground that often

causes significant devastation. Although the tectonic plates are always moving slowly, friction causes them to become impermeable at their borders. An earthquake occurs when the tension on the edge exceeds the friction, releasing energy quickly in the form of seismic waves that travel through the earth's crust and produce the shaking we experience.

Seismic waves cause the tectonic plates in the earth's crust, which are almost a hundred kilometers thick, to move. An earthquake happens naturally. However, other operations like mining for coal, building large dams, and drilling for oil might sometimes increase seismic activity. The focal point or hypocenter of an earthquake is where the first rupture occurs. The area just above the hypocenter at ground level is known as the epicenter. The position of the earthquake's epicenter affects the damage brought on by it. Because the earthquake's center is where its highest strength is located, significant devastation often happens there. There may sometimes be landslides and volcanic eruptions as a result of earthquakes. The bottom may be sufficiently moved to generate a tsunami when a big earthquake's epicenter is offshore.

After Shocks

An aftershock is an earthquake that happens after the primary shock. It happens in the same area as the first shock but with a lower intensity. As the crust near the relocated fault plane adapts to the impacts of the first shock, aftershocks are created. When an aftershock is greater than the main shock, the main shock that originally occurred is reclassified as a foreshock and the aftershock is reclassified as the main shock.

Swarms of Earthquakes

Sequences of earthquakes that occur in a given location over a short period of time are known as earthquake swarms. The fact that no one earthquake in the chain is evidently the primary shock and none have noticeably larger magnitudes than the other distinguishes them from earthquakes that are followed by a string of aftershocks. The action in Yellowstone National Park in 2004 is an example of an earthquake swarm.

Seismic Storms

A sequence of earthquakes hit a fault in what is referred to as a earthquake storm, with each one being sparked by the shaking or stress redistribution of the prior earthquakes. These storms, which are similar to aftershocks but on neighboring fault segments, happen over the period of years, with some of the later earthquakes being just as destructive as the earlier ones. A similar pattern has been deduced for earlier anomalous clusters of major earthquakes in the Middle East. This pattern was seen in the series of roughly a dozen earthquakes that hit the North Anatolian Fault in Turkey in the 20th century.

Earthquake Location and Measurement

Seismometers can detect earthquakes at a considerable distance because seismic waves may travel across the whole Earth's interior. While the felt magnitude is expressed using the modified Mercalli intensity scale, the absolute magnitude of an earthquake is traditionally expressed by numbers on the Moment magnitude scale (previously the Richter scale, with magnitude 7 inflicting catastrophic damage over vast regions). Different seismic wave types are generated by each earthquake, and these waves move through rock at various speeds:

1. Longitudinal pressure waves or shock waves

2. Both body waves exhibit transverse S-waves.
3. Rayleigh and Love waves are surface waves.

Occurrences of Natural Earthquakes

Faults or cracks distinguish the tectonic plates of the Earth. Earthquakes often occur when unexpectedly breaking subsurface rock occurs along a fault. An earthquake happens when the tectonic plates bump against one another or glide past one another. The seismic waves that cause the earth to tremble are brought on by this quick release of energy. The rocks snag on one other when two rock blocks or two plates scrape against one another; they glide somewhat but not smoothly. The rocks continue to collide but remain still. The pressure that builds up eventually causes the rocks to crack. A rock crack causes an earthquake. The plates or blocks of rock begin to move during and after the earthquake, and they keep moving until they get lodged once again.

Tectonic Tremors

Anywhere on Earth where there is enough elastic strain energy stored to cause fracture propagation along a fault plane is where tectonic earthquakes may happen. If there are no imperfections or asperities along the fault surface that would increase the frictional resistance, the sides of a fault can only pass one another smoothly and seismically. Such asperities are present on the majority of fault surfaces, which results in stick-slip behavior. Following the locking of the fault, ongoing relative motion between the plates causes an increase in stress, which releases stored strain energy in the area around the fault surface. Until the tension is high enough to pass through the asperity and abruptly permit sliding over the locked area of the fault, the process continues, releasing the stored energy. A combination of frictional heating of the fault surface, radiated elastic strain seismic waves, and rock fracture release this energy, resulting in an earthquake. The elastic-rebound hypothesis describes this pattern of gradually increasing strain and stress that is sometimes disrupted by catastrophic seismic collapse. Only 10% or less of an earthquake's total energy is thought to be released as seismic energy. The majority of an earthquake's energy is either transformed into heat produced by friction or utilized to drive the formation of seismic fractures. As a result, earthquakes increase the Earth's temperature and decrease its elastic potential energy, but these changes are minor in comparison to the conductive and convective transport of heat out of the Earth's deep core.

Kinds of Earthquake Faults

Normal, reverse, and strike-slip faults are the three basic kinds of faults that might result in an earthquake. Normal faults primarily appear along divergent boundaries or other regions where the crust is extending. Earthquakes linked to common faults often have a smaller magnitude. This is the case because an earthquake's energy release and, therefore, its magnitude, are directly correlated with the size of the ruptured fault and the reduction in stress. In regions where the crust is shortening, as near a convergent boundary, reverse faults develop. Most earthquakes of a magnitude of 8 or above and many others are linked to reverse faults, especially those at convergent plate boundaries. Strike-slip faults are steep formations where the fault's two sides slide past one another horizontally. Oblique slip is a term used to describe movement on faults that have elements of both dip-slip and strike-slip. Major earthquakes up to around magnitude 8 may be caused by strike-slip faults, especially continental transformations.

Distant from Plate Boundaries Earthquakes

In continental lithosphere, when plate borders exist, deformation is dispersed across a considerably wider region than the actual plate boundary. In the case of the San Andreas fault continental transform, several earthquakes take place outside of the plate boundary and are linked to stresses that have evolved inside the larger zone of deformation brought on by significant anomalies in the fault trace such as the big bend area. Another example is the extremely oblique convergent plate boundary that separates the Arabian and Eurasian plates and that passes through the northern portion of the Zagros Mountains. The focal processes of earthquakes show this. All tectonic plates contain internal stress fields brought on by interactions with other plates as well as sedimentary loading or unloading such as deglaciation. These stresses may be enough to bring about failure along existing fault lines, resulting in intraplate earthquakes.

Tremors and A Volcano Eruption

Volcanic areas often experience earthquakes. These are brought on by tectonic faults as well as the magma circulation in volcanoes. These earthquakes may act as a precursor to volcanic eruptions, as they did during the 1980 Mount St. Helens eruption. Swarms of earthquakes may be used to pinpoint where the moving magma is inside a volcano. Seismometers and tiltmeters, which measure ground slope, may record these swarms and utilize them as sensors to foretell impending or forthcoming eruptions.

Damage Dynamics

A tectonic earthquake starts with a nucleation, or early rupture, at a location on the fault surface. The rupture diameters of the smallest earthquakes, for example, imply that the nucleation zone is less than 100 m, but other data, such as a sluggish component seen in certain earthquakes' low-frequency spectra, implies that it is bigger. The finding that roughly 40% of earthquakes are preceded by foreshocks lends credence to the idea that the nucleation may include some type of pre-processing. As soon as the rupture starts, it spreads along the fault surface. The high sliding velocities are difficult to reproduce in a laboratory, which contributes to the lack of understanding of the mechanics of this process.

Wave Forces

Studies have shown a strong link between non-volcanic tremor activity and minor tidally produced stresses. The majority of earthquakes are connected to one another in terms of space and time and occur in a succession. Although there is a theory that says earthquakes may occur in predictable patterns, most earthquake clusters are made up of minor shocks that do little to no harm.

Generated Seismic Activity by Humans

Man has taken use of the abundance of nature via the advancement and development of technology. Drilling for oil wells, coal mining, and gathering enormous amounts of water for dam building are examples of human activities that cause earthquakes. When rock is broken underground to create tunnels for highways, trains, subways, or mines, there aren't many powerful seismic waves produced, and we may not even notice them. People around a mine may sometimes hear or feel seismic waves when the roof or walls of the mine collapse. Largest subterranean explosions from nuclear warhead (testing may produce seismic waves that closely resemble powerful earthquakes.

For instance, the building of a dam contributed to the 2008 Sichuan earthquake in China. A coal mining operation caused an earthquake in Australia as well.

Earthquakes' effects

An earthquake causes a lot of natural changes.

Ground Tearing: Because of the ground's trembling and rupturing, buildings and other structures sustain damage. Depending on how near the location is to the epicenter, the extent of the devastation will vary. The term ground rupture refers to the breaking and shifting of the earth's surface. Huge buildings like bridges, dams, and nuclear power plants are seriously at risk.

Landslides: Landslides are a significant danger that develops as a result of an earthquake. Landslides may happen when an earthquake is coupled with other serious risks like wildfires, volcanic activity, or storms.

Fire: An earthquake may greatly increase the likelihood of a fire breaking out owing to damage to gas or electrical lines.

Liquidation of Soil: Sand being transformed into a liquid when water-saturated granular material loses its strength as a result of an earthquake. Bridges and structures could be harmed as a result of this procedure. These constructions have a danger of collapsing to the ground.

Resulting From

Buildings and structures sustain extensive damage and destruction after a large earthquake. Diseases may spread due to a lack of basic utilities. Rehabilitating individuals will take a long time. In every area, man has been steadily progressing. He is credited with a number of discoveries and inventions. There is nothing that a man can do in such situations other than to be prepared to meet any kind of natural disaster. Nature often demonstrates that it is more powerful than people. Natural catastrophes often have long-term socio-economic and environmental effects in addition to their immediate effects. In order to minimize long-term effects and improve recovery, it is crucial to build resilience via sustainable development methods, such as robust infrastructure, ecosystem restoration, and community participation. There is a lot of promise in incorporating innovation and technology into disaster management initiatives.

More precise prediction and early warning systems are made possible by advanced modeling approaches, remote sensing, and data analytics, enabling for prompt and efficient responses. By embracing these technology developments, readiness, response, and recovery capacities may be greatly enhanced. Ultimately, cooperation and coordination amongst diverse stakeholders are necessary to lessen the effects of natural catastrophes. For effective disaster management, resource allocation, and information exchange, governments, local communities, academic institutions, and international organizations must collaborate. It is critical to give priority to preventative measures, research, and public awareness as the frequency and severity of natural disasters continue to rise as a result of climate change and other reasons. Societies may respond to the problems caused by natural catastrophes and create a safer, more resilient future by adopting sustainable practices, making investments in robust infrastructure, and promoting a culture of readiness.

CONCLUSION

In conclusion, because of the disastrous effects they have on infrastructure, the environment, and human life, natural catastrophes offer serious challenges to communities all over the globe. The origins, kinds, and effects of natural disasters have been clarified in this review, underscoring the need of elaborate disaster management plans. Effective mitigation and preparation depend on an understanding of the underlying geological, meteorological, or climatic causes of natural catastrophes. Communities may take steps to lessen their susceptibility and improve their capacity for response and recovery by understanding the patterns and causes of these catastrophes. The wide variety of natural hazards covered in this review emphasize how crucial it is to use specific strategies for every kind of catastrophe. Hurricanes need for early warning systems and evacuation strategies, whereas earthquakes demand stringent building regulations and seismic monitoring systems. Effective land and water management techniques are required to prevent floods and wildfires, and diligent monitoring and communication are essential to prevent volcanic eruptions.

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CHAPTER 5

AN OVERVIEW ON FORECASTING, WARNING & MONITORING EARTHQUAKE

Vikas Kumar Shukla, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: vikash.shukla@muit.in

ABSTRACT:

Forecasting, warning, and monitoring earthquakes are critical components of seismic risk management, allowing communities to prepare and respond effectively to potential seismic events. This chapter provides an overview of the methods and technologies employed in the field of earthquake forecasting, warning, and monitoring. The fundamental principles of earthquake occurrence, emphasizing the tectonic processes and plate interactions that give rise to seismic activity. It explores the various methods used to forecast earthquakes, including statistical analysis, seismological observations, and geodetic measurements. The chapter also discusses the challenges associated with earthquake forecasting, such as the inherent uncertainties and limitations in predicting the exact time, location, and magnitude of an earthquake. Furthermore, the study highlights the importance of earthquake warning systems in providing timely alerts to at-risk populations. It examines the principles behind these systems, which rely on the rapid detection and analysis of seismic waves to issue warnings before the arrival of damaging ground shaking. The study explores both local and regional warning systems and their potential to mitigate the impacts of earthquakes by enabling proactive measures, such as evacuation or shutdown of critical infrastructure. In addition, the study delves into the role of monitoring networks and technologies in capturing seismic activity and collecting real-time data. It discusses the deployment of seismometers, GPS receivers, and other instruments to detect and record seismic waves. The study also addresses the integration of advanced technologies, such as machine learning and artificial intelligence, in earthquake monitoring and data analysis, allowing for more accurate and efficient interpretation of seismic signals.

KEYWORDS:

Earthquake, Environment, Forecasting, Management, Natural Disaster, Susceptibility.

INTRODUCTION

Earthquake prediction is a branch of the science of seismology. It is concerned with the specification of the time, location, and magnitude of future earthquakes within stated confidence limits but with sufficient precision that a warning can be issued. Seismologists feel compelled to provide earthquake predictions to society. Location, magnitude, and recurrence interval of earthquakes have large uncertainty [1]–[3]. Early alert capabilities in some cases will allow some systems to automatically shut down before the strong shaking starts so that the services and people using them will be safe. Such systems may include elevators, utilities such as water and gas, and factory assembly lines. Small building is more affected, or shaken, by high frequency waves. For example, a small boat sailing in the ocean will not be greatly affected by a large swell. On the other hand, several small waves in quick succession can overturn, or capsize, the boat. The same way, a small building experience more shakes by high frequency earthquake waves. Large structures or

high-rise buildings are more affected by long period, or slow shaking. For instance, an ocean liner will experience little disturbance by short waves in quick succession. However, a large swell will significantly affect the ship. Similarly, a skyscraper will sustain greater shaking by long period earthquake waves, than by the shorter waves.

Earthquake Risk Mitigation

There is a thorough program for reducing earthquake risk. The Town and Country Planning Acts and Building Regulations govern the development of buildings in urban and suburban regions. The requirements for building in seismic zones were established by the BIS (Bureau of Indian requirements), however they were not effectively adhered to. Even if it is, the architects and engineers lack expertise in seismically safe building practices. In addition, the populace was not aware of their susceptibility, which resulted in the majority of development in urban and suburban regions not meeting BIS criteria. The risk is increased in rural regions where the predominant kind of home is non-engineered construction and the building method has evolved from mud and thatch to brick and concrete. Population growth has resulted in communities in liquefaction-prone, fragile locations along riverbeds. To address these challenges, the government has taken action.

National Core Group for the Reduction of Earthquake Risk

Engineers with expertise in earthquake engineering and administrators make up the National Core Group for Earthquake Risk Mitigation. The task of creating a strategy and action plan to lessen the effects of earthquakes has been given to the Core Group. The collapse of buildings during earthquakes results in the majority of deaths. Therefore, structural mitigation strategies are essential to having a big influence on our nation's earthquake safety. As a result, it has been urged that the States in earthquake-prone areas evaluate and, if required, revise their building ordinances to include the BIS seismic rules for construction in the affected areas.

Creation and Modification of Codes

For multi-hazard resistant design and construction, there are Bureau of Indian Standard (BIS) norms that are pertinent. These codes must be updated often. A plan of action has been created for the modification of current codes, the creation of new codes, documents, and commentaries, and the distribution of these codes and documents throughout the nation, including online access to these codes.

States with Hazard Safety Cells

The formation of Hazard Safety Cells (HSC), led by the Chief Engineer, State Public Works Department, and staffed with the requisite engineering personnel, has been suggested to the States in order to develop a system for the correct execution of the building codes in all future governmental operations. to protect buildings and other structures from numerous risks during constructions. The HSC will also be in charge of conducting a proper design review of all government buildings that will be built in the State, serving as a cell of advice to the State Government on various issues relating to building safety against hazards, and serving as a consultant to the State Government for the retrofitting of lifeline structures. These cells have already been established in Rajasthan, West Bengal, and Chhattisgarh, and other States are in the process of doing the same [4]–[6].

By ensuring that the structure complies with seismic safety standards, engineers and architects play a key role in lowering the danger of earthquakes. Due to this, earthquake engineering components are now being taught in undergraduate engineering and architecture courses. Each hospital should have an emergency readiness plan to cope with mass casualty situations, and the hospital management and doctors should be trained for this emergency, since hospital preparedness is essential to any disaster response system. Emergency hospital readiness is not included in the medical school curriculum. Therefore, it is crucial to strengthen the competence of existing health managers and medical staff via in-service training in hospital preparedness for crises or mass causality event management.

The State Government conceptualized a comprehensive program for rehabilitation and reconstruction right away, addressing all significant issues brought on by the earthquake, including immediate relief, economic recovery, the restoration of livelihoods, and long-term capacity building of all stakeholders to fend off future disasters. Gujarat Earthquake Reconstruction and Rehabilitation Policy, which encapsulates all institutional actions made by the Government in the earthquake-affected districts, was created by the government. The Policy served as a foundation for rights and a development prospectus that reflected the goal of an effective rebuilding and rehabilitation strategy.

The Gujarati government began a significant restoration and rehabilitation initiative in the damaged districts after the first relief phase. Although it was extremely difficult to conceptualize a massive reconstruction program, the government announced a comprehensive reconstruction and rehabilitation policy very quickly. This policy included assistance for the restoration of private homes, economic rehabilitation, and reconstruction of public infrastructure, as well as programs to prepare the public for disasters through community participation and multi-hazard preparedness. The Gujarat State Disaster Management Authority was established as the central organization to carry out the extensive rebuilding effort.

DISCUSSION

Better homes, improved infrastructure, excellent hospitals, and top-notch schools may all be considered positive changes in the earthquake-affected communities. The Gujarat earthquake not only caused a shift in emphasis from relief to mitigation and the establishment of institutional mechanisms for the same in Gujarat, but it also had a significant impact on disaster management throughout the country. Currently, disaster mitigation is being prioritized at the national level. The planning commission has suggested allocating 10% of the budget for pre-disaster planning and mitigation. At the federal level, plans are being made for a national disaster management agency along the lines of the GSDMA. There is a draft law on national disaster management. Many of the Gujarat earthquake's lessons learned and best practices are being reproduced at the federal and state levels in other states, including the creation of disaster management agencies and the passing of legislation. The strategy and procedure for Gujarat earthquake rebuilding are now being studied as a model for reconstruction in the earthquake-affected regions of Bam and tsunami-affected south Indian states. The many measures made to integrate rebuilding and the development of long-term disaster management capabilities have had a significant impact on how reconstruction projects are carried out in India and the surrounding nations. This has led to a significant change in disaster management in India away from the traditional relief-focused approach and toward prevention and mitigation.

Landslide

The flow of earth, rock, or other material down a slope is referred to as a landslide. They are caused by the materials that make up the hill slope failing, and they are propelled by gravity. Landslides thus occur when the soil, rock, and other earthly material can no longer resist gravity and give way. Slump, landslip, and slope collapse are other names for landslides. Although landslides often happen on steep slopes, they may also happen in places with modest relief. There are many different types of slope failures connected to quarries and open-pit mines, as well as cut-and-fill failures highway and construction excavations, river bluff failures, lateral spreading landslides, the collapse of mine-waste heaps, and landslides that occur in these locations. On the bottoms of lakes or reservoirs, or in offshore marine environments, underwater landslides often entail low relief terrain with gentle slope slopes. Underwater landslides result in tidal surges and harm to coastal regions. Submarine landslides are what these landslides are known as.

Landslide's Geographic Spread

Landslides may occur everywhere and in a variety of geological settings. Landslides are a frequent, all-natural mass-wasting phenomenon in hilly regions. Zones that have previously shown signs of landslide activity might be considered landslide prone zones. A recent scar in the terrain might serve as clear proof of this claim. When the slide has been concealed by plants or a building, it might be hard to tell. Slopes composed of weak, delicate, collapsible, worn, or fragmented materials with both internal and exterior flaws are among the other landslide-prone regions. Landslides are more likely to occur in areas where there has been a reduction of vegetation, continual seepage, or erosion of slope material by ocean waves, rivers, or creeks. Landslides often happen at weak points that may be parallel to a hill's slope. Beds, joints, or cracks are often the weak points in bedrock. Silt and clay are two examples of weaker than rock soils, and they often have complicated or many weak points [7], [8].

Landslide Causes and Effects

Causes

The process of hill slope erosion includes landslides, which may be caused by both natural and man-made changes in the environment. The circumstances that cause a slope to collapse are directly influenced by the geologic history of the region and human-related activities. Basic causes of slope instability include flaws in the makeup or structure of the rock or soil; variables like heavy rain, snowmelt, and changes in ground-water level; transient causes like seismic or volcanic activity; or due to novel environmental conditions imposed by construction activity. Every landslide has a number of contributing factors. When forces acting downhillprimarily those brought on by gravity exceed the stability of the earthen components that make up the slope, slope movement results. While certain slopes are more solid than others, others are prone to landslides. Slope instability is caused by a variety of causes, but the key ones that affect it are the types of bedrock and soil underneath, the slope's shape, its geometry, and the levels of ground water.

Natural Phenomena

Slope failure may result from a variety of natural sources. Some of them, such as cyclic or long-term climatic changes, cannot be identified without the use of instruments and/or extensive record-keeping.

Climate

The stability of a slope may be significantly impacted by long-term climatic changes. The wateris lowered as a consequence of a general drop in precipitation, which also affects the weight of the soil mass, the solution of materials, and the intensity of freeze-thaw activity. The level of the ground water will rise in response to an increase in precipitation or ground saturation.

Biologically Damaging

Landslides often cause biotic devastation; significant removal of forest cover due to mass movements has been seen in various regions of the globe. The habitat for animals is impacted by forest cover removal. Landslides have an important ecological function that is often ignored. Landslides support both terrestrial and aquatic life. Debris flows and other forms of mass movement are crucial for maintaining pool/riffle habitat in streams by delivering coarse woody debris and silt.

A Social Impact

Landslides have a negative impact on a number of resources and cause property damage, injuries, and even fatalities. For instance, years after a slide occurrence, water supplies, fisheries, sewage disposal systems, forests, dams, and roads may all be negatively impacted.

Economic Downturn

Property is harmed by landslides. The economy of a nation suffers as a result. Therefore, economic rehabilitation is required in the landslide-affected region. Landslides have a detrimental impact on the economy in a number of ways, including the cost of repairing buildings, loss of property value, interruption of transportation routes, medical expenses in the case of injuries, and indirect costs like lost fish and wood stocks. Landslides may have an impact on the availability, amount, and quality of water. Engineering projects and geotechnical studies to evaluate and stabilize potentially hazardous areas may be expensive.

Monitoring, Warning, and Forecasting

Forecasting

For policymakers and local authorities to evaluate corrective actions and disaster mitigation, it is vital for scientists from several scientific disciplines engineering geology, geomorphology, civil engineering, etc. to anticipate landslides at regional and local scales.

Using Rain Gauges

Rain gauges, like those used in Bangladesh's Chittagong area, are being used to measure landslides. They record rainfall levels, which may then be compared to historical data of amounts that caused a landslide.

Use of Sensors with a Single Axis

But many modern systems depend on point-based sensors, which are grounded-plugged devices that can only monitor from fixed points. Due to its physical position, India is one of the most disaster-prone nations in the world. The majestic Himalayan Mountain ranges are located in the north of India. These fold mountain ranges are thought to be the youngest in the whole planet. As

a result, the underground Himalayas are a geologically active and earthquake-prone region. The Himalayan, the northeastern hill ranges, and the Western Ghats also see a significant amount of landslides, but at various intensities [9], [10]. Long-term planning and preparation are taken into account as a component of the development planning process in India in order to battle all these natural calamities. For many years, a variety of unique programs have been in place to lessen the effects of natural catastrophes. GIS is regarded as the finest way for analyzing cyclones among other hazard monitoring systems since it can be utilized as a tool for creating a spatially enabled system. The chapter also emphasizes the value of global cooperation and information sharing in earthquake predicting, warning, and monitoring. In order to improve the precision and dependability of earthquake information, it highlights the need of international networks and collaboration between seismological organizations and research institutes.

CONCLUSION

Communities and governments may take appropriate action to lessen the effects of earthquakes by having a thorough awareness of the techniques and technology used in earthquake forecasting, warning, and monitoring. It makes it possible to create efficient emergency response plans, put construction norms and regulations into force, and incorporate seismic risk reduction techniques into urban planning. In conclusion, reducing the dangers connected to seismic occurrences is largely dependent on earthquake forecasting, warning, and monitoring. Our capacity to foresee and react to earthquakes will likely improve because to continued scientific study, technological development, and international cooperation. This will allow us to save lives and lessen the devastation that earthquakes due to infrastructure and communities.

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CHAPTER 6

MAN-MADE DISASTER: FOREST FIRE, TERRORISM

Dr. Annu Bahl Mehra, Associate Professor,
Maharishi Law School, Maharishi University of Information Technology,
Email Id: annu.mehra@muit.in

ABSTRACT:

Man-made disasters, such as forest fires and acts of terrorism, have significant impacts on human lives, the environment, and societal well-being. This study provides an overview of forest fires and terrorism as man-made disasters, examining their causes, consequences, and the measures taken to prevent and respond to these events. Forest fires, often caused by human activities or negligence, result in the destruction of vast areas of forestland, wildlife habitats, and properties. They pose a threat to human lives, air quality, and ecological balance. Effective prevention strategies, including public awareness campaigns, strict regulations, and prompt firefighting efforts, are crucial in mitigating the occurrence and severity of forest fires. Terrorism, characterized by acts of violence and intimidation intended to create fear and disrupt societies, has emerged as a significant man-made disaster. Terrorist attacks can cause mass casualties, destruction of infrastructure, and long-lasting psychological impacts on affected communities. Counter-terrorism measures, intelligence sharing, and international cooperation are essential to prevent and respond to acts of terrorism.

KEYWORDS:

Earthquake, Environment, Forecasting, Management, Man-Made Disaster, Susceptibility.

INTRODUCTION

A catastrophe, according to the United Nations, is a significant interruption in the normal operation of a society or a community. Disaster management, with its array of techniques, is essential to reducing the effects of catastrophes globally. The earth's inner and outside are both undergoing ongoing change. Some of these changes have very negative aftereffects and are often labeled as environmental catastrophes. However, not all environmental catastrophes are brought on by natural change. Disasters categorized as man-made often include human mistake and negligence. Natural catastrophes and the part humans play in them are still up for discussion. Both planned and inadvertent man-made catastrophes are possible. Both natural and man-made calamities have plagued humanity throughout history [1], [2]. As a result, these sorts of tragedies have always affected people worldwide. In the current day, man-made catastrophes do great harm to people. As ancient as the woods themselves, forest fires are the most frequent threat in forests. Any source of ignition that comes into touch with combustible material, including bare flame, cigarettes or bidis, electric sparks, or other sources of ignition, might be considered one of the man-made causes of forest fires. They pose a very significant danger to the whole regime of flora and fauna as well as the forest's richness. A region's ecology, biodiversity, and environment are also impacted. There is no general consensus on what constitutes terrorism, and the problem is not new. The illegal use of violence or the threat of violence to achieve political goals is known as terrorism. It puts the populace at risk of widespread illness and death, anxiety, panic, and societal upheaval on both a psychological and financial level.

Man-Made Mishap

Man-made disasters are events that are brought on by humans, either purposefully or accidentally. Warfare, civil conflicts, terrorism, design mistakes, nuclear calamities, industrial disasters, etc. are a few examples. Man-made catastrophes provide a difficult and serious danger to public health and/or well-being due to their unexpected occurrence, and they must be dealt with with strict attention, appropriate preparation, and appropriate responses. Knowing the main causes of man-made disasters makes it simpler to prepare for emergency situations related to these catastrophes by educating the public about their causes and consequences. The frequency and severity of man-made catastrophes have grown in proportion to how far humanity has progressed technologically with time. Disasters caused by humans are a byproduct of technological and material advancement. Negligence on the side of man is the cause of accidents. An accident that caused mayhem among the locals is what led to the Bhopal Gas disaster.

Different from a Natural Disaster

On the other hand, the phrase natural disasters refer to those catastrophes that are brought on by natural occurrences like earthquakes, landslides, epidemics, wildfires, etc. that cause enormous loss of life and property ever since the beginning of time. A natural event is not considered a natural catastrophe unless it affects people. A volcanic eruption, for instance, is a natural occurrence but not a natural catastrophe when it occurs in an unrestricted location. Inadequate human preparation may exacerbate natural catastrophes. When man is unprepared, a natural calamity has a greater effect. For instance, a significant number of people could be killed or injured during a nighttime earthquake that cannot be foreseen in advance. A tornado or hurricane may be prepared for when it is forecast, while. Natural and man-made catastrophes vary in that the former are brought on by forces of nature, whilst the latter are caused by human activity. They are unavoidable, while man-made calamities are. If man works carefully and effectively, these may be avoided. On the other hand, a natural calamity is beyond our control. Anthropogenic refers to risks or calamities caused by people. Different categories may be used to categorize man-made catastrophes. Similar to natural risks, man-made dangers are unrealized potential outcomes, such as terrorism. Natural disasters happen independently of human activity, although human activity may enhance their chance and effect, and nature can affect the likelihood and impact of catastrophes that are caused by people [3]–[6]. Direct human participation in the occurrence of several small natural catastrophes is noted. Furthermore, catastrophes caused by humans that might have been prevented are more devastating since they result in the loss of innocent lives that could have been prevented. It should be mentioned that certain natural disasters are a side effect of human activity. For instance, a dry spell could lead to the clearing of forests. As a result, there are more man-made catastrophes than natural disasters. Examples of particular situations where man-made risks have materialized in a situation include man-made catastrophes. High fuel use and a depletion of natural resources are effects of the growing population. Our social environment is also impacted by overpopulation. Nuclear bomb disasters are another kind that fits this group.

DISCUSSION

Man-Made Disasters' Root Causes

Some typical instances of man-made catastrophes are train accidents, airplane crashes, building collapses, bridge collapses, mine collapses, tunnel collapses, etc. These occur as a consequence of human negligence or improper handling of hazardous equipment during industrial and technical

usage. Accidents that happen out of the blue and cause severe damage to both property and human life are what constitute catastrophes. The majority of the time, these catastrophes result in casualties, illnesses, and injuries [7]–[10]. Disasters caused by people result from technical risks. Chemical spills and groundwater pollution fall under the category of hazardous materials crises. Workplace fires are increasingly frequent and may result in serious property damage and fatalities. Additionally, radical organizations that utilize violence against both people and property constitute a danger to communities. Military and civilian government buildings, international airports, major cities, and famous landmarks are examples of high-risk targets. Attacks on computers and networks used to threaten or compel a government or its citizens for political or social goals constitute cyberterrorism.

Fundamentals of Human-Caused Disaster

We have been forced to consider unrestrained expansion and resource exploitation as a result of several man-made catastrophes. In 2015, there were significant man-made disasters related to the sea, air, and train, as well as fires, explosions, terrorism, and civil unrest. These catastrophes serve as a somber warning that the planet can no longer support more human garbage. Man should exercise restraint in the here and now to prevent harm to our future generations. Most of our industries continue to flout environmental regulations and laws, and this has to be looked at. Environmental conservation and sustainability must be taught to our children. Man-made catastrophes have a variety of effects on the environment.

The environment and human health are affected both immediately and over time by nuclear reactor accidents and leaks of harmful substances from industrial sources. Short-term consequences on human health are related to accidents and illnesses include blindness, cancer, paralysis, heart issues, and abnormalities of the stomach and lungs. Human genetic imbalances and their impacts on future generations are among the long-term effects. Long periods of time can see long-term contamination of soil and water supplies. These are the end consequence of poorly controlled man-made dangers, and they often cost the most in terms of misery, fatalities, and long-term harm to a nation's economy and capacity for production.

Improvement of Disaster Management Systems: Need and Scope

The term disaster management refers to a variety of actions taken to keep emergency and disaster situations under control and to provide a framework for assisting vulnerable individuals in avoiding or recovering from the catastrophe's effects. The topics covered by disaster management include those that arise before, during, and after the event The following factors call for disaster management.

To Stop a Catastrophe

By looking into potential catastrophe causes, disaster management teams may assist prevent disasters from happening in the first place. They could take the necessary steps to prevent a catastrophe. For instance, with careful preparation and proactive measures, forest fires or even terrorist bombs may be avoided. Rescue operations may be carried out successfully during floods, large fires, building collapses, and certain man-made catastrophes by trained disaster management specialists. To offer relief measures: The disaster management team is in charge of setting up food, clothes, relief camps, medical supplies, and other necessities for the victims. These actions would lessen the suffering of the tragedy victims.

The Implementation of Rehabilitative Programs

In order to carry out rehabilitation programs in the affected regions, the disaster management team can function successfully. Construction of homes, schools, and other infrastructure, for instance, falls under rehabilitation programs in earthquake-affected communities.

Performing Liaison Work

The disaster management team handles all of the disaster's liaison tasks. In order to receive money and contributions, other resources or services, and liaison work is needed with many commercial and public institutions including hospitals, it is necessary to manage and overcome the crisis.

To lessen anxiety and trauma

The stress and strain both before and after the tragedy may be lessened with the assistance of the disaster management team. For instance, the team can effectively direct the populace to confront or manage a calamity, such as floods, before it occurs. Additionally, the team may provide post-disaster psychological care in addition to material or financial assistance to help people recover from the stress of the catastrophe.

To Safeguard the Environment

The ecosystem may be safeguarded and preserved with the aid of a disaster management team. A catastrophe management team may, for instance, prepare preventative measures to put out forest fires. Etc. Teams in charge of disaster management can reduce the damage and loss of life. This is due to the disaster management team's ability to prevent a catastrophe by taking preventative measures. In general, people prefer to solely consider disaster management in terms of the post-disaster measures conducted by authorities responsible for relief and rebuilding. However, the phrase disaster management refers to the whole of catastrophe-related activity. As current disaster managers are more involved in pre-disaster operations than in post-disaster response, it covers a considerably wider range of topics. This is due to the fact that many individuals who work in the development sector or who routinely plan economic, urban, regional, or agricultural development initiatives are also responsible for disaster management.

For instance, if the homes adopt disaster resistant building techniques, housing professionals constructing a low-income housing project in a disaster-prone location have the chance and duty to lessen the effects of a future catastrophe. Similar to this, programs for agricultural growth must be designed such that they aid in slowing down environmental deterioration and lessen the susceptibility of farmers to losses from cyclones, floods, and other natural disasters. In actuality, only a tiny fraction of disaster management operations in dealing with natural hazards are linked to emergency response; the great majority are tied to development initiatives. Of course, disaster management also covers the provision of ongoing care for displaced people and refugee refugees. Disaster management for refugees is a highly specialized subject that calls for a deep understanding of political, legal, and humanitarian challenges in addition to various development skills.

A Range of Man-Made Catastrophes

There are Two Primary Categories of Man-Made Disasters

Small-scale local calamities including railroad derailments, aircraft crashes, and shipwrecks. Disasters related to industry and technology is the other. These are the outcome of technological

failures or industrial mishaps, and they are far wider in scope. Such catastrophes impact the local populace as well as those that may extend over a much wider region. Accidental leaks of water or air pollutants lead to industrial catastrophes. Many of the compounds are very carcinogenic and poisonous, negatively affecting the human population. Some individuals pass away suddenly, while others suffer from blindness, paralysis, and other chronic conditions that leave them permanently disabled.

Psychological Risks

Crime

A crime is an act or omission that is illegal and subject to punishment. The severity of the punishments might vary, from paying a fee to spending time in prison. diverse human communities may have diverse definitions of crime. Even if every crime is against the law, not every legal transgression is a crime; for instance, violations of contract and other private laws may be considered offenses or infractions instead. In modern nations, crimes are often seen as transgressions against the state or the public, as opposed to torts, which are offenses against private persons that might result in a civil cause of action.

Civil Unrest

The word civil disorder is wide. It also goes by the name of civil disturbance. It is often used by law enforcement to refer to disturbance that is brought on by a crowd. Civil unrest has the potential to turn into widespread anarchy, even if it doesn't always go to tragedy. Rioting may be caused by a variety of things, including racism and discontent over low minimum wages.

Terrorism

The unofficial or illegal use of force and intimidation to further political objectives is known as terrorism. There are many meanings for this contentious phrase. One term refers to a violent act that only targets people. The use of violence or the threat of violence to instill fear in order to further political, religious, or ideological objectives is another description. Terrorism is defined by the Federal Bureau of Investigation (FBI) as the unlawful use of force against persons or property with the intent to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives. To accomplish their goals, terrorists use a range of techniques.

There are two sorts of biological weapons. replicating infectious agents and non-replicating non-infecting or intoxicating agents. Agents that reproduce include harmful bacteria, viruses, and fungi. Toxins are non-replicating substances that are created from reproducing substances, other living things, and plants. The danger of nuclear terrorism is comprised of two distinct categories. One is the explosion of a nuclear weapon, whether it be actual or threatened. The other is the explosion, or threat of detonation, of radiological dispersion devices, sometimes known as RDDs, which are conventional explosives that contain nuclear elements. Any mechanical, electrical, or chemical device used purposefully to ignite combustion and a fire is considered an incendiary weapon. Chemical-chemical weapons are substances that may harm or kill people, animals, plants, or other things due to their chemical qualities.

The United States Department of Transportation (DOT) defines an explosive as any substance or article, including a device, designed to function by explosion for example, an extremely rapid

release of gas and heat, or any substance or article, including a device, which by chemical reaction within itself can function in a similar manner even if it is not designed to function by explosion, unless the substance. Conflict involving relatively large groups of people that includes the use of weapons to inflict physical force is known as war. Warfare has caused a huge deal of pain for mankind by destroying whole civilizations, nations, and economies. Armed conflict, hostilities, and police action are other words for war. Normally, catastrophe planning and insurance contracts do not cover wartime activities.

Risks Posed by Technology

Commercial Risks

Industrial catastrophes, including mining accidents, happen in a professional setting. They often affect the environment. The Chernobyl tragedy is recognized as the worst nuclear accident in history, while the Bhopal disaster is the biggest industrial disaster to date. Longer-lasting and more widespread consequences of hazards include poisoning from dioxin and DDT.

Power Failure

A power outage is a disruption of the regular electrical power supplies. Power outages that last just a few hours are frequent and only have a modest negative impact since most companies and medical institutions are equipped to handle them. However, prolonged power outages may interfere with daily activities, including work and personal life, as well as rescue and medical services, resulting in financial losses and unexpected medical problems. Civil unrest may result from a prolonged power outage, as was the case with the 1977 blackout in New York City. The 2005 Java-Bali Blackout, which impacted 100 million people, and the 2009 Brazil and Paraguay Blackout, which affected 60 million people, are recent noteworthy power disruptions.

Fire

Inadequate emergency planning may make fire casualties worse, regardless of the fire's origin or original cause. More people may die or be hurt as a consequence of dangers such a lack of accessible emergency exits, poorly designated escape routes, or badly maintained fire extinguisher or sprinkler systems.

Transportation

i. **Aviation:** Disasters in the air are incidents, not accidents. It has to do with how an airplane operates. A vehicle that may be a helicopter, airplane, or space shuttle is an aircraft. The Tenerife crash of 1977, which resulted in the collision of two fully loaded planes on the runway and the death of 583 persons, is the deadliest airplane accident in aviation history.
ii. **Train:** A tragedy involving one or more trains is referred to as a train wreck or train accident. Miscommunication often results in this. Accidents happen when trains traveling in opposite directions collide on the same track. Again, there will be railway mishaps that result in calamity if a train wheel derailment or boiler explosion occurs.
iii. **Road:** Road-based pollution poses a serious health risk, particularly in big conurbations where traffic accidents are the main cause of fatalities. Road transportation contributes significantly to anthropogenic global warming, and the Hubbard peak is accelerated by the increased usage of fossil fuels.

Adaptation to Human-Made Disasters

Disasters caused by humans have significant financial and human consequences. They may result in many fatalities, serious injuries, and food shortages. Depending on the kind of catastrophe and how long it lasts, the majority of occurrences involving serious injuries and fatalities take place immediately after an impact, although disease epidemics and food shortages may appear much later. Understanding the probable impacts of catastrophes may assist identify the steps that need to be taken before to the disaster occurring in order to reduce its effects. Response is a group of actions taken in the wake of a catastrophe to determine needs, ease suffering, stop the disaster's spread and effects, and pave the way for recovery.

CONCLUSION

Both forest fires and terrorism require robust emergency response and management systems. Timely detection, rapid mobilization of resources, coordination between agencies, and effective communication are critical for mitigating the impacts and facilitating recovery. Enhancing preparedness, training first responders, and implementing early warning systems are key components of disaster management strategies. Addressing the root causes of forest fires and terrorism is essential for long-term prevention. This includes addressing deforestation, promoting sustainable land management practices, enhancing security measures, and addressing the socio-political factors that contribute to terrorism. In conclusion, forest fires and terrorism as man-made disasters have wide-ranging impacts on society. By implementing preventive measures, strengthening emergency response systems, and addressing the underlying causes, communities can better mitigate the risks, protect lives, and promote resilience in the face of these man-made disasters.

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CHAPTER 7

MAN-MADE DISASTER: ROAD, RAIL ACCIDENTS

Nishant Kumar, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: nishant.kumar@muit.in

ABSTRACT:

Man-made disasters resulting from road and rail accidents have become a pressing concern globally, posing significant threats to human life, infrastructure, and the environment. This study explores the causes, consequences, and mitigation strategies associated with these accidents. Road accidents are a major contributor to man-made disasters, with factors such as driver error, impaired driving, poor road conditions, and inadequate infrastructure playing significant roles. These accidents result in severe injuries, fatalities, and substantial economic losses. Moreover, they can lead to secondary impacts such as traffic congestion, disruptions in emergency services, and psychological trauma. Similarly, rail accidents can have devastating consequences. Factors such as human error, mechanical failures, and inadequate maintenance contribute to derailments, collisions, and fires. These accidents not only cause casualties and property damage but also disrupt transportation networks, affecting trade, passenger mobility, and emergency response capabilities. Efforts to mitigate the occurrence and severity of road and rail accidents encompass various strategies. Improving infrastructure, enhancing driver training and education, implementing stricter regulations, and promoting technological advancements like intelligent transportation systems are essential steps. Additionally, fostering public awareness and encouraging responsible behavior can contribute to accident prevention and improved response during emergencies. Addressing the aftermath of road and rail accidents requires an integrated approach. Emergency response planning, rapid medical assistance, efficient rescue operations, and effective communication networks play crucial roles in minimizing casualties and providing timely aid. Furthermore, post-accident investigations, data analysis, and implementation of safety recommendations are vital to prevent similar incidents in the future.

KEYWORDS:

Earthquake, Environment, Forecasting, Management, Man-Made Disaster, Susceptibility.

INTRODUCTION

The Indian Railways is the largest rail-passenger carrier in the world. The rapidly growing economy of India has resulted in an exponentially increasing demand for transportation in recent years, and this has led to an enormous rise in the volume of traffic in the Indian Railways network. However, it is a commonly voiced opinion among economists that the current Indian Railways infrastructure is not capable of efficiently handling this increased volume of traffic, and this is resulting in frequent delay in running of trains and increasing cost of transportation. Air crash is also known as an aviation accident. Much of the aviation such as airplane, helicopter, air balloon and jet plane are designed ensuring a high level of safety. As aviation accidents are unpredictable

and unpreventable, accident do happen anytime and harm human life [1]–[4]. Ship accidents have occurred down the ages due to the complex environment in which ships operate. Therefore, oceans are considered the most dangerous workplace on the planet. Several vessel accidents and spills of oil and other fuel in recent years have drawn attention on the potential risks posed by vessels operating in the region. It is observed that maritime disasters have greatly diminished. Improved ships and more efficient navigation systems may be attributed to this. Also, the increasing and more or less exclusive use of commercial aviation for passenger transport, especially for international travel has lessened marine travelers. Hence demise of travelers by ship wreck has reduced.

Road Accidents

Road accident, considered as a 'global tragedy', is one of the major causes of death and injuries in the world. It has an ever- increasing trend. The problem of road accident is very acute in highway transportation due to complex flow pattern of vehicular traffic, presence of mixed traffic along with pedestrians. Traffic accident leads to loss of life and property. Thus, the traffic engineers have to undertake a big responsibility of providing safe traffic movements to the road users and ensure their safety. Road accidents cannot be totally prevented but by suitable traffic engineering and management the accident rate can be reduced to a certain extent. For this reason, systematic study of traffic accidents is required to be carried out. Proper investigation of the cause of accident will help to propose preventive measures in terms of design and control.

Geographical Distribution

Major car accidents occur near our home because most driving occurs close to home. The following are some of the most common places where car crashes happen:

Neighborhoods

It has been said that most car accidents happen close to home. Studies reveal that 52% of all accidents occur within 5 miles from a person's home. Common neighborhood collisions include crashing into parked cars, backing out of a driveway and into someone driving by and side-swiping a car to avoid pedestrians or other vehicles in the road. In parking lots, the most accidents occur. It is very common for 2 cars backing out of parking spaces to bump each other.

Daily Commutes

In large metropolitan areas such as New York and Los Angeles, people may not be completely alert during their commute, as they are either tired from getting up early or tired from working a long day. Moreover, commuters spend hours each day sitting in traffic travelling to and from work. and use this time to multi-task, such as shaving, eating or even reading the newspaper while behind the wheel. From the above stated list, we come to know the common places where usually car accidents occur. While every car crash cannot be avoided, there are certain steps all drivers can take to ensure their safety on the roads.

Response to Road Accidents

Few road users are aware of the factors that could determine the time needed to respond to a vehicle accident. So, importance lies in the awareness of these factors. Also steps that road users can take to assist emergency teams in responding swiftly to accidents must be taken into consideration. Up

to 46 per cent of road traffic fatalities could be prevented if the right first aid assistance was available in those first moments [5]–[7].

Responses to Road Accidents are Stated Under

All emergency medical calls are categorized and prioritized when they are received and resources are allocated according to the category and priority of the call as well as available resources at the time. A straight forward and consistent process is followed regarding the caller number and name, what and where the emergency is with all demographic information. This information is sent to the Emergency dispatchers through the Integrated Call Taking and immediate dispatch system who then use satellite tracking to allocate the closest, most appropriate resources to the call. Following factors play a role in determining the time before a response vehicle will arrive at an accident scene

Check on All Drivers and Passengers

Before assessing property damage, one must make sure everyone involved in the accident is alright. Prompt medical attention must be present at the accident spot for anyone who needs it. If a person is unconscious or has neck or back pain, we should not move them until qualified medical help arrives. But if any hazardous situation requires moving the person, that should be done without hesitation, with proper care and expertise.

Call the Police

If there's significant property damage, physical injury, or death, we need to call the police. We should also ask that a police report be filed in situations where police do arrive at the scene, and obtain the name and badge numbers of the responding officers.

Exchange Information

Get the names, numbers, addresses, drivers' license numbers, license plate numbers, and basic insurance information from all drivers involved. If there are passengers, also obtain their names, numbers, and addresses. In talking to other drivers, try to be cordial and cooperative.

Talk to Witnesses

Every witness must be asked for what he or she saw and if possible, their names, numbers, or addresses must be collected. The opinion of the local people is also very important and they must be asked if they have ever witnessed other accidents in the same place before or in the same date.

Inform Your Insurance Company

We must promptly tell our insurance company that we have been in an accident and cooperate with them and tell them the truth about what happened and the extent of your injuries. Explain the facts clearly.

Keep Track of Your Medical Treatment

Note any doctors, physical therapists, chiropractors, or other medical professionals that you receive treatment from, and each medical provider that referred you to other caregivers. Keep a detailed account of the treatments or medications you receive. Also, request copies of all medical reports and bills as this help you prove your medical expenses later. Medical expenses are relatively easy to document, but pain and suffering is trickier to prove. Keep a record of how your injuries have

impacted your daily life. Include any missed workdays, list any routine activities you can't undertake, and describe how the injuries have affected your family life.

Photograph and Document the Accident

Take photographs of any damage to your vehicle as soon as possible after the accident. Photos helps your insurance adjuster determine how much you should be compensated for the damage to your car and can help in court. Use your camera to document the damage to all the vehicles. We should keep in mind that we want our photos to show the overall context of the accident so that we can make our case to a claims adjuster. If there were witnesses, we must try to get their contact information; they may be able to help us if the other drivers dispute our version of what happened. However, we should in no way interfere with the on-going police investigation. If we cannot take pictures at the scene of the accident, we must take them as soon as possible after the accident. Obtain your insurance company's damage valuation. If you aren't satisfied with how your insurance company has valued your vehicle, don't give up. Get two independent repair estimates or replacement quotes. Assertively inform the adjuster of your concerns. If you can't agree on your car's value, consider mediation or consult an attorney.

Use Caution in Discussing the Incident

Don't talk to anyone about the accident other than your lawyer, your insurance company, and the police. Don't talk to a representative of another insurance company, without the knowledge of your attorney or insurer. If called by the other insurance company, be polite, but ask them to call your attorney or insurer to arrange an interview. Also, tell your lawyer or insurer about the call.

Be Wary of Early Settlement Offers

Be careful if you're offered a settlement from an insurance company. Confirm all your physical injuries have been treated. Some injuries don't show up or reach their greatest level of discomfort until many days, weeks, or months later. Don't settle a claim until you know you'll be compensated for all your injuries, and consult an attorney before signing any settlement documents.

Consider Hiring an Attorney

If anyone was injured in the accident, it's best to consult an experienced attorney. An attorney can help you maximize your recovery if you're injured or better defend yourself if you're at fault. Most accident attorneys work on a contingency fee basis. That means that your lawyer only receives a fee if you're awarded damages or receive a settlement. Contact an experienced attorney now for a free claim review.

Keep Safety First

Drivers who are involved in minor accidents with no serious injuries should move cars to the side of the road and out of the way of oncoming traffic. If they leave cars parked in the middle of the road or busy intersection additional accidents and injuries may occur. But in a road accident if a car cannot be moved, drivers and passengers should remain in the cars. They must keep their seatbelts fastened for their safety till help arrives. Make sure to turn on hazard lights and set out cones, flares or warning triangles if possible.

File An Accident Report

Although law enforcement officers in many locations may not respond to accidents unless there are injuries, drivers should file a state vehicle accident report, which is available at police stations and often on the Department of Motor Vehicles Web site as a downloadable file. Police report often helps insurance companies speed up the claims process.

Know What Your Insurance Covers

The whole insurance process will be easier following your accident if you know the details of your coverage. For example, don't wait until after an accident to find out that your policy doesn't automatically cover costs for towing or a replacement rental car. Generally, for only a dollar or two extra each month, you can add coverage for rental car reimbursement, which provides a rental car for little or no money while your car is in the repair shop or if it is stolen. Check your policy for specifics. Despite the above facts one final question that usually arrives with an accident is who will pay for the damage. In case of a minor accident the drivers may decide to handle the damages themselves without the involvement of an insurance company. But this isn't always the best idea, for several reasons. While the other driver may agree to pay for the damage to the other one's car on the day of the accident, he may see the repair bills and decide it's too high. At this point, time has passed and the insurance company will have more difficulty piecing together the evidence if one files a claim. Also, keep we should keep in mind that we have no way of knowing whether another driver will change his mind and report the accident to his insurance company [8]–[11].

Case Study of Road Accident

Indian Scenario

In the past one decade, over 1.3 million people have been killed in road accidents but there is still no comprehensive road safety legislation in the country. According to the 234th report of the Standing Committee on Transport, Tourism and Culture which has recently been tabled in Parliament, there are several stumbling blocks for replacing the existing Motor Vehicles Act with a proposed Road Transport and Safety Bill, 2015. According to the report, the Ministry wanted to change the entire architecture over road transport and road safety in the whole country, basically, setting up a set of authorities at the Central level and the State level to control all aspects of transport and public transport including driving licenses. However, this has not been possible because the main hitch is on sharing of revenues between the Centre and the state in implementing the changes which have been proposed. In an effort to still try and push the safety measures through, the government claims it is trying to focus on noncontroversial, achievable goals such as an increase in the penalty for drunken driving or increasing the penalty for unauthorized driving, minor driving.

Rail Accidents

Rail Accidents with Reference to Nature

Railway accidents are comparatively rare but their consequences can be very severe, involving many injuries and loss of life. A high-speed crash or derailment is inevitably very high profile in the media and can cause disruption to transport links for many weeks. The nature of the equipment involved often means that even 'minor' incidents can have significant operational and financial consequences. Railway accidents include incidents such as:

i. Derailments.
ii. Collisions with objects on the track.
iii. Collisions with vehicles on level crossings.
iv. Potential inadequate maintenance of track and rolling stock.
v. Mechanical failure of the permanent way and rolling stock.
vi. Fires on trains and in the load on trains.

Geographical Distribution of Rail Accidents

Train accidents are common around the world. Unfortunately, when these accidents occur, people are often seriously injured or even killed. Accidents involving trains are often the result of mechanical failures and human error, and often it's a combination of both. Indian Railways (IR), the largest rail passenger carrier in the world, has experienced 11 major accidents due to derailment or collision between trains in the year 2010, leading to several human casualties and large-scale disruptions in traffic. Alarmingly, 8 of these 11 accidents have occurred within a specific geographical region known as the Indo-Gangetic plain.

Causes and Impact of Rail Accidents

A rail accident is a type of disaster involving one or more trains. Rail accidents occur when trains travelling on the same tracks collide or when trains derail because of technical faults in the rolling stock, the rails or the security systems, or because of landslides, avalanches or objects obstructing the rails by deliberate actions, such as terrorist attacks.

Causes

Generally, these accidents cannot be avoided because the train driver or security personnel do not have enough time to react. Such accidents cause direct and indirect damage to people and the environment, especially when they involve trains carrying freight or dangerous or polluting substances. A majority of the train accidents that take place in India are due to human error. CNN-IBN has accessed an internal safety report of the Railways which says that 18 of 21 accidents in the last four months took place due to human error. Manpower shortage, financial bottlenecks and delay in installing anti-collision devices are among key reasons why safety is being compromised. Reports also show that there are shortages of 16,000 locomotive drivers in the railways. When driver over speed and skip red signals, accidents happen. There is shortage of drivers too. There are a variety of different reasons that these railroad accidents occur, and some of these include:

i. Train conductor negligence.
ii. Train derailment.
iii. Improper maintenance of the train tracks.
iv. Faulty equipment.
v. Collision with another train.
vi. Collision with a car, bus or truck trying to cross train tracks.
vii. Collapsed bridges.

Faulty Train Crossings: The number of European level crossing crashes between 1990 and 2009 remained the same in relation to the number of passenger kilometers travelled. This makes level crossing crashes a high priority issue. For example, in 1999 a passenger train collided with a tractor-semitrailer at a grade crossing in Bourbonnais, Illinois. U.S. Major reasons leading to rail accidents in India are as follows:

Low Investment

Official records say that the Indian Railway is carrying 15 times more people than its capacity for the past 20-23 years. Hence, damaging the old tracks is done by overloading. Most of the Indian trains are not equipped with fire detection systems. Sometimes smoke and fire detection systems are installed in AC coaches but not in the other compartments of the same train. Detecting fire in the open coaches is more problematic. In some nations devices to automatically stop the train if it crosses red signal are in place. These avert head on collisions to a great extent. But no such devices are provided in Indian Railways leading to certain avoidable collisions. Train crashes caused by carriage and equipment failure must be avoided by for example timely inspections and maintenance.

Human Errors

The Human factor has proved to be the direct cause of several train crashes. Many studies have been carried out within this factor and contain aspects of the human factor through investigations of crash causes and user-friendly instruments and tools. The term is often used to denote the human tendency to misunderstand, make miscalculations, and mistakes. It has been found out by CNN-IBN after assessing the internal safety report of the Railways that 18 out of every 21 accidents occur because of human error. As the Indian Railways lacks new technologies, the chances of human error are more. Hence, it is one of the major causes of rail accidents in India. Moreover, the organizations compromise on the safety measures because of low investment, delay in installing anti- collision devices and shortage in manpower. Shortage of staff is another major reason leading to human errors. Less staff means work overload. In India train accidents also occur because of the fault of driver and negligence of railway staff. Manual signaling system between stations must be replaced with automated one. Again, this needs a huge investment, maintenance and management.

Impact of Rail Accidents

Train crashes causing severe consequences for passengers are not a problem of the past, rather they continue to be highly relevant today.

Environmental

In a rail accident, the damage is not only limited to the people injured or killed but also affect the environment by contaminating the surrounding area. These damages require extensive remediation and cleanup. Moreover, a rail accident has significant effect on individuals as well as organizations regarding property damage and financial loss. They may even be injured or become ill as a result of toxic substances released into the environment by a train crash.

i. Disruption of rail traffic.
ii. Loss of commercial and public confidence in the transport system.
iii. Often, physical environment made it difficult to evacuate and transport the injured from the steep embankment to the road.

Further, railway crashes might happen far from roads as was the case when two trains collided head-on due to a signal malfunction in Japan, 1991, The rural setting of the crash hampered rescue efforts.

Response to Rail Accident

Response: Once the Emergency occurs, the railway authorities coordinate with external organizations, perform the initial measures on the field, deploy staff on the site and define the need of technical means support. In this phase, the Emergency is usually solved by external organizations with the support of the railway authorities. The first persons arriving at a railway accident site can render valuable assistance to minimise injury and loss of life, reduce property loss through damage, and prevent loss of clues and evidence that can identify the factors that contributed to the accident. Often Police and Emergency Services and representatives of the Railway Network Owner and/or Railway Operator are the first trained personnel to arrive at railway accident sites. In addition, supervisory officers coordinate response and recovery from locations off-site.

Specific Risk Reduction and Preparedness Measures of Rail Accident

Preparedness: At this stage, the railway authorities define capacities, maintain the resources human and technical and define the Emergency Plans and Organization to be prepared for an unlikely Emergency situation. Preparedness largely approaches to achieve risk reduction from people side. So, preparedness may be largely common to all hazards but prevention and mitigation have to be hazard specific. Preparedness may be a matter of inculcation and readiness but prevention & mitigation have to be concrete and specific. Preparedness is people and area specific. Best of preventive measures cannot ensure that disaster would not happen. Therefore, it is essential to be prepared for emergency response through having an effective Disaster Management Plan, backed by provision of adequate support capacity and empowered delegation to enable response team to tackle the situation. Plan should be supported by provision of requisite infrastructure, reserved and kept spare in readiness for emergency and otherwise. Indian Railways emergency response system has all these elements.

Training and Preparedness of Rail Accident

Cyclic training and retraining of manpower, system of periodic inspections of the resource and rehearsing and examination of preparedness through mock drills are essential ingredients of a sound disaster response mechanism. These all elements are provided in railways disaster response system. The dedicated and nominated staffs for ARMVs and ARTs have specific work assigned to them in case called for. For example, if the break down crane has to be brought in use pre-assigned staff by himself takes over the duty of watching supports ensuring stability of the crane. Both kinds of staff are sent for periodic training and knowledge up gradation to zonal as well as divisional training schools. Even the officers are given training on disaster management at National Academy of Indian Railways at Vadodara. Active assistance of NDRF is also being taken for four-week training of trainers on disaster management, who in turn becomes nodes for imparting further awareness among frontline staff. Extract from the relevant paras pertaining to disaster management training are at annexure 3 for reference purposes only.

There is a well laid out system of periodic inspections of both ARMVs and ARTs at various levels with frequency increasing from weekly inspections at supervisory level to quarterly inspections at divisional officer's level. This is also a scheduled item of inspection during safety audit of the division and inspection at zonal level by Principal Head of Department of concerned officer who is invariably an HAG level officer. The preparedness of system is practiced through mock drills. These are planned exercises wherein a situation is artificially created and ARMV / ART 'ordered'

to carry out prescribed task. The exercise is also carried out at a larger scale involving other participants like NDRF and other stake holders in order to have synchronization and coordination should the need arise. The system is tested for response from time to time by actual ordering of the ARMV and / or ART in day as well as night to check actual response in terms of available of manpower, readiness of system to turn out required unit in specified time etc. Incidentally the prescribed time for turning out ART during day and night is 30 minutes and 45 minutes respectively. Similarly, the ARMV is to be turned out in 25 minutes and 15 minutes depending upon single exit or double exit irrespective of day or night.

Typical Post-Disaster Needs of Rail Accident

Recovery: This phase begins once the Emergency is solved usually the injured people have been treated, the site has been processed by all the organizations according to their duties and those external organizations have finished their main tasks. Here, the railway authorities take a leading position with their own resource's human and technical in order to restore the railway service as soon as possible. The findings of the emergency investigation are the basis to create or modify the safety rules and recommendations. This is known as the 360º safety circle.

1. Prevent the marshalling of the form of energy in the first place.
2. Reduce the amount of energy marshalled.
3. Prevent the release of energy.
4. Modify the rate of spatial distribution of release of the energy from its source.
5. Separate, in space or time, the energy being released from the susceptible structure.
6. Separation by barrier.
7. Modify appropriately contact surfaces.
8. Strengthen the human resistance.
9. Prevent aggravation of occurred injury event emergency care.
10. Restoration and rehabilitation of those injured.

CONCLUSION

Accidents can take place anywhere. Even the most advanced technology can't ensure accident free and hundred percent safe working conditions. Many cities around the world are becoming increasingly unfriendly to pedestrians because of too many road accidents. It has turned out to be a global tragedy with ever-rising trend. Due to these accidents, there is loss of life and limb on a large scale. These may be single vehicle accidents in which the vehicle is either colliding with fixed objects or with pedestrians or the vehicle may fall in a ditch. In case of multiple vehicle accidents two or more vehicle is involved. But both the cases may cause uncountable casualties. There are various reasons behind serious and most dangerous road accident such as design of the road, driver's impairment and vehicle design. There has been an unbelievable growth in the frequency of rail accidents. The earliest railways had no signal systems hence station employees used hand gestures to train drivers indicating whether to stop or go on. This led to rail accidents because drivers often missed or ignored the hand signals. With the advent of time fool-proof signaling system has been developed assuming that could prevent train accidents. It succeeded. But as soon as a new system was introduced to prevent one type of accident, a new type of error cropped up and caused another accident. So, invention of new system to mitigate rail accidents continued. Serious design flaws, train conductor negligence, train derailment, improper maintenance of the train tracks, faulty equipment, collision with another train, collision with a car, bus or truck trying to cross train tracks and collapsed bridges are some of the major causes of rail

accidents. To make India's railways safer we must put stress on fire detection systems, anti-collision technologies, improved staffing, new tracks and manned railway crossings.

In conclusion, man-made disasters resulting from road and rail accidents pose significant threats to societies worldwide. Understanding the causes, consequences, and mitigation strategies associated with these accidents is imperative for developing effective preventive measures. By fostering collaboration among stakeholders, implementing comprehensive safety measures, and promoting responsible behavior, it is possible to reduce the occurrence and severity of these man-made disasters and safeguard human lives, infrastructure, and the environment.

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CHAPTER 8

MAN-MADE DISASTER: AIR AND SEA ACCIDENTS

Himani Kulkshetra, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: himani.kulshrestha@muit.in

ABSTRACT:

Man-made disasters resulting from air and sea accidents have garnered increased attention due to their potential for widespread devastation, loss of life, and environmental impact. This study explores the causes, consequences, and mitigation strategies associated with these accidents, highlighting the urgent need for enhanced safety measures in the aviation and maritime industries. Air accidents, including plane crashes and aviation incidents, are complex events with multifaceted causes. Factors such as human error, mechanical failures, adverse weather conditions, and inadequate maintenance can contribute to catastrophic outcomes. These accidents result in the loss of passengers and crew, property damage, economic implications, and psychological trauma for survivors and their families. Similarly, sea accidents, such as ship collisions, groundings, and oil spills, have far-reaching consequences. Human errors, navigational mistakes, equipment malfunctions, and inadequate safety protocols can lead to disastrous outcomes. These accidents pose threats to marine ecosystems, coastal communities, and the economy, with long-term environmental repercussions.

KEYWORDS:

Catastrophic, Economy, Environmental, Man-Made Disaster, Management.

INTRODUCTION

Mitigating the risks associated with air and sea accidents requires a comprehensive approach. Improved pilot and crew training, rigorous maintenance standards, advanced technology integration, and effective air traffic control systems are vital to enhancing aviation safety. Similarly, implementing stringent safety regulations, promoting responsible ship operations, ensuring effective communication protocols, and enhancing emergency response capabilities are crucial for maritime accident prevention. Post-accident response and recovery efforts are equally important in mitigating the impacts of air and sea accidents. Timely search and rescue operations, medical aid provision, accident investigations, and subsequent safety recommendations are key components of effective disaster management. Additionally, the development and implementation of preventive measures based on lessons learned from previous incidents are essential for ensuring a safer future.

Air Accidents

Even while flying is widely seen to be the safest form of transportation, it is still relatively new, and when an accident happens in the air, the results are sometimes tragic.

Air Mishaps May Be Predicted by Nature

It has been shown that accidents mostly occur in the immediate vicinity of airports. Injuries to passengers and crew in aircraft accidents may be seen as body contusions and vertical distortions.

It's common to find the sufferer has had several traumas [1]–[3]. Therefore, in order to save lives, local and regional rescue services must respond with the highest promptness, precision, and organization. Furthermore, the development of effective prevention measures depends on extensive studies of such catastrophes. The 10% of fatal aviation accidents that occurred while the aircraft was on the ground during the preceding ten years was another important statistic. According to aviation experts, the takeoff and climb phase, which consists of three phases, has been involved in 22% of all fatal airline accidents. When the airplane takes off, there is a quick ascent that is followed by a gradual ascent that brings it to cruising altitude. The jet accelerates down the runway during the takeoff phase. In the preceding 10 years, there were six fatal occurrences on takeoff, four during the first climb, and six throughout the time of rise to cruising altitude. The descent, approach, and landing are the riskiest phases of a flight. When an aircraft begins to descend from its cruising altitude in preparation for landing, that is when the bulk of fatal aviation accidents occur.

Effects and Causes of Air Crashes

These are the most typical reasons for aircraft accidents: Any news of an aviation catastrophe quickly raises questions about the safety of aircraft and the potential for terrorism. Without all the facts, it is impossible to speculate as to what may have really caused a particular accident. Several variables may be found in every aircraft disaster. A discussion of them is given below:

Pilot Mistake: Pilot mistake now contributes more to accidents as a whole. The cause of 50% of all aviation accidents is pilot error. A lot of management is required for airplanes since they are complex machines. There are many possible problems during a flight since the pilots actively engage with the aircraft at every stage. This can include underestimating the required fuel uplift or improperly configuring the essential flight-management computer (FMC). Pilots are responsible for safely performing takeoffs and landings, navigating in inclement weather, and responding to mechanical issues [4]–[6]. Accidents involving aircraft may happen when pilots misunderstand instruments, underestimate the weather, or fail to recognize mechanical problems until it is too late. Sometimes during critical parts of a flight, pilots pass out, which causes an aircraft accident. Due to cabin depressurization, a Helios Airways flight to Greece crashed in 2005, knocking out the entire flight crew. Even mental health conditions have been linked to certain pilot errors.

When a pilot with a history of significant psychological problems set the plane's engines to reverse in 1987, a trip to Tokyo was lost in midflight. Even while such errors are regrettable, it's important to remember that the pilot is the last line of defense when things go disastrously wrong. The second most common cause of airplane accidents is mechanical error. Even with improvements in manufacture and design, 20% to 22% of all aviation accidents are still the result of equipment failure. Even while engines are far more reliable now than they were fifty years ago, they nonetheless sometimes have catastrophic failures. Some mechanical errors are the consequence of an aircraft's design flaw. For instance, a 1974 disaster involving Turkish Airlines was brought on by a design flaw in the cargo door lock. When an aircraft is damaged by outside forces, mechanical breakdown sometimes occurs. For instance, the 1962 accident involving the left horizontal stabilizer of a United Airlines airliner was caused by a single swan striking the plane. Birds have been implicated in at least seven aircraft mishaps thus far.

Weather: About 12% of all aircraft accidents are caused by unfavorable weather. Even though it's common for flights to be canceled when the weather is deemed hazardous, pilots and air traffic controllers may be caught off guard by storms, high winds, and even fog. Lightning strikes may

be very dangerous. Aviation accidents have been caused by lightning-related issues with electrical systems, fuel tank and pipe ignitions, and even temporary blindness from the flash itself. Sometimes even milder weather circumstances may lead to catastrophic aircraft failures, as in the case of a flight to Lebanon in 1977 when the pilot discovered a thick fog as he was getting ready to land. He circled and made a couple more landing attempts until the jet's fuel ran out and it could no longer stay in the air [7], [8]. An Indonesian airplane carrying 103 passengers overshot the runway in 2010 due to severe weather, which resulted in the accident.

The plane skidded into a body of water at the end of the runway before crashing into a nearby hillside. The power of the impact caused the jet to split in half. Sabotage-related crashes involving airplanes account for around 9% of all crashes. Of course, the most well-known hijacked aircraft crashes were the three planes that were hijacked on September 11. However, some passengers still manage to carry explosives or weapons into flights despite the TSA's stricter security measures. If they are successful, one person may bring down an airplane and kill hundreds of people. Other forms of human error account for around 7% of aviation disasters. A lot of airplane accidents are the fault of air traffic controllers. Air traffic control mistakes have caused planes to collide in midair, crash into mountains, and land on congested runways. Human error occurs in the field when an aircraft is improperly loaded, fueled, or maintained. One of the most common catastrophic mistakes that individuals make is fuel starvation, yet this mistake isn't always the result of an insufficiently filled gas tank. Due to incorrect fuel valve positioning, both engines of a Coastal Airlines airplane that crashed in 1948 were forced to take fuel from the same tank.

DISCUSSION

Impact of Air Accidents

An airplane accident that causes injury or death to people also affects the reputation and finances of the country's air transportation industry. In order to reduce the accident rate, researchers are approaching the problem from a number of aspects, including improving meteorological forecasting techniques, increasing the amount of weather data that is automatically collected using on-board sensors and flight modems, and improving weather data transmission.

Influence on Finances

Less travel will have a negative impact on the economy. If the exact same number of people travel with multiple airlines, the overall effect is zero. There are large money transfers because of insurance claims and legal fees. The accident site incurs significant localized costs for everything from security and investigation to food and housing for all visitors. CNN will need to charter helicopters to fly over the disaster area for the next three days. Talking head jobs is rising in Atlanta. Millions of dollars may be spent on rescue operations, body retrieval, retrieving aircraft wreckage, and investigations.

The Heart's Health

Despite the very low risk of dying in an aircraft tragedy as opposed to a far larger likelihood of dying in a vehicle accident, the public's reaction to such tragedies is extraordinarily intense. Regardless of whether there were fatalities, it is common for individuals to lose trust in an airline or in flying in general. There are more severe effects of collisions.

Psychological Effects

Psychological research suggests that those who survive an airplane accident may suffer severe mental health consequences. Posttraumatic Stress Disorder and a variety of other, less well-researched diseases and symptoms are manifestations of these impacts.

If an Accident Occurs in the Air

Emergency action is taken as soon as an aircraft disaster is found or reported. The order of the numbers does not imply priority since everything should be finished as soon as feasible. Complex and tragic aviation accidents need a prompt personal and professional response. A company's first and greatest responsibility is to the families of those who were hurt in the accident. Every reasonable plan for their comfort and accommodation should be considered, assigned, and put into place before internal company or public remark. The management of the firm should inform the families as soon as possible, provide counseling and other types of support, make the appropriate arrangements, and keep them informed. Primary sources for details on the affected aircraft, crew, and passengers may include the company's human resources or personnel departments, flight department records, flight department workers who weren't involved in the accident, and flight department people.

It is essential to get in contact with the executives of such departments as soon as possible. Call the insurance companies, public affairs, and investor relations departments as well straight away. The level of public and professional scrutiny that follows aircraft accidents is sometimes unprecedented for managers in a subject outside of their expertise. The general public's attention is often ephemeral, even if this curiosity typically persists for a long period while an investigation moves forward. It is highly recommended that an obvious tragedy be recognized as quickly as possible, that regret be conveyed, that care be given to the relatives of the wounded, and that a proactive corporate attitude of cooperation with investigating authorities be demonstrated. The public's perception of a company's professionalism during a crisis often has a significant influence on the public's and shareholders' evaluation of the company's competence [9], [10].

Safety is ultimately the CEO's responsibility and need to be seen as an integral part of business culture. Management should put their commitment to safety in writing and make it clear. Aviation accident investigators from the past claim that corporate safety standards for air travel often succeed in stopping the majority of accidents before they happen. If an accident does occur, company management should have procedures in place to help them deal with the situation quickly and effectively. The sections that follow provide specific recommendations for actions that business representatives should take after an airline disaster. Corporate officials also detail the facts they should be aware of concerning the accident and business aviation in general in order to effectively answer to any press and public inquiries.

Risk Reduction

In serious aviation disasters, the victims and survivors may be distributed across a wide area. This problem is further complicated by hazardous goods. The following steps might be taken to reduce risk. Automation is designed to lessen a pilot's workload and reduce errors. Unfortunately, reality may sometimes be quite different. When the captain and the aircraft do not interact as intended, automation technology may be the cause of unsettling instability that has resulted in disastrous

accidents. A risk reduction strategy has been developed for the air transportation of hazardous chemicals. It makes the transporting of these objects acceptable when applied to reality.

In Aircraft Accidents, Common Post-Disaster Needs

Despite being tragic, aircraft accidents are not always unavoidable. The National Transportation Safety Board examined aviation occurrences from 1983 to 2000 and found that the survival percentage of collisions was 95.7%. Yes, there have been accidents when all or almost all of the victims died, but these occurrences are far less often than you would imagine based on what you read or see in the news. The NTSB found that 76.6% of passengers survived even in catastrophic collisions with fire and extensive damage. If one survives the crash landing, they have a chance to leave the airplane in less than 90 seconds and still be alive. This is because an airplane's metal fuselage often burns through in 90 seconds, engulfing the whole cabin. Young, slender men have the best chances of surviving an airplane crash. One must walk quickly through narrow corridors while surrounded by luggage and other debris to escape an airplane tragedy. If at all possible, travelers ought to choose bigger planes. Additionally, one should avoid flying with smaller airlines whenever possible since their risk of errors and accidents is twice that of big carriers, and their pilots are often inexperienced and overworked. Due to the normality bias, our brains have a tendency to believe that everything will always be predictable and usual. Abnormal events take a long time for our brain to process.

Instead of responding instantly when something unexpected happens, our brain makes the assumption that because really terrible events are so uncommon, what has happened cannot be that dreadful. The passenger is required to read the safety card and pay attention to the pre-flight safety briefing given by the flight attendants. A frequent traveler may think he has every reason to feel certain, yet he is probably complacent. The FAA discovered that frequent travelers were most susceptible to the normalcy bias and had the least awareness about what to do in the event of an aircraft tragedy. In the aviation business, the first three minutes after takeoff and the last eight minutes before to landing are referred to as Plus 3/Minus 8. Crash investigators estimate that this time period is responsible for over 80% of all aviation mishaps. Therefore, if you want to improve your odds of survival, you should exercise great caution and be ready to take action during the first three minutes after takeoff and the last eight minutes before to landing. We would have a better chance of surviving an airplane crash or even an emergency crash landing if we adopted the bracing position. Due to the placements, your head will surely collide with the seat in front of you less forcefully. Furthermore, they reduce limb flapping. We must put the carryon luggage aside and think about the children. The fact is that sometimes we rush to get off the plane and overlook our kids. Our brain displays odd actions during disasters.

Mishaps at Sea

The bulk of maritime mishaps may be prevented, much as those on land. However, the environment and working conditions aboard seagoing vessels create additional dangers that do not exist on land. There is a chain of duty for accident prevention that extends from the shore institution to the Master and to every individual on board. The most crucial factor in reducing accident rates is safety awareness among all people.

Sea Mishaps with Connection to the Environment

Improvements in maritime law have been motivated by the grave environmental consequences associated with these maritime disasters and the obvious links with inappropriate vessel operation and maintenance. As a result, marine disasters over the last 40 years have acted as a spur for environmental protection regulations. Environmental risk is affected by the kind and amount of oil and/or hazardous goods being carried as well as the sensitivity of the marine environment where any incidents occur. Along with areas of concern and causes of shipping accidents, the impacts of these disasters on the marine ecosystem are discussed. This article pays particular attention to the issues surrounding the function of flag states, the country to which the ship is registered and which has the authority and responsibility to enforce laws over that vessel, as well as the extent of their obligations with regard to ship safety and the implementation of international rules and regulations. Environmental risk is directly influenced by the kind and amount of hazardous chemicals, including oil, that are transported as well as the sensitivity of the marine environment where any disaster might occur. The dependability and security of seagoing ships worldwide continue to depend on the efficacy of flag nations. Numerous organizations provide standards for operating as a flag State.

Locations Where Marine Accidents have Occurred

Despite the huge efforts made by several maritime organizations to create a safe and secure maritime transportation system, the number of maritime accidents and incidents is always growing. The geographic information system (GIS) is an outstanding and effective tool for geographical analysis with high visualization. It is used to the research of maritime accidents. The buffer analysis is used to identify accident hot zones and to quantify incidents that occurred in coastal areas. The area surrounding the United Kingdom, the Mediterranean Sea, and the coasts of East Asian countries (such as China, Japan, and Korea), according to the data gathered, have the greatest accident rates. Additionally, while maritime disasters are less frequent in open waters, they are more frequent in coastal areas, with 62.2% of mishaps happening within 50 miles and 51.1% within 25 miles of the continents, respectively.

Causes and Consequences of Maritime Accidents

Causes

Numerous studies and statistics indicate that human error was mostly to blame for maritime catastrophes, despite the fact that the average seafarer is capable and well-trained, has been shown the correct operating procedure, and is equipped with the tools needed for the job. Trips and falls, fire, pollution, and accidents are just a few of these mishaps, which often happen as a consequence of weak safe working practices. The crew is often hurt or killed in these situations, which slows or damages the ship. Human error may take the form of neglected maintenance, insufficient system checks, a lack of communication among crew members, weariness, or an inadequate response to a minor incident that develops into a major disaster. Practically speaking, an analysis of the circumstances of accidents reveals that collisions and groundings account for a significant portion of spills. Collisions often result from maneuvering errors, especially in areas with poor visibility and/or high freight traffic. Groundings are often the result of poor maneuvering, which may sometimes be exacerbated by high winds, perilous currents, and bad weather.

Mechanical Failure

Human error may contribute significantly even when there has been a mechanical failure because of poor maintenance or monitoring failing to see a potential problem, a lack of suitable tools or safety precautions, a breakdown in communication or procedures, or any of these reasons.

Manning Issues

Crew fatigue and complacency often play a big part in accidents. The shrewd ship-owner or management will see to it that problems are resolved by adding additional crew members or rotating the ship's workforce more often if the ship is employed on a challenging trade route. While this is often due to commercial or operational considerations, some owners and managers are unable to do this. This may be partly caused by a shortage of qualified sailors. Even though superior equipment could be more costly, safety should be given a higher priority as a ship cannot be operated effectively without the seafarer.

Yacht Design

Ship designs often used individuals with minimal prior knowledge in the field. The ship design team does, however, often take into consideration the opinions of sailors who are informed about or have sailed on the kind of ship being designed. When building is properly managed, disparities and potential problem areas may be addressed.

Operating Instructions

The bulk of marine accidents have revealed that the operating instructions are difficult to understand. Therefore, a better ship design method does not completely resolve the problem since the seafarer still has to comprehend the equipment's user instructions. The manual is sometimes only a simple pamphlet that cannot even be prepared in the crew's native language. Given that there are enough resources for human translation into practically every language, this is unacceptable.

Lack of Unified Standards

Equipment problems are made worse by the absence of a uniform standard for important pieces of gear including oily water separators, voyage data recorders, and lifeboat launching apparatus. Seafarers will be required to comprehend and use novel and unnecessarily complicated equipment, usually in hazardous conditions, until regulatory and industry groups can agree on a uniform standard. It is often said that quality and safety must come first and serve as a guide. Sadly, things don't always turn out this way. Our common responsibility is to ensure that seafarers have a secure environment in which to live and work. Environmental elements including current, tide, and tidal stream, powerful winds, poor sight due to fog, heavy snow, and rain, storm waves, darkness, etc., may have an impact on the ship or the persons in charge. Technical defects may be in the ship itself, such as corrosion, steering, engine, or hull failure caused by inferior building materials or workmanship, or they can be in shore-based infrastructure, such as navigational aids.

A few examples of route conditions include anchorages next to traffic separation lanes, confined marine areas with insufficient sea room, anchorages next to such lanes, narrow channels with abrupt and angular windings that allow for very little maneuverability and are exposed to heavy marine traffic, like the Turkish Straits, and navigational hazards like shoals, reefs, and wrecks. A ship's vulnerability, which is linked to her larger size and resulting in less agility and stability, as

well as draught limitations, are examples of ship-related issues. Human error can happen for a number of different reasons, including insufficient training and experience, technical difficulty, poor lookout, disregard for protocol and rules, carelessness when commanding a ship, incorrect interpretations of radar data, fatigue and lack of alertness, excessive working and resting, etc. The majority of cargo-related factors are connected to dangerous goods and heavy cargoes, specifically their hazardous characteristics oils, chemicals, and nuclear materials, the area or compartment on board ships where they are stored on deck or below deck, and the degree of care needed for such cargoes, all of which are connected to the seaworthiness of ships.

Impacts of Marine Accidents

90% of all commerce is handled by the marine industry. Even though shipping is thought of as a cost-effective, ecologically friendly, and safe form of transportation, every shipping tragedy, no matter how big or little, is the greatest nightmare of every seafarer. Shipping accidents are tragically an inevitable aspect of the maritime business, despite the employment of innovative and creative technologies in the shipping sector and the enforcement of preventive safety legislation and regulations. Maritime accidents negatively affect people, the marine environment, assets, and activities both on board ships and ashore in a variety of ways and to differing degrees. Accidental repercussions may vary from minor injuries to fatalities, as well as from minor property damage to extremely major environmental damage. There are several ways that shipping mishaps might affect the marine ecology. In addition to crashes and catastrophes, human error such as oil spills, solid waste, oil transfer, and unintended bunkering may also contribute to marine pollution.

The effects of a ship collision are significant for both marine and terrestrial life. The concerned ship suffers serious structural and stability damage in a collision. In addition to damaging the ship, a collision also has the following effects. The ecosystem is negatively impacted by collisions. If the ship collides with a tanker or chemical vessel, there is a strong chance that oil or chemical may leak into the ocean. Both large and minor oil spills have the potential to harm the marine ecosystem and the nearby coastal areas. The owner of the ship and the nearby neighborhood would both suffer huge financial losses. Ship collisions pose a serious risk to human life. In past occurrences, the ship sank in a matter of minutes, leaving no time for the passengers to escape. Collisions with ports or offshore constructions cause infrastructure damage, which is a major setback for human undertakings. Accidents involving port structures and bridges have in the past resulted in considerable losses in terms of money and manpower.

Responding to Man-Made Disasters: Marine Accidents

Accidents are the outcome of very complex coincidences. A significant factor among the many other factors is human error. So, one possible area for accident prevention is reducing human error. The International Maritime Organization (IMO) estimates that more than half of packaged goods and bulk cargoes sent by water today might be classified as unsafe, hazardous, or bad for the environment. Many of these substances, things, and materials are likewise hazardous or dangerous for people's safety. As a consequence of the expanding trend in the sea transportation of chemicals and hazardous goods, accidents involving such items are increasing. This development sets high expectations on the staff members in charge of adopting preventive steps in order to avoid damage to people and the environment.

The activities performed to protect people, the environment, and property while reducing the risks presented by an emergency are referred to as responses. It may also refer to steps done to put the

situation back to how it was before the incident. Most chemical and marine spills are found with advance notice. They participate in maritime incidents the majority of the time, and sometimes they may be seen, checked on, or tracked in the local sea region. Sometimes mysterious missing packages containing dangerous contents wash ashore or are discovered floating at sea. However, these products may often be connected to well-known accidents. Accidents, chemical spills, and lost shipments of hazardous goods must all be reported to the relevant authorities in accordance with national and international agreements and standards. For many incidents involving chemicals or hazardous materials, there are certain universal responses that must be made.

Specific Methods for Risk Reduction and Hazard Avoidance at Sea

Identifying the risk, its sources, as well as the probability and severity of its impacts, is all part of the difficult process of risk assessment. Through the use of preventive, risk-control, and risk-reduction strategies, this is utilized to create solutions for risk reduction and safety improvement at sea. The International Maritime Organization (IMO) has devised a structured and systematic procedure for a formal safety assessment (FSA) employing risk analysis and effective risk management. The formal safety assessment (FSA) is the IMO's response to the need for a more modern technique of formulating regulations in order to promote maritime safety. Even if there has lately been an improvement in maritime safety, accidents still occur often, necessitating additional development. The following should make up the present safety regulatory strategy:

- **a.** Proactive attempting to spot dangers before they materialize as opposed to waiting for accidents to do so;
- **b.** Adopting a strict, regulated, and scientific process to draft new laws and choose the most crucial fields of research;
- **c.** Being transparent entails being up front about the level of reliability and safety obtained as well as the impact each rule has made;
- **d.** Being cost-effective means striking a balance between the degree of safety and reliability and the cost to the ship owner in doing so.

Risk assessment is the process of identifying potential environmental dangers. It makes up the most crucial initial stage of a risk assessment. Regardless matter how likely or unlikely an incident may be, any situation that has the potential to threaten people, the environment, property, or a business is seen as a hazard. Danger identification requires careful planning, meticulous execution, and is essential. Actually, the risk assessment is a review of the dangers posed by various risks. It assumes that the likelihood of risk events, their frequency or likelihood, and the severity of their effects have been assessed. This enables one to pay careful attention to high-risk areas and to identify and evaluate the factors that influence the level of danger. The next step is the risk assessment. In risk assessment, the likelihood and consequences of events are integrated to determine risk. The risk classification may then be prioritized in order to choose whether to put new safety measures into place or enhance those that are currently there. Oil spill risk assessment is quite difficult due to the many impacts and factors that determined how severe the spills were. In conclusion, it may be stated that the findings of assessments of risk management, prevention, and reduction techniques provide the basis for recommendations to regulators and decision-making bodies to reduce risk to the barest minimum. Response plans must include reporting procedures and assign responsibilities for reporting occurrences involving pollution.

As a consequence, we need to be more cautious than usual while operating a watercraft. In the case of a maritime disaster, rescue operations are conducted in accordance with national and

international maritime legislation. In conclusion, it can be said that when these accidents occur, we should make every effort to maintain our composure and avoid becoming alarmed, keep our identity documents and other important personal documents with us, seek refuge as far away from the accident site as we can, and try to start the rescue process by calling the local security or specialist services. After the disaster, we should remain calm, try not to panic, and follow the instructions of the rescuers and other assisting parties. Man-made disasters caused by aviation and maritime accidents have a huge impact on the environment, the economy, and human life. By focusing on safety procedures, investing in cutting-edge technology, enforcing regulations, and promoting global cooperation, it is possible to lessen the frequency and severity of catastrophic disasters. Collaboration is the only way to make the aviation and maritime sectors safer, save lives, protect ecosystems, and promote sustainable practices.

CONCLUSION

Air travel is now the safest form of transportation, despite the fact that there are more aircraft in operation than ever before. Sometimes during critical parts of a flight, pilots pass out, which causes an aircraft accident. Aviation accidents may have a variety of reasons, including human error, sabotage, technical failure, and unfavorable weather conditions. To avoid aviation disasters, one might fly in larger aircraft, choose for nonstop trips, and pay attention to the flight attendants. In order to decrease these events, it is also necessary to enhance air traffic services, the New Air Navigation System, and airspace capacity. Enhancing disaster prevention methods for airports and aviation safety infrastructure, stepping up monitoring of air carriers, and placing a higher emphasis on prevention in traffic safety administration are other measures taken to enhance the environment for air traffic. Since many boats use the same waterways, maritime areas are often congested with them. As a result, high traffic may cause marine accidents. The majority of incidents involve aging or overcrowded ships and take place while ships pass through estuaries or sea channels. Other factors that contribute to these disasters include bad weather, technology setbacks, or navigational errors.

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CHAPTER 9

GEOGRAPHY AND DISASTER PREVENTION AND MANAGEMENT

Sneha Verma, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: sneha.verma@muit.in

ABSTRACT:

This study explores the critical role of geography in the field of disaster prevention and management. By examining the physical and human aspects of the Earth's surface, geographers provide valuable insights into understanding the causes, patterns, and impacts of natural disasters. The paper highlights the contributions of geography in hazard identification and mapping, vulnerability and risk assessment, land use planning and zoning, emergency response and preparedness, climate change adaptation, community engagement and education, and post-disaster recovery and reconstruction. By incorporating spatial analysis and geographic information systems (GIS), geographers offer a comprehensive understanding of the complex interactions between natural hazards, human activities, and the environment. This interdisciplinary approach enables the identification of high-risk areas, the development of preventive measures, the allocation of resources, and the enhancement of community resilience. Understanding the role of geography in disaster prevention and management is essential for effective planning, response, and recovery efforts in the face of natural disasters.

KEYWORDS:

Adaptation, Environment, Geography, Management, Natural Disasters.

INTRODUCTION

A catastrophe is an occurrence, or a sequence of occurrences, that endangers and disrupts human life. Because people are both the source and the victim of disasters as well as the ones who carry out the response efforts, human beings are often included in disaster studies. Human geography, which was developed by Gilbert White and continued by other specialists, subsequently demonstrated the need of looking at catastrophe studies, particularly in terms of disaster mitigation. Numerous specialists in human geography concur that there is nothing natural about natural disasters, based on various studies and ideas. Even though geosphere-related physical phenomena often influence catastrophes, diverse human activities on the earth's surface make certain populations more vulnerable to natural disasters. Greater focus must be placed on reducing population vulnerability, boosting disaster preparedness, and enhancing long-term human capacity to adapt to disaster areas if the chances of catastrophe are to be decreased [1], [2].

Since the majority of development strategy and programming are not specifically designed for risk reduction, the rush for development in nations with medium or low levels of human development is, to some degree, producing new disaster risks. Numerous and often occurring natural catastrophes have recently caused significant financial and human losses in the afflicted areas and hampered regional socioeconomic growth. Academic institutions and all levels of government are becoming more concerned about efficiently preventing and controlling catastrophic scenarios as

well as guaranteeing sustainable regional development. In truth, geographers have long contributed to our knowledge of the complete spectrum of crises resulting from the interconnections of natural and social systems, and the topic is often regarded as one of the ones that gave birth to the subject of hazard studies. Human geography and physical geography are the two primary subfields of geography, the study of place and space. Physical geographers investigate patterns of climate, land formations, vegetation, soils, and water, whereas human geographers focus on the spatial elements of human life.

Additionally, geography is exceptional in that it connects the social sciences with the scientific sciences, effectively linking the physical and cultural worlds. One of the most important responsibilities of geographical study is to investigate the connections between human activity and natural systems, or human-environment interactions. This serves to illustrate how both individuals and their environment are influenced by one another. These interactions may sometimes take the form of a single event or a chain of smaller ones that add up to a more significant shift over time [3]–[5]. The geographical characteristics of catastrophes should get greater attention in the area of disaster prevention and management. Actually, catastrophes are spatial by nature, both in terms of the physical processes involved and the effects on people. The position of fault lines, how tornadoes form, and hurricane tracks are all examples of patterns or processes that have or leave geographical imprints. Another example of a spatial pattern is the relationship between a population's location and possible dangers, or the social effects left behind after a catastrophe. Human locations, cultures, and interactions may be found within these patterns. A disaster-devastated area includes lost communities, disturbed social networks, differences in resilience, and social and environmental justice in addition to a landscape of destruction, sickness, and death. Geography, which is distinguished by its regional and integrative research approaches, may play a key role in mapping, forecasting, and eventually understanding these environments.

The distributions and interactions of phenomena relevant to catastrophe prevention and management may be explained or predicted using geographic approaches, which have a high capability for drawing ideas and empirical data from other disciplines and molding them with a spatial viewpoint. The intriguing truth is that disasters vary in terms of nature, type, and intensity as per the geographical locations. All of us live in disaster-prone zones, which may be of varied natures, kinds, and intensities. In theory, geography should be the field most suited to handle the demands of catastrophe prevention and management, a problem involving distance, time, the environment, society, and development. When it comes to catastrophe management and prevention, geography is very important. Geographers provide important insights into the causes, trends, and effects of natural catastrophes by researching both the physical and human components of the Earth's surface. Here are some examples of how geography and disaster management interact. Geographers evaluate the physical characteristics of the Earth, such as tectonic plates, fault lines, climatic patterns, and hydrological systems, to pinpoint locations that are vulnerable to certain hazards, such as earthquakes, floods, hurricanes, and wildfires. Geographers develop hazard maps using Geographic Information Systems (GIS) and remote sensing methods to detect high-risk areas, which enables efficient land use planning and the execution of preventative measures.

Geographers evaluate a community's susceptibility and exposure to different risks by taking socioeconomic considerations, population density, infrastructure, and environmental conditions into account. They assess the probable effects of catastrophes on various populations and determine the most pressing need for actions. The allocation of resources and the creation of

initiatives to lower risks and improve resilience are guided by this knowledge. Zoning and land use planning are influenced by geography, which identifies acceptable locations away from high-risk regions for locating populated areas and essential infrastructure. Geographers may suggest suitable land use rules, zoning restrictions, and construction laws to lessen the effect of catastrophes by studying the physical features of a place. Additionally, they aid in establishing buffer zones to safeguard sensitive regions and secure evacuation routes.

Disaster Response and Preparedness

By mapping the existing infrastructure, transportation systems, and resources in a specific region, geographers help in disaster response planning. They aid in deciding how emergency services, such as hospitals, shelters, and supply distribution locations, should be deployed to maximize efficiency. Geographical knowledge aids in coordinating efforts and maximizing reaction times during and after a crisis [6]–[8]. Geographers are essential to the research of the effects of climate change and the creation of adaption plans. They examine variations in temperature, patterns of precipitation, sea level rise, and other aspects of the climate. Geographers may aid in the development of climate-resilient infrastructure, the promotion of sustainable land use practices, and the support of community-based adaption activities by comprehending these changes. Geographers help communities become more aware of the dangers connected with natural disasters and educate them about those risks via community engagement and education. They create instructional materials, hold seminars, and interact with the community to equip people with the information and abilities needed for disaster preparation and response. In disaster management initiatives, geographers promote community engagement and a feeling of ownership.

Recovery and Rebuilding after a Catastrophe

After a disaster, geographers evaluate the degree of damage and aid in the formulation and execution of recovery and reconstruction plans. They provide geographical analysis, assess the viability of potential replacement locations, and aid in the recovery of vital ecosystems and infrastructure. In order to help create sustainable recovery plans, geographers also evaluate the long-term effects of catastrophes on the environment, society, and economy.

DISCUSSION

During a natural or man-made catastrophe, India has policies, regulations, procedures, and plans of action to help save and recover lives and property. Plans for disaster management are multi-layered and are designed to solve problems including floods, hurricanes/cyclones, fires, widespread utility failures, blackouts, and the pandemic spread of disease. India is particularly vulnerable to natural disasters from a meteorological perspective because of its unique location beneath the Himalayas, facing the open Indian Ocean, as well as its geo-climatic conditions and diverse landscapes; monsoons, followed by landslides and floods, droughts, famine, wildfires, cyclones, and earthquakes are all experienced to varying degrees on the Subcontinent, in addition to areas of dense overpopulation being at greater risk for disease outbreak and earthquakes.

The size of the nation makes various areas susceptible to various natural calamities. For instance, during the monsoon season, the peninsular parts of South India are often the most impacted by cyclones and tsunamis; during the summer, the more temperate to desert states of Western India run the danger of severe drought, starvation, and/or wildfire. The Himalayan nations, in particular, may endure deadly avalanches in the winter, spring floods, and significant landslides during rainy

times in the more isolated, mountainous parts of the North. Along with this, earthquakes in the mountains have the potential to cause much more destruction owing to rockslides, mudslides, and flash floods. The new strategy was founded on the idea that development cannot be maintained if mitigation is not included into the process. The idea that mitigation must be multidisciplinary and include all areas of development is another tenet of the strategy. The new approach is also a result of the conviction that spending on mitigation is significantly more economical than on relief and rehabilitation. Since impoverished people are the group most impacted by disasters and make up the majority of India's population, disaster management plays a significant role in the country's policy framework.

The actions the government is doing are a result of the above-described strategy. A National Disaster Framework that includes institutional processes, a plan for disaster prevention, early warning systems, disaster mitigation, preparation and response, and the development of human resources has been developed using the concept. The roadmap identifies and lists the anticipated inputs, intervention areas, and agencies at the national, state, and district levels. A natural hazard is defined as the occurrence of a harmful condition brought on by a natural phenomenon in a certain area and over a specific amount of time. But it's important to understand that these dangers might have negative effects that extend well beyond the immediate occurrence. They could thus have a significant impact in the future. Natural hazards should be studied and investigated from a geomorphological viewpoint because they are principally significant components of the Earth's surface dynamics, even if they are often associated with geological, geophysical, and hydrometeorological processes. Risks are created by natural phenomena including earthquakes, landslides, floods, and volcanic activity that imperil both cultural and natural settings. A cultural group transforms a natural setting into a cultural landscape; culture acts as the agent, nature serves as the medium, and the cultural landscape itself serves as the final result. In addition to attempting to understand and enjoy natural landscapes and landforms, geomorphology also recognizes and examines the processes and landforms that are associated to potentially dangerous situations.

Geography's Role in Disaster Management and Prevention

Assessing Vulnerability Caused by Humans

As a result of our interaction with the environment through some human activities relating to rapid industrialization and urbanization, such as designing and locating our infrastructure, utilizing natural resources, concentrating our population, and so on, disasters result in large part from human-created vulnerability. Although the general public typically does not understand this difference, the risks community and government and non-government groups are becoming more aware of it6. Vulnerability assessments with a focus on disaster management and prevention often include techniques from human geography research and geographic information systems. As shown, for instance, by study on Tokyo's social geography and catastrophe risk.

One of Tokyo's social groups has a well-defined spatial distribution, and there is often a tight correlation between that pattern and a geographical indicator of earthquake susceptibility, suggesting that certain social groups and some parts of Tokyo are more sensitive to seismic tragedy than others. Similar to this, a model of social vulnerability among one disadvantaged group was created to enhance disaster planning and management among the homeless and other ‘special needs' groups in megacities at risk across the globe. Additionally, there have been studies on GIS-

based integrated evaluations of household economic risk, agricultural drought sensitivity, and population famine vulnerability [9], [10].

How to Manage a Technical Disaster

Rapid industrialization and urbanization processes in emerging nations often result in technology catastrophes because there are insufficient or ineffective risk management solutions. Geographical study in this area primarily focuses on how to manage the dispersion and removal of toxic waste and their closeness to other land uses, such as populated regions and agricultural land. Studying the distribution of trace metals in surface soils to evaluate the environmental quality of the soil, assessing soil heavy metal contamination and potential risk for human heavy metals in soils and crops, as well as related public health risk and environmental remediation related to heavy metal pollution, are just a few of the research projects that have been conducted.

Creating Disaster Monitoring and Simulation Systems: Remote sensing, GIS, and related technologies have been used to give authorities access to real-time, value-added data and information in the fields of environmental management and natural resource management. GIS technologies play a particularly important role in identifying, simulating, and monitoring natural hazards. The potential of natural disasters occurring and the idea of history repeating itself may be taken into account while building simulation systems for significant natural catastrophes and associated emergency preparations. It is possible to construct a regional disasters reduction capacity assessment system and a large natural disaster monitoring and circumstances evaluation system by using 3S technology and network information management systems.

Recovery and Reconstruction after a Disaster

Local post-disaster recovery plans must include an effective participation approach and create a link between local needs and policy goals in order to produce beneficial recovery results. The geography discipline provides distinct benefits in this kind of design, as seen by the aforementioned discipline features.

Decreased Risk of Disaster

While emergency response has historically been the primary strategy for dealing with disasters, it became increasingly clear toward the end of the 20th century that disasters are man-made (even though the hazard they are associated with is natural), and that the only way to stop losses and lessen the effects of disasters is by reducing and managing conditions of hazard, exposure, and vulnerability. The greatest possibility of reducing risk is through decreasing vulnerability and exposure since we cannot diminish how terrible natural catastrophes are. It is necessary to recognize and address the root causes of these two risk factors, which are in particular connected to irresponsible economic and urban development decisions and practices, environmental degradation, poverty and inequality, and climate change. These factors all exacerbate and produce hazardous, exposed, and vulnerable conditions. Catastrophe risk will be reduced, the consequences of climate change will be lessened, and development will continue to be sustainable by addressing these fundamental risk elements.

Land use planning, building codes, and other structural risk-reduction strategies fall under the structural category, while non-structural strategies like policy development and awareness-raising go under the non-structural umbrella. Governments, civil society, and other parties employ risk governance to organize DRM via institutional framework, legal framework, decentralization, and

techniques for accountability and engagement. The concept that low-income countries with inadequate governance are more prone to disaster risk is well supported by the available data. Fundamentally, DRR lowers risk through strengthening the capabilities found within a community, society, or organization collectively referred to as strengths, characteristics, and resources. DRM measures are designed to increase a population's ability to endure risks, adapt to them, recover from them, and improve well-being. Thus, risk management and reduction actions may be used to increase resistance to diverse threats. DRM need to be used to a number of areas outside development, such conflict and climate change.

CONCLUSION

Long-term planning is necessary, but short-term decision making supported by geographers and the geographic work is equally crucial. This is because geographic work has been easily transferable to policy making demands. Both the particular guidelines for disaster management and prevention and their guiding principles should be accorded equal weight. Geographics is the epitome of an interdisciplinary field in many aspects. Geography will undoubtedly become more effective in the aspects of disaster prevention and management as more people become concerned with the intersection of socio-economic, physical, technological, and political/legal systems. They will also share their areas of interest, knowledge, and methods with many other fields of study. In conclusion, geography plays a crucial role in disaster management and prevention. Geographers provide important insights and geographical analysis to detect hazards, minimize vulnerabilities, improve readiness, and create resilient communities by researching the Earth's physical and human systems. Geographics is an interdisciplinary field that enables a thorough knowledge of the intricate relationships that exist between environmental factors, human activity, and the environment. This understanding results in more efficient and sustainable catastrophe management techniques.

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CHAPTER 10

HUMAN AND ENVIRONMENTAL ECOSYSTEM INTERACTION

Ramakant, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: ramakant@muit.in

ABSTRACT:

The relationship between humans and the environment is a complex and interconnected web, where human activities significantly influence and are influenced by ecological systems. This chapter delves into the multifaceted interaction between human and environmental ecosystems, examining the impacts, challenges, and potential solutions to foster sustainable coexistence. Humans, as a dominant species, have profoundly altered ecosystems through resource extraction, land use changes, pollution, and climate change. These anthropogenic activities have led to the degradation of natural habitats, loss of biodiversity, and disruption of ecosystem services. Conversely, environmental changes, such as climate variability, natural disasters, and availability of resources, shape human societies, livelihoods, and well-being. Understanding the intricate relationship between human and environmental ecosystems is crucial for addressing pressing global challenges. Sustainable development approaches that balance human needs and environmental conservation are gaining recognition. By integrating environmental considerations into decision-making processes, promoting responsible consumption and production, and adopting nature-based solutions, it is possible to enhance ecosystem resilience while ensuring human well-being.

KEYWORDS:

Disaster, Ecosystem, Geographic, Management, Sustainable Development.

INTRODUCTION

Everyone uses the word environment to describe a variety of different emotions. There is no good atmosphere if it is too hot, too smoky, too chilly, too dry, or too dusty. On the other hand, if the environment is clean, gentle, and green, utilize it. The term environment may also refer to the daily weather as well as the seasonal and yearly climatic conditions in a specific geographic area. Common people sometimes mix up the term's climate, weather, and even environment. However, regardless of the variables and degree of familiarity with them, the ordinary people's comprehension clearly demonstrates the state of their immediate surroundings. Moreover, recognizing the value of ecosystem services is vital for sustainable development. Ecosystems provide essential services, including clean water, air purification, climate regulation, and food production, which are fundamental for human survival and prosperity. Integrating these services into economic systems through approaches like ecosystem valuation and natural capital accounting can foster more informed policy-making and promote sustainable resource management. The common understanding and scientific knowledge must be interwoven within a single thread from the perspective of teaching and learning. Thus, it necessitates looking into the etymological meaning of the language we use on a regular basis. The phrase's dictionary definition has been used in a number of contexts to [1]–[3].

i. The whole of the external factors, circumstances, or effects; the environment; the milieu;
ii. Ecology, the air, water, minerals, creatures, and any other external variables that may be present at any particular moment and have an impact on a certain organism.
iii. The social and cultural factors that influence a person's or a population's quality of life.
iv. Computers, the configuration of a computer system's hardware or software, or its mode of operation: In a time-sharing setting, transactions are processed as they happen.
v. A situation, whether inside or outdoors, that is distinguished by the presence of environmental art that is specifically made for the location. Even in the dictionary, the phrase has been employed in a variety of contexts to denote various situations and conditions.

Environment geography must thus be strictly defined in this context in accordance with the geographical contextual grounds. The interactions between people and the environment have definitely been the emphasis. The lithosphere, hydrosphere, atmosphere, and biosphere all exist on the planet earth. These are the main elements that make up the environment. Within these elements, man engaged and created his own environment. Nature provided food, clothing, shelter, and many other requirements and comforts. As a result, nature serves as a reservoir for humanity, from which people continuously and without hesitation draw what they need. The wealth of natural resources, a small population of people, and a lack of human understanding all contributed to earlier restrictions on the exploitation of natural resources. Because of this, people and the environment have historically coexisted peacefully [4], [5]. As a result, geography uses spatial viewpoints to address environmental content. Environment is not sufficient on its own. It combines a number of different environmental factors. The atmosphere, hydrosphere, lithosphere, and biosphere all contribute to those components.

The distribution, affiliation, interaction, and interrelationships of different environmental factors have the effect of forming a particular geographical location on the surface of the globe. Geographical space is made more complicated by its variable structure, the occurrence of various forces that come from various dimensions of that area, and their typologies of processes across time. Because processes and their effects on geographic space across time are involved, environmental geography has a tight relationship to the factors that give rise to features. Events caused by the environmental effects of such various environmental components across the geographical space include disaster, danger, susceptibility, and risk to the earth's surface. In these situations, it is essential to include geographical study information into environmental, hazard, and catastrophe management. The word management has been used here in the context of a human-centric viewpoint. A geographical area's typical environmental conditions may lead to hazards and disasters, which can lead to the loss of life and property. As a result, managing such events necessitates dealing with geographical material as a topic.

Human behavior is influenced by the natural resources that are available. However, as human population and knowledge have expanded through time, together with an increase in the share of natural resources used, this has led to a shift in how people interact with their environment. People have always handled their resources in accordance with their own perception abilities and knowledge. It was customary to engage in activities like hunting, gathering, transhumance or nomadism, building terraces across sloping hillsides, creating irrigation systems from flowing water channels, using fires, and varying farming methods. At that period, there weren't as many people on the planet, and consumption habits were simpler and less varied. As a result, the systems for resource extraction and supply were in balance. However, the economic expansion that

followed the industrial revolution has reversed this pattern [6]–[8]. The boundaries of usage have to be expanded due to resource demands. George Perkins Marsh of Vermont, USA, first observed this situation in western civilizations in 1864. Man is a disturbing agent everywhere, he has said. Wherever he sets foot, nature's harmonies are disrupted by man. Man has upset the harmony of nature (Marsh, 1964:36). In contrast to certain other disciplines that only concentrate on one or a few of the environment's characteristics, environment geography works with the environment as a whole within this conceptual framework.

It examines how time and place relate to how people interact with their surroundings. Environmental geography essentially consists of three elements: the environment, the human race, and their interactions. Different strategies are used when dealing with these aspects. Either the human aspects or the natural sciences have been used to discuss the environment. The physical environment is what makes up ecosystems' natural rules. Examples may be taken from physical geography's land systems, including the landscape attributes. Many of these aspects come from the characteristics and elements of the physical settings. Physical environmental systems are created by the lithospheres, atmosphere, hydrosphere, and biosphere components. The technique effectively creates habitat for biotic and abiotic species components in any piece of land. Man operates as an individual physical being inside the physical environmental system, as a group of physical beings within the community and in social organizations, and as an economic being with actions carried out across space to extract and use the resources from the system.

Teaching Strategies for Environmental Geography

The link that is very closely related to space and time. It clearly interacts with space and time. Some things that happen in a place could alter throughout time. The importance of resource extraction for human subsistence might be used as an example. Man used to obtain resources by hunting and gathering in the past. As expertise of crop cultivation developed, the value system progressively shifted, increasing the worth of farms. Similar to this, some industrial facilities in Western Europe abandoned agriculture and relocated to mineral resources in the 18th and early 19th centuries. Around the globe, a number of significant metropolitan centers developed as a result of high population density. There is now a functional change in place. Economic activity are quite diverse. Human development started. Several causal connections between man and the environment are shown. As human knowledge systems mature, feedback mechanisms may be used to change the environment. As a result, rather of taking a static shape, the connection may be seen in a dynamic system. Some fundamental ideas are included in the environmental geography's central subject, including:

1. All living things and components interact with one another and the environment in different ways, as well as the other way around.
2. There are states of equilibrium and disequilibrium in the environment, which is very dynamic in nature and varies with time and place.
3. Each element, component, and factor has a defined purpose to carry out and a role to play.
4. The environment is based on cause and effect and is supported by structure and function.
5. Species work to preserve uniformity in the environment in terms of structure, function, growth, and development.
6. Each society passes through several phases of development, expansion, and extinction.
7. There are biomes, which are particular regions with a range of flora and fauna and a similar temperature.

8. There is energy flow, biomass production, and a clear cyclic sequence for the movement of chemical components.
9. Man, and the environment interact and have relationships at various stages.

The space and organism interactions throughout time within these conceptual frameworks adhere to a number of principles. However, in environmental geography, emphasis must be placed on the connections between people and the environment within human interaction with the physical elements and components that might be referred to as geo-ecosystems. Every organism's ecosystem function and the temporal evolution of the ecosystem inside that agroecosystem must be carefully considered. The ecology changes and functions in relation to space. Environmental geography also covers the topics of man and the environment, global environmental viewpoint, hazard and disaster management perspective, environmental deterioration and pollution, and environmental management.

Environmental and Human Interactions

Teachers of geography have been pioneers in environmental education. We may use our own nation as an example, where we can see diverse geographic phenomena within small spatial distances. The southern plains have mild weather. The peak has a cold temperature, whereas the main hill is temperate. The southern plain is also level. People who live there have been involved in a variety of activities that are quite different from what is done on the middle hill and the mountain to the north. The variances in physiography have been linked to variations in human activities as well as in a number of environmental elements. As a result, the pupils discover a larger universe inside a small geographic region of Nepal. What sort of homes we construct, what kind of clothing we wear, and what kind of food we can farm are all influenced by the physical environment. Senior folks have been seen in a variety of local settings participating in a variety of activities in an effort to fit in with their surroundings. People progressively alter and modify their environs to some degree as well. Societies have been interacting with both their environs and one another. While certain activities seem to have had short-term positive effects on some people, others have had long-term harmful effects. The environment has been degraded to such an extent that it can no longer sustain the population. The sand and gravel extraction during the dry season, but floods and river side cutting during the monsoon in the plain region, are examples of human actions along the river network. Additionally, the road building on the inclining hillside and the monsoon landslides could be observed. A number of human settlements are damaged, and both floods in the plains and landslides in the middle hills and mountains result in the loss of both life and property. The Kathmandu Valley's terrain also evolved through time. The vast majority of the once-green agricultural fields have now been replaced by a concrete jungle. The effects of changing the terrain on the ecosystem are many. Due to the lack of agricultural labor caused by the migration of foreign workers over the last several decades, rural farmlands in the nation have been turning into forest and bush land. These are only a few examples of the interactions and links between man and the environment. These serve as examples of environmental geography study topics as well.

DISCUSSION

Interaction between Ecosystems and Humans

The term ecosystem is defined by Encyclopedia Britannica as the complex of living organisms, their physical environment, and all of their interrelationships in a particular unit of land. Ecosystem

can be divided into its biotic constituents, which consists of all of its living members, and its abiotic constituents, which include minerals, climate, soil, water, and all other nonliving elements. The movement of energy through the ecosystem and the cycling of nutrients within the ecosystem are the two main factors that bind these components together. One of the system's active parts is the human race. The biotic and abiotic components of ecosystems are both dynamically impacted by human activity. Here, the farming operations of the agricultural community might be used as an example. A farmer cultivates crops on their property. She or he prepares farmland by applying energy, manure, and nonliving materials, grows crops, and produces foods like grains, fruits, and vegetables, etc. The farmer uses the knowledge, skills, and technology that were made possible by her or his enabling settings.

Additionally, these enabling settings are influenced by internal and/or external driving elements in society, culture, education, and governance systems. There is no denying that while making economic decisions, nature is often unseen. Without understanding the true cost of replacing services that nature provides for free, or the fact that sometimes-using man-made alternatives would be much more expensive, we have been steadily depleting our natural capital. Natural ecosystems and human abilities, knowledge, and their facilitators are connected through the study of geography of environment, hazards, and disaster management. The development of the contents used to be based on a holistic perception. Here is an illustration: unlike the phrase we typically use, a building is not just a sum of bricks, rods, concrete, and cement, a structure has the sense of abilities, knowledge, and technology that emerge from the human mind. Similar to this, the material interacts with the systems via some unseen driving forces.

Natural Disasters and Disaster Management Theory

Nature is quite diverse. The varied natural terrain is the source of many natural phenomena. A natural hazard is the possibility that a naturally occurring occurrence may have a detrimental impact on people's lives and property. We refer to this adverse outcome as a natural catastrophe. In other words, we refer to an occurrence as a natural catastrophe when the dangerous threat really materializes and causes human suffering. Natural processes that have existed throughout Earth's history have led to natural hazards and the tragedies that arise from them. Beyond that, however, a number of natural occurrences are made worse by human activity, which enhances the intensity of human injury or destruction and raises the magnitude of catastrophes. Sometimes human behavior encourages the development of microorganisms in the environment, which has detrimental consequences on people's health and property and may cause epidemics and other dangers to people's life.

Such occurrences result from inappropriate waste management procedures. We practice classifying hazards and catastrophes based on those grounds of genesis for occurrences in literature. Hazards cannot always be classified as either naturally occurring or caused by humans. The example may be used here to show how the collapse of a crumbling structure or a residential complex with insufficient structural integrity might result in fatalities during an earthquake [9], [10]. The fatality was brought on by the collapse of a decaying structure, which is not a natural cause, although the earthquake had a role in this. Similar instances include a city that caught fire after an earthquake, as well as a structure that collapsed due to a tsunami along the coast. These examples show that there is no real distinction between natural and man-made catastrophes; rather, disaster is a general term for events that cause harm to people's lives and property. Therefore,

environmental geography must combine its contents from the viewpoint of disaster studies and the connection between man and the environment.

Relevance in Academic Programs' Teaching

The teaching that takes place inside the academic program is the only efficient way to transfer information and skills to society. In particular, instructors acquire the information and skills required by the particular curriculum from a variety of sources and impart them to the pupils. The planned curriculum also maintains statutory requirements for environmental geography and hazard and catastrophe management, allowing students to acquire information in a methodical manner. The incorporation of a number of biotic and abiotic environmental constituents, causative factors and drivers of hazards, disasters, and their management components is made possible by the application of various supporting technologies in the teaching of this subject, such as geographic information systems, remote sensing, mathematics, and statistics. As a result, the classroom instruction of this topic merits great relevance.

CONCLUSION

However, developing harmonious interactions between the environment, ecosystems, and people presents major difficulties. Sustainable practices are often hampered by disputes over the distribution of resources, conflicting stakeholder interests, and socioeconomic inequality. Overcoming these difficulties needs cooperation across multiple sectors, including governments, communities, academics, and companies, as well as inclusive governance and participatory decision-making. The development of a sustainable mentality and behavior depends heavily on education and awareness. Individuals may be empowered to make knowledgeable decisions and actively participate in sustainable development by promoting environmental literacy, increasing understanding of ecological interdependencies, and creating a feeling of responsibility towards the environment. In conclusion, a comprehensive and integrated strategy is necessary to address the complex interactions between human and natural ecosystems. We may work toward peaceful cohabitation by acknowledging the effects that human activity has on the environment, placing a high value on ecosystem services, encouraging sustainable behaviors, and encouraging cooperation. In the end, we can ensure human well-being while emphasizing the preservation of ecological integrity, paving the path for a sustainable future for both people and the environment.

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CHAPTER 11

RELATIONSHIP OF ENVIRONMENTAL: GEOGRAPHY AND BIOLOGICAL SCIENCES

Neeraj Jain, Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: neeraj.jain@muit.in

ABSTRACT:

Environmental geography is an interdisciplinary field that investigates the complex interactions between the environment and human activities. This chapter explores the relationships of environmental geography with other branches of geography and biological sciences, highlighting the synergistic nature of these disciplines in understanding and addressing environmental challenges. Environmental geography encompasses various sub-disciplines within geography, such as physical geography, human geography, and spatial analysis. Physical geography provides a foundation for understanding the natural processes shaping the environment, including landforms, climate patterns, ecosystems, and natural resources. Human geography focuses on human-environment interactions, examining how societies perceive, use, and transform the environment through factors like urbanization, resource exploitation, and cultural practices. Spatial analysis utilizes geospatial technologies to analyze environmental data, model spatial patterns, and inform decision-making processes.

KEYWORDS:

Biodiversity, Disaster, Ecosystem, Geographic, Management, Sustainable Development.

INTRODUCTION

The sources of physical parameters include the lithosphere, atmospheres, hydrosphere, and biosphere. The subject matter of environmental geography is determined by the physical characteristics of the planet and its surroundings. Many elements and their parameters within those spheres have a significant impact in shaping the immediate environment. This viewpoint shows how tightly connected the physical characteristics, their elements, and criteria are to the environmental geography. These topics are divided into their respective academic divisions according to physical geography [1], [2]. Along with physical limitations, a number of human activities are also restricted to certain geographical regions. There are distinct geographical entities for such activities. They each have certain geographical linkages and characteristics. These activities are often divided into economic and human geography. Despite this, biological sciences, as well as the movement of materials and energy within systems, play a significant role in the primary cluster of physical, human, and economic disciplines of study. These have an impact on the environment's elements, the way things evolve through time and space, and how things interact with one another and with matter and energy. From this angle, it is necessary for the study of environmental geography to be connected to other fields that are actively collaborating to define its boundaries.

Geographical Terrain

One of the core topics in geography, physical geography focuses primarily on the physical elements and their characteristics of the earth's surface. Physical geography is an area of study that examines natural characteristics and processes on Earth from a spatial viewpoint, according to the dictionary. It is described as the area of geography that deals with the natural characteristics of the earth's surface in the online edition of the Collins English Dictionary. the examination of the characteristics and makeup of the earth's surface, its seas, its atmosphere, its climate, its plant and animal life distribution, etc. Physical geography is the fundamental science that deals with many natural or physiographic aspects, according to William Harmon Norton's essay relation of physical geography to other science subjects in the Science Journal. Physical geography philosophy is as much about using your boots and compass as it is about using your brain. Physical geography philosophy is an ongoing process that is prone to change as the field is studied and applied [3]–[5]. According to the analysis of the philosophical trend, between 1850 and 1950, uniformitarianism, evolution, exploration and survey, and conservation were the major concepts that had a significant impact on the field. A brand-new branch of physical geography started to take shape in the 1960s, emphasizing a concern with the dynamic processes that affect earth systems. It is based on fundamental physical, chemical, and biological principles and makes use of statistical and quantitative analysis. This method has developed to the point where it is now. The process approach to physical geography has come to be known as it. Physical geographers, who have long recognized the complexity of the systems they study, turned to new concepts in the natural sciences, such as nonlinear dynamical systems and complexity, in the late 1980s to investigate the applicability of these concepts for comprehending physical-geographic phenomena.

Geomorphology, climatology, hydrology, and biogeography were the traditional divisions, but systems analysis of current environmental and quaternary changes has made it more comprehensive. It makes use of skills in geographic information systems, remote sensing, mathematical and statistical modeling, as well as research to guide environmental management and environmental design. It also benefits from collaborative ties with many other disciplines, including biology. A broader global perspective is now possible because to developments in remote sensing, geographic information systems, and information technology. The introduction of a more culturally-based methodology across several fields of physical geography is the second novel development. By the year 2000, a number of difficulties could be highlighted, such as the tendency toward broader holistic thinking, increased awareness of challenges with environmental change and a global perspective, as well as the opportune possibilities that may result from stronger relationships to human geography and other fields.

Physical geography, on the other hand, stresses the spatial variations that take place and the temporal changes required to comprehend the current habitats on Earth, focusing on the nature of the processes forming the land-surface of the Earth and its envelope. Its goal is to comprehend how human activity affects and is influenced by the physical environment of the Earth. The extent of the human footprint on this planet challenges physical geographers to pay more attention to the role of people in environmental change and the interactions between people and their environments. While the sub-discipline of physical geography remains firmly grounded in research undertaken to explain Earth's landscapes and its geomorphic, hydrologic, atmospheric, cryosphere, petrologic, and biogeographical processes, which change over time and space. It is evident from these physical geography's developmental processes that it interacts closely with the environment, which is the main focus of human and environmental geography [6]–[8]. Physical geography's

main focus is on the physical terrain, which has a variety of physical characteristics. Numerous landscape environmental phenomena, such as height, slope, aspect, and relief characteristics, are influenced by the geological structure, lithology, and surface morphometry.

Geographical Organization and Lithology

The creation process of the landscape and its shape have been linked to the lithology and geological structure of the terrain. The underlying rocks, geological formation, structure, and qualities of the landscape have an impact on how it was formed. Changes above the surface were caused by endogenetic movement and forces that came from the interior of the earth's surface. Examples include the surface-level earthquake and volcanic occurrences that are readily seen. The earthquakes that occurred in the Nepal Himalayas, when two plates were convergent in the area, might serve as an example. As a result, tectonic movements affect the surface. Similar to this, the hardness and softness of the rocks had a significant impact on how surface landforms and features developed. In Nepal's central hills and Siwalik area, a number of landslides have their origins in the loose soil and regolith. Exogen etic factors, such as snow, ice, glaciers, rains, and winds, operate below the surface, yet their activities are directly influenced by the geology and different kinds of rocks. Thus, the geological structure and regolith of the landscape are primarily linked to the causes of environmental deterioration.

Morphological Variables

Surface geometry is shaped by factors such as altitude, slope, aspect relief, etc. Although these characteristics are intimately related to lithology and geology as well, they are most directly related to surface formations. Because of these surface shapes, the interactions between humans and the environment are determined. An example may be given from the high slopes and hills of Nepal, where snow and ice were first introduced owing to the area's high elevation. Along with snow and ice activities, weathering and frost cracking actions might also manifest. The 'environmental temperature lapse rate' from valley bottoms to hilltops is what causes the temperature to drop. Similar to this, increased ground inclination produces steep slopes that speed up the flow of materials by gravity from higher convexities to the base. As a result, there are many landslides and rock/mass flows on the earth's surface that are connected to the steep hillslope. Due to their directional positions, solar radiation on the ground at hill and mountain aspects varies.

The northern faces of mountains and hills get significant radiation in the southern hemisphere, while the opposite is true in the northern hemisphere. That was brought on by the Sun's location, which was brought on by the Earth's tilt with respect to its axis. As a result, compared to their northern counterparts, Nepal's southern hills and mountains experience greater year-round warmth. People choose to dwell in the southern part of the country because of this. In comparison to the north, human activity in the south puts greater strain on the environment. The surface roughness is also influenced by relief features. The surface geometry's undulations make the ground more porous to the movement of materials and energy. These various morphometric traits result in significant variances in how people and their environments interact.

Either a River System or Hydraulic Systems

Water sources are provided via river networks or hydraulic systems, which also allow goods and energy to move over the landscape along the network's channels. In the past, a number of significant human civilizations spread out along the main river network channels all across the

planet. Large river systems are where the majority of the modern industry and agricultural land are concentrated. Some typical instances of how water is provided to humans include drinking water, irrigation water, navigation, hydropower, aquatic life, and resources. From a geographical or environmental standpoint, wetland and river networks play important roles and take use of many possibilities.

Acidification and Salinization of Soil

The human being receives life sustenance from the soil. From an environmental standpoint, the production system is severely hampered by important soil features including acidification and salinization. The majority of acidic soils are caused by soils with high acid content that are supported by acid rain from a dirty atmosphere and also by the addition of too large amounts of ammonia. The dauphiness of the soils is pushed by acid rain and excessive ammonia chemical substances, which also speeds up the salinization processes. In the top horizon of the soils, the hard pan of salt minerals formed. The soils eventually become unusable. Both soil conditions, namely acidification and salinization, are detrimental to the development of species from an environmental standpoint. Therefore, links between the idea of soil characteristics and environmental geography are required. Sunshine, precipitation, temperature, humidity, and other climatic factors.

Climate factors including sunlight, precipitation, temperature, humidity, air pressure, wind, and others are equally vital for species development and their dynamic changes on the earth's surface. These are aspects of the atmosphere. Any sort of organism's growth is controlled by the climatic factors. Photosynthesis is directly impacted by sunlight. Similar to how water supply from the roots after precipitation controls energy and mineral movement. As a result, these variables greatly influence how plants develop, how energy and minerals move from the earth's surface, how the hydrological cycle and food chain systems work, and much more. The atmospheric or climatic parameters and environmental geography are closely related since the climatic factors influence many different environmental circumstances.

Economic and Human Geography

Man, the environment, and their interactions are the three fundamental components of environmental geography, according to its definition. From this description, it is clear that research must be done on peoplehow many there are, where they reside, and what they do for a living. In such setting, the main focus of environmental geography is on population, settlement, and human activity.

Population

The primary population contents that must be evaluated within the context of environmental geography are the population's size, dispersion, makeup, and characteristics. Any geographical unit's environmental characteristics directly affect its population. Therefore, it is necessary to integrate people within environmental geography.

Settlement

Certain forms of landscape are shaped by human habitation on the surface of the world. Their morphological patterns differ from one another. Settlements in urban and rural areas go through several stages of development. The settlement affects a variety of geographical and environmental factors. The earth's surface is influenced by human activity in many different ways. People build

infrastructure, cultivate their fields, and advance urbanization and industrialization. These actions have a variety of effects on the geo-ecosystem and the ecology of physical space. Consequently, it is necessary for environmental geography to establish connections with human activity.

Sciences of life

The study of life, living things, their life cycles, adaptations, and environments is known as biological science. The biological sciences include a wide range of disciplines, including ecology, ecosystems, and biodiversity. These biological sciences are entertained by environmental geography in order to determine various repercussions inside it.

The Idea of Ecology

Ecology is the scientific study of the factors affecting the quantity and distribution of organisms, as well as their interactions with one another and with the flow and transformation of matter and energy. From these angles, it is necessary for environmental geography to identify the ecological components of the organisms.

Biodiversity and the Ecosystem

The variety of life on earth is gauged by its biodiversity. At the genetic, species, and ecological levels, it may be evaluated. A community of living things and the physical environment they are now a part of are referred to as an ecosystem. Ecosystems blend into one another, and larger ecosystems may contain more variety than smaller ones, making it difficult to evaluate the diversity of ecosystems. Our globe is an ecosystem as a whole, but it also includes many different ecosystems, such as forests, deserts, and seas, which are made up of smaller ecosystems themselves. Ecosystems that it grades into and overlaps with will be affected by changes in one environment.

Several Ecotypes

Every living and non-living object in a certain natural environment makes up an ecosystem. Major elements of many ecosystems include plants, animals, insects, microbes, rocks, soil, water, and sunshine. Terrestrial or aquatic ecosystems are the two main kinds of ecosystems. Aquatic ecosystems are based on water, whereas terrestrial ecosystems exist on land. Forests, grasslands, deserts, tundra, freshwater, and marine environments are the main categories. The term biome may also refer to terrestrial ecosystems that cover a significant region of land, such as tundra. But keep in mind that precise characteristics of any ecosystem might vary greatly from one to another; for instance, an oceanic environment in the Caribbean Sea would have quite different species than one in the Gulf of Alaska.

Energy and Material Movement throughout the Ecosystem

Primary producers at the lowest trophic level utilize sun energy to create organic plant material via photosynthesis. Large volumes of organic matter are decomposed by decomposers, who subsequently return nutrients to the environment in inorganic form, where they are reabsorbed by primary producers. Life is moved by energy. The movement of energy via various trophic levels in an ecosystem is the basis of the energy cycle. The energy and nutrients that cycle through our ecosystem come from several outside sources. Primary producers at the lowest trophic level utilize solar energy to create organic matter via photosynthesis. At the second trophic level, herbivores feed on plants to get their energy. The metabolic processes of these creatures, including breathing,

food digestion, sustaining tissue development, maintaining blood circulation, and controlling body temperature, use a significant portion of this energy. At the next trophic level, predators eat herbivores to get the energy they need to survive and develop. Large predators are still at a higher trophic level and feed on carnivores to get energy if they are there. As a result, food chains connect many plant and animal species to one another. Wastes and dead creatures are broken down by decomposers, which include bacteria, fungus, molds, worms, and insects. The nutrients are subsequently returned to the soil, where they are ingested by the producers [9], [10].

Ecologists can no longer ignore the dynamics of biodiversity within ecosystems if biodiversity influences ecosystem functioning. Ecology has long thought of biodiversity as an epiphenomenon caused by the abiotic environment and the health of the ecosystem. Ecosystem ecology and community ecology provide two viewpoints on intricate ecological systems that are mostly complimentary in their advantages and disadvantages. The two viewpoints must be combined in order to advance science and provide society the tools it needs to address the world's mounting environmental problems. This objective has benefited from research on ecosystem health and biodiversity in a variety of ways. It has contributed to the transformation of ecology both in terms of content and form by posing a new question with high relevance for science and society, challenging accepted paradigms, closely tying theory and experimentation, achieving scientific agreement despite differences in opinion, integrating disparate disciplines and research fields, and connecting with other disciplines and management concerns. This much-needed process of unification across ecological disciplines would gain additional momentum if an actual evolutionary ecosystem ecology was developed that connected the evolution of species features at the individual level, the dynamics of species interactions, and the overall functioning of ecosystems.

This debate has shown that biological sciences and environmental geography are closely related to each other as well as to other fields of geography. It is impossible to appreciate the philosophical approach to environmental geography without a solid comprehension of the foundational concepts in the 30 various physical and biological disciplines that have been included into it. Understanding the complex relationships between ecosystems, biodiversity, and human well-being depends on the interaction between environmental geography and biological sciences. Ecosystem function, species dynamics, and the effects of environmental change are all subjects covered by the biological sciences, such as ecology, conservation biology, and environmental biology. We get a comprehensive grasp of the intricate interdependencies between natural systems, human activities, and ecological health by combining biological knowledge with environmental geography.

Collaboration across different fields of study makes it easier to conduct research, share information, and create sustainable management and environmental protection methods. A geographical context and analytic framework are provided by environmental geography to address issues including climate change, habitat loss, pollution, and the depletion of natural resources. For measuring ecosystem services, tracking species populations, and assessing biodiversity, biological sciences provide factual data, ecological theories, and methodology. In the realm of policy and decision-making, there is a connection between environmental geography and biological sciences. These fields may influence environmental policy, land-use planning, and conservation efforts via multidisciplinary study and cooperation. For the purpose of promoting sustainable development and biodiversity protection, integrated methods that take into account ecological, social, and economic components are essential. The links between environmental geography and the biological sciences are further strengthened by newer disciplines like landscape ecology,

biogeography, and ecosystem services. In order to understand how spatial patterns and processes within landscapes affect biodiversity, ecosystem health, and human activities, landscape ecology is a field of research. Biogeography studies how species and ecosystems are distributed geographically, offering insight on the variables influencing patterns of biodiversity.

CONCLUSION

Understanding and managing environmental concerns depend on the interaction between environmental geography and other fields of geography and the biological sciences, which is mutually beneficial. We can improve our understanding of the environment, inform sustainable practices, and contribute to the conservation and well-being of both human and natural systems by combining the spatial perspectives and analytical tools of environmental geography with the ecological knowledge and principles of biological sciences. Research on ecosystem services evaluates the advantages that ecosystems provide to human society, with special emphasis on their support of livelihoods, food security, water resources, and climate control.

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CHAPTER 12

SUSTAINABLE PERSPECTIVES: ENVIRONMENTAL ISSUES AND THEIR LINKAGES

Kanchan Awasthi, Assistant Professor,
Maharishi School of Science, Maharishi University of Information Technology,
Email Id: kanchan.awasthi@muit.in

ABSTRACT:

Environmental issues have gained significant attention in recent years due to their far-reaching impacts on ecosystems, human health, and the planet as a whole. This chapter provides an overview of the various environmental issues and explores their interconnectedness, emphasizing the need for comprehensive and collaborative approaches to address these challenges. Environmental issues encompass a wide range of concerns, including climate change, deforestation, air and water pollution, biodiversity loss, habitat degradation, resource depletion, and waste management. These issues are interconnected, with each problem influencing and exacerbating others, creating complex and intertwined challenges. Understanding the linkages between environmental issues is crucial for effective environmental management and sustainable development. For example, climate change affects ecosystems and biodiversity, which, in turn, impact water availability and quality. Similarly, deforestation contributes to climate change and leads to habitat loss, affecting both local and global ecosystems.

KEYWORDS:

Biodiversity, Ecosystem, Geographic, Management, Sustainable Development.

INTRODUCTION

Interdisciplinary methods including scientists, legislators, corporations, communities, and people are necessary to address environmental concerns. Integrated approaches that take the interdependence of environmental issues into account might result in more potent fixes. Implementing sustainable land use techniques, for instance, may reduce climate change, preserve biodiversity, and safeguard water supplies. Global environmental challenges must be mitigated by cooperative efforts. The goal of international accords like the Paris Agreement is to bring countries together in the fight against climate change. Environmental concerns must also be addressed via community engagement, local and regional efforts, and public awareness campaigns [1]–[3]. The importance of environmental concerns and their connections to each system's component was highlighted by environmental geography. In essence, each of these problems has a unique genesis, however they may sometimes be connected by more than one causal element. Examples of current environmental problems with a direct or indirect human involvement include land degradation, deforestation, biodiversity loss, endangered species, climate change, air pollution, and ozone depletion. Sometimes it is difficult to tell what causes them. But in the end, these concerns become very delicate for the continued evolution of humanity.

Degrading of the Land

The Latin origin of the term degradation suggests reduction to a lower grade. Reduction suggests a difficulty for individuals who utilize the land since the rank is in proportion to present or potential uses. According to Blaikie and Brookfield, land degradation is a societal concern. Leaching and

erosion are simply environmental processes that take place with or without human intervention; nonetheless, the term degradation incorporates societal criteria that relate to its existing or potential uses. According to the Environmental Management Agency, land degradation is any change in the state of the land that lessens its capacity for production. It is the degradation of land quality and productivity brought on by the removal of organic matter, rich topsoil, or excessive or unsuitable usage [4], [5]. It is brought on by a number of factors, such as drought and severe weather events, as well as human activities that degrade soil quality, which has an impact on food production, livelihoods, and the creation and supply of other ecosystem goods and services. It is a worldwide problem.

It has had significant global effects on socioeconomic stability, biodiversity, Eco safety, reducing poverty, and sustainable development. According to the United Nations Convention to Combat Desertification, which is a kind of land degradation, 50 million people might be uprooted over the next 10 years as a consequence of desertification. Although the causes of salinization and desertification are entirely natural, it is excessive land degradation brought on by human activities that causes desertification. There are a number of causes for the deterioration of the land. The causes may be divided into two categories, natural and human-induced. However, handling the two in distinct order is not that simple. The population is always utilized to pinpoint the root cause or primary responsible party for the deterioration of the land. Numerous examples have shown that the number of people alone is not the main cause of the deterioration of the land.

Human knowledge, talent, and a number of other regional and international elements are to blame. The altered rainfall patterns are a result of the rising global temperature. Cloudbursts cause temporary runoff and lessen water penetration. The irrigation system changes as a result of the rapid influx of precipitation in the form of run-off, which directly affects the regularity of spring water outflow. Productivity suffers because to a lack of green water. However, farmers supplement natural fertilizer in the meantime to maintain the productivity necessary for their livelihood. The extra use of chemical fertilizer raises the soil's salinity level. The deterioration of the land and, eventually, the conversion of farming to desert arise from the indirect danger to the ecosystem. This is only one illustration of how the deterioration of the land begins. There are a number of causal factors, including:

1. Land degradation is a result of biophysical, socioeconomic, and political issues such urbanization, competition for limited resources, unsustainable water management, and regulations.
2. Ineffective agricultural methods and a lack of conservation efforts.
3. Soil erosion brought on by poor maintenance practices or by neglect,
4. Unplanned infrastructure development, such as the building of roads, dams, buildings, and mining operations, etc.
5. Loss of biodiversity and invasive alien species dominance in natural vegetal cover regimes
6. Penalties for illegal logging and the exploitation of marginal land
7. Unintentional and excessive grazing these causal variables often vary across various geographic locations.

As a result, generalization in a global setting is challenging. The severity and scope of land degradation are determined by the local geological, topographical, and socioeconomic conditions. If we consider the backdrop of land degradation in Nepal over the last twenty years, at the very least, the degradation has been brought on by a lack of agricultural laborers as a result of labor

migration to other countries. A large portion of the farmlands are neglected and left fallow. In addition to this, additional causes include the unpredictable pattern of rainfall, the drying up of springs, and the inconsistency of weather, which are all changing the sociocultural and global economic systems.

According to UN agencies, 25% of the planet's geographical surface is either severely degraded or degrading rapidly. In underdeveloped nations, there is particularly significant land degradation. At least 485 million people are impacted by the erosion of the land that makes up two-thirds of Africa. 50% of Latin American agricultural land will be decertified by the mid-2050s. Additionally, in the context of developing nations, the issue of gender cannot be disregarded because poor women are most susceptible to land degradation.

The world's poorest inhabitants are those who are most affected by negative changes to the natural environment and climate change, and of the world's poor, about 60% are female. Rural women in developing nations are the group most affected by environmental degradation and the depletion of natural resources because of their dependence on these resources. In addition, women often have less control and decision-making authority over property. People must be at the core of a land degradation-neutral world since they are often the most impacted, particularly impoverished and disadvantaged groups. The effects of land degradation on both the ecology and human existence are significant.

Reduced productivity as a result of diminished soil nutrition and production capacity is the direct effect of land degradation. There is a direct effect on human livelihood when the soils' capacity for production is reduced. The value of the land declines similarly. To retain their way of life, people move their operations to marginal terrain. That directly affects the land quality and starts a vicious cycle. The situation of active rural population migration to urban and sub-urban regions as well as to non-farming occupations is present in many emerging nations of the globe. Due to the changes in farming practices and land management brought about by this, crop yield and the sustainability of food have decreased. This eventually results in the destruction of the land, marginalization, and a vicious circle of subsistence.

Deforestation

Deforestation is defined by the dictionary as the felling and removal of all or most of the trees in a forested area. By destroying habitat, deforestation may erode soils, lead to desertification, pollute streams, and reduce biodiversity. It involves removing the forest and replacing it with something else. However, the phrase is most often used to refer to agricultural activity and the removal of vegetation. In recent years, it has been clear through observation that deforestation has become a practice that is not just related with the marginalization of agricultural activities but also with other goals including infrastructure development and commercial interests.

DISCUSSION

Biodiversity Loss and Threatened Species

According to the dictionary, biological variety in a habitat is expressed by the quantity of various plant and animal species. The term biodiversity refers to all forms of life on Earth as well as the ecological processes that support them, according to the Nepal National Biodiversity Strategy and Action Plan 2014-2020. It is often discussed in terms of hierarchical diversity, such as genetic diversity, species diversity, and ecological diversity. The notion of biological variety, which still

has a great deal of unexplored potential and knowledge, is essentially tied to the concept of biodiversity. In both terrestrial and marine habitats, there is biodiversity. The variety of life may change throughout time. The number of species in a given geographic area is influenced by its environment. Numerous variables influence the richness and poverty of species. Over time, it is always evolving. Threats that cause population decline and extinction of species may either increase it by causing genetic change and natural evolutionary processes, or they can diminish it. It is determined by the presence of existing species in the ecosystem or by the introduction of new species into the same habitat. Some species may live for a longer period of time than others. Changes in other environmental factors and disruptions to species' habitats contribute to the loss of biodiversity. Biodiversity is a dynamic aspect of the ecosystem as a result. The pace of biodiversity loss depends on an ecosystem's ability to adapt to threats and changes. Many factors make biodiversity essential, including:

1. Species are valuable to humans in terms of utility.
2. Biodiversity symbolizes the natural equilibrium within an ecosystem that offers a variety of ecological services, such as the cycling of nutrients and plant pollination.
3. There is inherent worth in species.

Thus, preserving biodiversity is crucial to preserving the biological systems that sustain life as we know it on Earth. Millions of rural people in Nepal directly rely on natural resources to satisfy their daily requirements for sustenance and to earn a living, making biodiversity important to their livelihoods and economic well-being. Agricultural productivity, food security, human health and nutrition, indigenous knowledge, gender and social equality, culture, climate, water resources, and aesthetic value to society are only a few of the topics that are directly and indirectly addressed by the topic. The nation's biodiversity is also a significant source of tax money. According to this viewpoint, if biodiversity were to decline in the nation, it may result in significant losses for a variety of industries. The chain begins and supports a different species at a particular trophic level. The variety of species helps to keep the number of trophic levels constant and ensures that species continue to survive within the ecosystem. Therefore, the concerns of biodiversity and endangered species must be addressed in environmental geography. Students can grasp the significance of species variety thanks to their knowledge and expertise in biodiversity and endangered species [6], [7].

Emission of Carbon

According to the National Aeronautics and Space Agencies, carbon is the foundation of life on Earth. Our civilizations including our 39 economies, our houses, and our modes of transportation are composed of carbon, from which we are produced, what we consume, and how we live. We need carbon, but that requirement is also linked to one of the biggest issues we face right now global climate change. Our planet's carbon cycle is ongoing. The development of biotic and abiotic organisms follows the carbon cycle. About 0.033% of our atmosphere is made up of carbon dioxide. However, the majority of the carbon found in rocks nearly 80% comes from sedimentary rocks, fossil fuels, and marine creatures. 20% of all living entities, including humans, plant species, and microorganisms, are made of carbon. There is a Carbon Cycle that keeps the earth's surface in balance. If some chemicals within the cycle release more carbon, the cycle becomes out of equilibrium, which results in changes. The burning of fossil fuels and deforestation are the main causes of the recent rise in atmospheric CO2 concentration. In addition to such actions, factory-level carbon emissions seem to be a significant influence. High carbon emissions are released as

smoke by manufacturing and urban operations, forest fires, volcano eruptions, and vehicle exhaust. These actions result in a rise in atmospheric carbon levels, which affects the heat budget. We also referred to it as greenhouse effect. Climate change is projected to bring about the largest changes in the terrestrial carbon cycle.

Temperatures rise as a result of carbon dioxide, prolonging the growth season and increasing humidity. Each of these elements has stimulated some extra plant growth. But hotter weather also stresses plants. Plants need more water to live in an extended, warmer growth season. Scientists have previously seen indications that summertime heat and water scarcity in the Northern Hemisphere lead plants to grow more slowly. Recently, the idea of carbon reservoirs or carbon pooling has gained traction. This has been used to preserve the forest and other natural areas without causing any harm. 'Carbon sequestration' is the term used to describe the ability of healthy plants to store carbon. The upkeep of carbon reservoirs in least developed and developing nations must be funded by the wealthy countries that emit significant levels of carbon via the combustion of fossil fuels by major industries and motor vehicles. The idea of carbon trading has controlled this activity, and the World Bank has agreed to oversee it. Nepal is a participant in 40 carbon trades and receives financial assistance for preserving carbon sinks. The Special Working Group on the UNFCCC and COP15 resolved to provide nations the chance to participate in the carbon pool and reap its advantages. From these angles, environmental geography must consider these problems in the context of both the global and local levels.

Air Toxicity

A combination of gases and solid particles in the air cause air pollution. Particles that may be suspended in the air include factory chemicals, pollen and mold spores, dust, and vehicle emissions. Large cities release smog and many pollutants. Poisonous air pollution exists. Another related phenomenon to the atmospheric events is air pollution. The main causes of air pollution carbon emissions, dust, smog, noise, and other substances mixed together in the atmosphere and are particularly hazardous to human health. Such changes are also in charge of affecting the carbon cycle and the earth's surface heat budget. The biggest pollutant warming Earth is carbon dioxide, a greenhouse gas, according to the National Geographic Channel. Although carbon dioxide is emitted when living organisms breathe, it is often seen as a pollution when connected to vehicles, aircraft, power plants, and other human activities that entail the combustion of fossil fuels like gasoline and natural gas. These activities have increased the amount of carbon dioxide in the atmosphere during the last 150 years to levels unseen in tens of thousands of years. Methane, which is produced by marshes and animals, as well as chlorofluorocarbons, which were once employed as refrigerants and aerosol propellants before being outlawed due to their detrimental effects on the ozone layer, are examples of other greenhouse gases [8]–[10].

Loss of Ozone

The ozone layer in the upper atmosphere gradually thins due to the discharge of chemical compounds containing gaseous chlorine or bromine from industry and other human activities, according to the Encyclopedia Britannica. The polar areas, particularly over Antarctica, are where the thinning is most noticeable. Because it increases the quantity of UV light that reaches Earth's surface, ozone depletion is a serious environmental issue because it raises the risk of skin cancer, eye cataracts, immune system damage, and genetic mutations. The first of several extensive international accords made to stop the manufacturing and use of ozone-depleting chemicals was the Montreal Protocol, which was approved in 1987. Over time, it is anticipated that the ozone

layer would rebound as a consequence of ongoing worldwide collaboration on this problem. The production and release of CFCs and other halocarbons have increased the amount of chlorine and bromine in the stratosphere, which is closely connected with the worldwide decline in stratospheric ozone. Industry manufactures halocarbons for a range of applications, including refrigerants, aerosol can propellants, blowing agents for plastic foams, firefighting agents, and solvents for dry cleaning and degreasing. Theoretical studies demonstrating that chlorine and bromine emitted from halocarbons in the stratosphere react with and destroy ozone have been amply supported by atmospheric observations.

Climate change According to the NASA's Global Climate Change paper, the climate of the Earth has changed throughout time. Seven cycles of glacial advance and retreat have occurred in the past 650,000 years alone, with the abrupt end of the previous ice age 7,000 years ago signaling the start of the current climatic period and the development of human civilization. The majority of these climatic fluctuations are a result of minute variations in the Earth's orbit, which alter the quantity of solar energy our planet gets. The majority of the present warming trend is likely caused by human activities since the mid-20th century and is progressing at a pace that is unprecedented throughout decades to millennia, making it particularly significant. With the help of earth-orbiting satellites and other technical advancements, scientists can now gather a wide range of data on our planet and its climate on a worldwide scale. The indications of a changing climate are shown by this collection of data, which has been gathered over many years. In the middle of the 19th century, carbon dioxide and other gases were shown to trap heat. Numerous NASA-flewn equipment are supported scientifically by their capacity to influence how infrared energy is transferred through the atmosphere. There is no doubt that the Earth must warm as a result of rising greenhouse gas concentrations.

Greenland, Antarctica, and Tropical Mountain glacier ice cores demonstrate how the Earth's climate varies in response to variations in greenhouse gas concentrations. Tree rings, ocean sediments, coral reefs, and sedimentary rock strata are further sources of ancient information. This old, or paleoclimate, data shows that the present pace of warming is around 10 times greater than the rate of warming associated with the ice age recovery. In the case of climate change in the Himalayan region, a book titled Himalayan Glaciers: Climate Change, Water Resources, and Water Security published in 2012 by the National Academy of Sciences through the National Academic Press, where some of the evidences of climate change in the region have been exclusively described. The book was prepared by the Scientific Committee of the National Research Council of America. For over half of the world's population, the Himalayas serve as a water tower. The water resources' living storehouse are glaciers. The physical characteristics of the glaciers are directly affected by the changing climate. Because of this, a sizable portion of the world's population may experience financial insecurity.

Environmental problems are urgent concerns that have serious effects on the ecosystems of the world and the welfare of both people and the environment. These problems are caused by a variety of human endeavors and natural phenomena, and they are intricately intertwined. Creating successful solutions to solve environmental challenges and promote sustainability requires an understanding of the connections between various environmental problems. Climate change is a significant environmental problem that is mostly caused by greenhouse gas emissions. Climate change has an impact on many environmental factors, including species distribution, weather patterns, sea level rise, and temperature trends. Additionally, it aggravates other environmental issues including glacier melting, biodiversity loss, and ecological disturbance. Another big

environmental problem that fuels climate change is deforestation. By removing forests for logging, urbanization, and agriculture, carbon dioxide is released into the atmosphere while the planet's ability to absorb it is diminished. In addition to having an adverse effect on biodiversity, upsetting ecological balances, and endangering local inhabitants' way of life, deforestation also causes habitat loss.

Risks to human health and ecosystems are posed by the interconnections between air and water pollution. Air pollution causes breathing difficulties, smog, and acid rain and is a result of agricultural practices, car exhaust, industrial pollutants, and agricultural emissions. Water quality, aquatic life, and human access to clean water are all threatened by sources including industrial discharge, poor waste disposal, and agricultural runoff. A serious environmental problem brought on by habitat destruction, pollution, climate change, and invasive species is biodiversity loss. Ecological processes are disturbed, resilience is decreased, and ecosystem stability is threatened by the loss of species and ecosystems. By altering food security, pollination, and the accessibility of natural resources, it also has an influence on human communities.

CONCLUSION

It is crucial to understand how these environmental concerns are interrelated and to use comprehensive strategies to solve them. Policies, scientists, companies, communities, and people should collaborate to create sustainable practices, advance renewable energy, and safeguard ecosystems, and lower pollution as part of integrated environmental management initiatives. For establishing a worldwide commitment to environmental conservation and reducing the negative effects of human activity on Earth's systems, international cooperation and agreements, public awareness campaigns, and education are essential. In conclusion, since environmental concerns are complex and linked, complete solutions are required. For effective sustainable environmental management, it is crucial to understand the connections between diverse environmental issues and to encourage cooperation across various sectors. We can safeguard ecosystems, advance human welfare, and assure a sustainable future for future generations by tackling environmental concerns together. Environmental problems including overconsumption, overfishing, and the unsustainable mining of minerals, water, and fossil fuels are all directly related to resource depletion. Natural resource depletion, soil erosion, habitat damage, and the loss of important ecosystems may all be caused by these activities. The creation, disposal, and treatment of diverse waste kinds are all aspects of waste management, which is a concern for the environment. Pollution of land, water, and the seas is caused by inefficient waste management techniques, such as incorrect disposal of plastics and dangerous items. Waste management has effects on recycling, the circular economy, and resource conservation.

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CHAPTER 13

DISASTER RESPONSE IN INDIA: AN OVERVIEW

Yukti Khajanchi, Assistant Professor,
ISME - School of Management & Entrepreneurship, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: yukti.khajanchi@atlasuniversity.edu.in

ABSTRACT:

Disaster response is a critical aspect of emergency management in India, a country prone to various natural and man-made disasters. This study provides an overview of the disaster response framework in India, highlighting key elements, challenges, and strategies employed to mitigate the impacts of disasters and enhance resilience. India is exposed to a wide range of disasters, including cyclones, floods, earthquakes, droughts, industrial accidents, and terrorist attacks. The country has developed a comprehensive disaster response framework that encompasses preparedness, response, recovery, and mitigation measures. The National Disaster Management Authority (NDMA) is the apex body responsible for policy formulation, coordination, and implementation of disaster management efforts. It works in collaboration with state disaster management authorities and various stakeholders to ensure effective disaster response. Key elements of India's disaster response include early warning systems, evacuation plans, search and rescue operations, medical assistance, relief distribution, infrastructure restoration, and psychosocial support. The response is coordinated through multi-agency coordination mechanisms, involving the armed forces, paramilitary forces, civil defense organizations, and volunteers. Challenges in disaster response in India include the scale and complexity of disasters, limited resources, inadequate infrastructure, population density, and geographical diversity. Additionally, the country faces unique challenges such as rapid urbanization, climate change, and the need for community participation.

KEYWORDS:

Disaster, Ecosystem, Geographic, Management, Risk, Sustainable Development.

INTRODUCTION

Natural disasters, such floods, droughts, cyclones, and earthquakes, or man-made ones, like riots, wars, and refugee crises, as well as others like fires, diseases, industrial accidents, and environmental consequences, are all examples of disasters. The distinction between them is often slight. Nearly 80% of all catastrophe victims worldwide are afflicted by natural disasters. According to estimates from the insurance sector, natural catastrophes account for 85% of all insured catastrophic losses worldwide [1]–[3]. The alarming reality is that even in an area like South Asia, where disaster-related deaths, poverty, and suffering are fairly typical occurrences, India continues to be the worst-affected nation. In fact, the frequency of all types of disasters from epidemics to traffic accidents to recurring droughts and floods is increasing, which has a multiplicative effect on the number of illnesses, injuries, and deaths while upsetting life-sustaining systems and adding to the health, social, and economic burden of an already underprivileged population.

Disaster Classification

Disaster definitions and classifications differ depending on georeactors, the geographical and social contexts in which they occur. Every new catastrophe increases the depth of human pain. Disaster-affected populations in developing nations often face realities that go against traditional academic standards from the West. In the lack of official criteria, field observations point to three major classifications for catastrophes: natural, man-made, and other disasters. There are both huge catastrophes and small disasters among them. A disaster's potential for damage and devastation is not the only factor that determines whether it is large or small; media coverage and discussion may also play a role in the former category's designation. The difference is meaningless to a substantial portion of the population in numerous Indian states since they experience catastrophic catastrophes on a regular basis.

Policy Mishaps

Disasters brought on by the policy-makers' negligence fall under yet another category, which also includes things like the absence of sensible regulations to control the sale of dangerous and harmful drugs, the unrestricted sale of alcohol and tobacco, the use of banned pesticides, and the excessive uprooting of populations due to development projects. This division exists only for logistical and explanatory reasons. For instance, the flood-accumulated water in the Western desert state of Rajasthan in 1996 produced the perfect mosquito breeding environment. This sparked the growth of vectors, which sparked an outbreak of malaria. The pandemic caused significantly more damage than the flood tragedy itself, amplified by a systemic flaw. The real cause was not only the amount of rainfall, which had surely been more than average; rather, it was the manner that municipal constructions built during the previous 20 years many of which broke fundamental laws increased the flood. Similar to this, despite a reasonably robust crop, severe flood scarcity and hunger were to blame in several drought-affected areas of Orissa. The factors included the way in which individuals interacted with the market, as well as unfair trade and commercial practices. Similar to how TB, which kills one Indian every minute, has returned, policy changes that damaged the public health system have been blamed. A policy that allows the dumping of toxic and deadly materials, for example, is illogical and results in irreversible teratogenic effects as well as exaggerated health issues for specific groups of people and larger susceptibility to catastrophes [4]–[7].

Human Suffering and Disasters

Natural resources and inanimate energy are seen as having a greater impact on the population. The most significant concept that has shaped this discussion is that catastrophes happen when natural or man-made hazards or threats of hazards have an influence on a region's or an area's vulnerabilities and its inhabitants. Within these constraints, suffering is more severe for disadvantaged people. A community's vulnerability to disaster or its capacity to react to events is fundamentally defined as a set of prevailing or consequential conditions composed of physical, socio-economic, and/or political factors. In comparison to other groups of people, some are more susceptible to certain natural and man-made calamities. If these vulnerable individuals also happen to reside in disaster-prone areas, this lengthens and intensifies their suffering. A region's susceptibility is a complicated phenomenon that may be simply characterized as the effect of a variety of social, political, and economic elements. This is why it is critical that we concentrate on the variables that make communities vulnerable and situate catastrophes in both narrow and large, socio-political settings. Even a quick look at history reveals that susceptibility to catastrophes has

always been made worse in developing nations, despite the fact that natural occurrences of catastrophic size continue to have varied effects in various regions of the globe. The poor and certain ethnic groups in the developing world experience levels of human and material loss that are unfathomable to the rest of the world, and their ability to bounce back quickly is constrained by the exact circumstances that contributed to the damage in the first place. Lack of infrastructure, inadequate capacity, and high vulnerabilities in such dire and unforeseen circumstances not only increase the toll on human and material life, but also impede and slow down recovery. While the cash-strapped governments of the Czech Republic and Poland seemed, at times, to be straining and failing to avoid flooding, coordinate rescue operations, and marshal funding, Germany was able to mobilize resources more quickly to cope with the floods. The popular opinion that the administration had handled the incident disastrously was a contributing factor in Poland's government losing the ensuing legislative elections.

Social and Political Environment

The residents of underdeveloped countries who have experienced a tragedy are not granted such indulgences by their governments. Governments in developing nations seldom ever provide compensation for shoddy or subpar disaster response efforts. This omission has a number of factors at play, including inadequate informational and logistical systems and a lack of an investigation of the root causes of the problems. Human-made catastrophes tend to happen often and with high severity in societies where disparities in gender, caste, religion, region, and class are particularly evident, and when distinctions, rights, and duties along the same differentials are well defined and observed. The susceptibility of various groups of people to adverse effects from natural and man-made catastrophes is defined by the socio-political, economic, and ecological setting. A person's rights and real access to resources, support, and services are determined by their social status in society and how important they are to various ethnic, caste, and gender groups. The principles and practices of political participation, information access, governance, and accountability, as well as economic entitlement and resource distribution and the ecological impact of nature, all imply a complex interaction of societal variables that affect how people prepare for, respond to, and recover from natural and man-made disasters.

The impoverished and underprivileged portions and communities inside these topographical peculiarities are hardest impacted. catastrophes in turn make people's social and economic disempowerment more pronounced, which increases their vulnerability to catastrophes. Disasters create new vulnerabilities by exacerbating previously present ones. Numerous calamities and disasters have a variety of political implications. Some of them are too complicated and tragically unnecessary. In India, these include the sub-ethnic conflict in the North-East, the communal unrest after the destruction of the Babri Masjid, the ongoing violence against Dalits, and other issues. Second, it is feasible to pinpoint the causes and manners by which certain people are vulnerable to catastrophes in specific areas. The world's catastrophe response may have been determined by the knowledge that, between 1960 and 1980, the majority of human deaths from disasters occurred in emerging nations like Bangladesh, Nicaragua, Ethiopia, Peru, and India.

DISCUSSION

Issues with Gender and Factors Highlighting Vulnerabilities

Before there has been a generation of moms and women who are free, there will never be a generation of great men. South Asia is quickly emerging as the most underdeveloped, illiterate,

malnourished, and gender insensitive region in the world. This statement is damning. Gender roles are the collection of customs that men and women have traditionally followed, and they differ depending on culture, ethnicity, race, class, and age. Global and local economic, cultural, and societal changes have a variety of influences on how gender roles and relationships are evolving around the globe at varying speeds and in different ways in different cultures and social groupings. Because they have less resources that they can manage and employ on their own, women are more susceptible. They take on extra and often full-time duties including looking for young children, the elderly, and the ill. They experience conventional, frequent, and blatantly prejudiced gender discrimination and have no permanent presence in the decision-making processes. Women are often more susceptible to catastrophes due to their lesser economic, social, and political standing.

According to reports from several disaster-affected regions of India, women were had to labor more than normal and against their own safety imperatives to collect wood for cooking even when they had access to cyclone shelters. Their unique healthcare requirements indeed, particularly those of nursing and pregnant women are disregarded. Women have not been significantly impacted by the numerous broad economic operations that the government and NGOs have undertaken. Even the subtleties of growth often ignore or completely ignore them. For example, sites are always assigned in the names of wives and sons when they are to be used for the building of homes. Many elderly ladies are still without shelter 20 years after the AP cyclone of 1977. Women in charge of their homes often lose out on the job chances generated and offered during the relief and restoration phase, adding the responsibility of seeking work for themselves to their already overburdened tasks as a result of catastrophe.

Women and children tend to drown and die in disproportionately high numbers during floods. Younger women struggle with poverty, and there are frequent reports of them being coerced into prostitution in urban areas. Older women sometimes go one-way into patronized dependence by turning to begging and charitable giving. Traditional anatomy works against women in crisis circumstances in a variety of ways. For example, during storms, women are often placed at danger because their long hair becomes tangled in shrubs and flotsam and because their sarees limit their range of motion.

Agencies often reflect the outside world. One of the relief organizations, run by an all-male relief agency, was found to be gender-insensitive in an analysis of the 1996 hurricane response in AP. Cooking was impossible despite the agency providing all food supplies, including dry ration and fuel, to the catastrophe victims. Women complained that they had not received any cooking equipment. That important factor had been disregarded by the agency. Women handle food distribution networks most efficiently, which is a characteristic that has to be taken into account during the design stages of relief logistics. Female aid workers may detect the victims' distress in less visible ways. The gender ratios of the relief team impacted the afflicted women's attention, the authors of a new research on the long-term psycho-social effects of the AP storm of 1996 remark. After the cyclone, divorce rates rose, and plenty of women started drinking. The number of suicides has gone up, particularly among women. If not reversed, this troubling tendency may have been identified in time for effective intervention if there had been a greater representation of female aid workers. Gender-sensitive treatments can only be ensured with such a proactive role for women. Women and men have distinct requirements during catastrophes, and gender awareness may assist to recognize these needs as well as the ability and reactions of both groups to change. Women sometimes have low self-esteem and are used to seeing themselves as strong survivors who are capable of handling a variety of domestic and social tasks. women also tend to

underestimate the great range of loads women carry. It is crucial for intervention planners to make a concerted effort to ensure women's engagement in order for them to get the same benefits as men.

Bihar, Orissa, Uttar Pradesh, Rajasthan, and numerous other states and areas of the nation have greater rates of poverty than the country as a whole. Additionally, poverty is pervasive in regions more vulnerable to natural catastrophes, like Rajasthan, Marathwada, and northern Karnataka as well as flood- and drought-prone regions like north Bihar, east Uttar Pradesh, and north Bengal. India's population of over 40% has no option but to rely on an ecological foundation that is already eroded. En masse migrations of individuals in pursuit of work have been shown to be both ethnically and environmentally unstable. Today, it is widely accepted that this is one of the main reasons of riots and civil wars in many regions of India, which is exacerbated by desperate (forced) migration. Additionally, there has been ethnic division across most of the nation. Conflicts based on race, religion, and ethnicity have become prevalent. The basis of the conflict was, and still is, economic in north-east India, a troubled region since Independence. The general population's resource base has shriveled as a result of being caught in the web of natural resource extraction that is dictated by market forces, while a tiny minority that has made use of its ability to efficiently interact with the market has profited.

Following the ensuing unhappiness, there has been a growing realization that some natural disasters may in fact be caused by human activities. Recurring floods and droughts, for example, may be caused by the unchecked clearing of forests, severe harm to the ecology of mountains, excessive groundwater use, shifting agricultural practices, etc. The unrestrained exploitation of forest and mountain vegetation and the indiscriminate construction of road networks in the name of development are directly responsible for the current spate of landslides in the Himalayas. Punjab has seen widespread salinization, water logging, and groundwater pollution as a result of heavily chemicalized canal irrigation. Mega-development projects like dam’s flood tens of thousands of acres of rich land and forest in other regions of India, forcing millions of people from their homes. A few of these big dams, with their enormous reservoirs, may have increased seismicity in earthquake-prone regions, as Koyna in Maharashtra 1967.

Disasters like the ongoing drought in Orissa, the desertification of large portions of Gujarat and Rajasthan, where economic ruin continues to have an adverse effect on already fragile ecologies, and environmental degradation in the upstream regions of Uttar Pradesh and Bihar are now a permanent part of life. In the plains, flooding is causing a growing amount of damage to property, the environment, and human lives. Although earthquakes and cyclones may elude a simple, linear causation, there is an underlying, if concealed, connection between human activity and what are seemingly natural catastrophes. The post-Independence pattern of industrial growth has resulted in the severe concentration and localization of industries in particular locations, nearly in perfect harmony with all of this. These areas have attracted hordes of people as opportunities elsewhere have shrunk, particularly in rural India. This has led to the haphazard growth of enormous urban conglomerations that are ill-prepared to handle exponential population growth.

Attempts to control the nature of unplanned industrial growth in order to make it more environmentally sustainable and less prone to accidents and catastrophes have been sparse and ineffective. The lack of proper institutional and implementer support for the legislative frameworks that already exist or have just been formed has led to tragedies like the Bhopal Gas Tragedy and the more recent catastrophe at the Vizag. Steel. In addition, the expanding metropolitan centers are

become so congested and ghettoized that they are getting out of control. Local governments and other institutional structures in metropolitan India have historically failed to carry out their duties, leaving their domains vulnerable to catastrophic events like epidemics, fires, and gas leaks. They have become ethnic and communal tinderboxes due to an increased inflow of migrants, individuals driven from their homes and livelihoods in rural and tribal regions by development projects and market pressures, as well as an increase in unemployment and social tensions. Reducing the vulnerability of populations to disasters is inextricably linked to social and economic development, as evidenced by the UN General Assembly Resolution 46/182 on Emergencies' expansion of the disaster management continuum to include sustainable development. According to a 1980s UNDP study on disaster mitigation efforts in Bangladesh, Ethiopia, and Ecuador, disaster preparedness and prevention are only truly effective when integrated into a larger framework of sustainable development that increases social opportunity and economic growth.

Comfort and Restoration

However, since development is by its very nature a long-term process, it has sometimes been suggested that sometimes the present would have to be foregone in the sake of future generations. The need of giving the disaster-affected people prompt help is now widely acknowledged as a fundamental value. In that regard, it is indisputable that after a number of large catastrophes in India, the State and, to a lesser degree, civil society have sometimes reacted rapidly and effectively with rescue and relief activities. The experience in Marathwada and other Indian cities, however, demonstrated that local residents' and civil society organizations' participation in rescue and relief efforts was not a well-defined procedure. It demonstrated how the government treats rescue and relief efforts as a piecemeal business since they fall under the purview of its revenue department and do not take into account public assistance. Because there isn't a clear procedure for engaging individuals, spontaneous engagement often goes in the wrong direction and is seen as hindrance by the authorities.

The administration views citizens generally as passive beneficiaries of government handouts rather than as important collaborators in disaster relief. However, making individuals passive does not lessen their desire to take part. They swarm catastrophe locations only to be accused of being spectators interfering with life-saving efforts since their rightful role in disaster aid has not been recognized or sought. Initiatives for post-disaster recovery would be greatly enhanced by giving them a real place to play a substantial role. There is no replacement for people-focused initiatives for relief. The state has never denied that those impacted by calamities have a right to assistance, but a right is not an entitlement. It responds administratively and only when authorized by the government. Relief efforts are still seen as a temporary, supporting measure. The most important requirements for returning to pre-disaster living levels are still unmet. As a result, addressing the problem of vulnerability is seldom planned into relief action. Despite respite, the population's ability to tolerate the effects of recurrent drought and flooding is diminished, which results in long-term poverty. In practically all locations vulnerable to recurring droughts, floods, heat waves, and riots, the consistent yearly supply of relief has turned into an economic opportunity for a small number of individuals, establishing it as a pattern. The motivation to see relief in a development mode nearly ever continues in the interest of the major stakeholders when relief develops into a business.

The state of rehabilitation is even more concerning. First, since it is impossible to plan for relief as a chance for growth, there are little efforts made to help the afflicted people reestablish

sustainable means of subsistence. Second, although the Indian public sees the giving of aid as a shared duty, it sees rehabilitation and development as the province of the state, the people who were harmed, and their families. Disasters do not hold the attention of the unaffected for very long after the first shock of realizing the significant suffering. In a nation that experiences disasters one after another quickly, this constant shift in focus poses a risk. This idea is counterproductive. While consecutive floods and droughts degrade the ability of the impacted to regenerate, the government has no legally enforceable obligation to offer rehabilitation. It anticipates that its ongoing measures for development and welfare will help those who are impacted. However, based on collective experience, it seems that the government's standard programs are both difficult to obtain and, when they are, horribly deficient. As a result, it is crucial that recovery efforts and measures assist the impacted population in dealing not only with their own personal needs but also with the additional vulnerabilities and uncontrollable conditions that the catastrophe has brought about.

The only mechanism that can address these vulnerabilities, both reoccurring and newly formed, is effective rehabilitation. Protection against life-threatening conditions is an unquestionable right that transcends governmental restrictions and is essential to the nation's growth and welfare objectives. Everything leads to one fundamental truth: Disaster Management, a more comprehensive strategic approach to catastrophes that goes beyond a reactive reaction, including rehabilitation as a component. It has so far been almost nonexistent in India and is now starting to gain recognition as a significant issue of public policy. Therefore, it should come as no surprise that individuals afflicted by the following earthquake in Uttarkashi or the even more recent earthquake in Jabalpur were not as lucky as those who survived the Marathwada earthquake, which had a rehabilitation scheme in place. At best, the present ad hoc rehabilitation plan is limited to rebuilding and relocating the impacted communities, and even that plan is poorly executed and non-participatory. Such

Measures nearly invariably result in crippling reliance and misdirected growth while leaving the afflicted communities just as vulnerable as they were. This does not mean that individuals completely disintegrate in the face of catastrophes. Contrary to what is shown in the media, people make an effort to cope, and such hardship often strengthens communal ties. The capacity to not only take care of their immediate needs but also to navigate their own paths out of hardship and rebuild their lives and livelihoods is the basis upon which a long-term and reliable survival strategy may be established. A plethora of traditional knowledge and practices including warning signals, a map of safe and risky locations, survival techniques, and conventional insurance models based on kinship and families can be found practically everywhere in the nation.

Policy on Rehabilitation

Any program for disaster mitigation, relief, or post-disaster rehabilitation must thus manage the collection of knowledge and the mobilization of it if it is to be successful. The success of a program's execution depends on how honestly its major players carry out their own duties. Some of the key factors in implementation include the structure and method of decision-making, devolution of powers and responsibilities, level of teamwork, flow of information and communication between and within different levels of the apparatus for implementing the program, and personnel needs and strengths. Effective execution requires widespread and thorough communication of accurate information about all the elements of the rehabilitation plan among all the key players, notably the line department workers. A catastrophe region is analogous to a

combat zone from a strictly logistical standpoint. Since knowledge is the foundation of action, a lack of it may and often does result in major errors in the real world, leading to uncertainty and ambiguity where none previously existed. Therefore, the rehabilitation strategy has to be clear, condensed, and exact. It must unavoidably include a plan for ongoing, extensive distribution of knowledge among key players about every element and component.

Any updates or modifications to the policy or rules need to be communicated to the line department officials on a regular basis. If required, the project management must bring on board communication specialists or consultants for this specific reason. Using regional and common languages to communicate would be both socially and technologically acceptable. Handbooks, manuals, handouts, or any other appropriate media that clearly explains all the pertinent material in sufficient depth would be of optimum efficacy and worth the cost. More so than reams of teaching material, frequent updates and the publication of new and updated rules in the local newspaper would serve the goal brilliantly. at the impacted region, a network of information centers could be established at key areas where officials, as well as concerned and impacted individuals, could be guaranteed access to all the most recent and comprehensive information about the rehabilitation efforts. Even the best-designed rehabilitation program must be implemented by individuals who are prone to not just the usual human faults and frailties but also the pitfalls and difficulties that catastrophes might provide. It is crucial to do a thorough yet quick evaluation of the available human resources before starting a rehabilitation project. This ought to:

1. Consider the project staff's general profiles in light of the program and policy.
2. Define any unique training requirements.
3. Determine what requirements the rehabilitation program will place on the project staff.
4. Determine the human resources' potential advantages and disadvantages.
5. Describe the requirement for new or extra workers.

A rehabilitation strategy places unusual obligations on project staff. The fact that rehabilitative work is time-bound sometimes causes obligations to run at breakneck speeds. Compact interdisciplinary work teams, even if they required temporary drafting in or deputization of extra individuals from different institutions and departments, might significantly reduce or spread the physical and psychological stress.

Corporate, Nonprofit, and Governmental Partnerships

There is a serious but sensitive urgency to this issue. Contrary to how the public reacted, there are numerous lessons to be learned from the relief and reconstruction efforts that followed the Marathwada earthquake about the efficacy of NGO and donor agency involvement. The oft-mentioned approach of just throwing up the doors to commercial firms in this crisis would only increase the confusion and mayhem that characterize a post-disaster environment. Even if a large amount of engagement from non-governmental organizations is desired, the rehabilitation program must include mechanisms for assuring the participation's quality. There has to be a clear definition of the NGOs and donor organizations that serve the business sector. Finding their abilities and the elements and sub-elements of the rehabilitation strategy where they can provide the greatest assistance are two ways to go about this. They might include measures for housing, social and economic rehabilitation, information distribution, program monitoring, and staff training for projects.

The agencies' tasks, responsibilities, and authority must be clearly defined to the fullest degree feasible. Additionally, although clear-cut standards and rules must be created to prevent unneeded distortions that may result from variations in method and content across NGOs, they must also be allowed enough leeway to experiment and develop new ideas. The agencies must provide a time-bound plan of action, clearly define their specialized duties, articulate a strategy for program management, and demonstrate that they have the resources to carry the project through. The work of NGOs and donor organizations in disaster situations is influenced by a wide range of variables, including funding, their relationship with the government agencies, their capacities (which are frequently fluid), personnel, and community response and support. They also make up a part of the reason why their presence is precarious within the program because of these factors. The end consequence is that the neighborhood and individuals who are being targeted are often left knee-deep in quicksand, and the government complains [8]–[10].

The proposal that the government, the corporate NGO/donor agency, and the community support a tripartite agreement that is binding on all three parties and explains the NGO's mission as well as its duties and obligations has a lot of validity. Although it will need to be promoted throughout the community for a really consensual mandate, this may also be a beneficial technique for community engagement. This necessitates the mutual establishment of specific standards by which the best NGO partners may be sought and chosen. This approach will make the NGO more responsible and guarantee that the people are not taken advantage of, in addition to assisting the government in setting priorities for its own work in the region. Collaboration is the only way to minimize the lack of trust and openness between NGOs, the government, and the commercial sector. Key staff rotations and catastrophe and grant-focused secondments might improve relationships, provide a fuller perspective of the realities and capabilities on the ground, and allow for a better knowledge of various constituents. Such openness will stifle baseless accusations, promises, and claims.

Making Participative Environments

Despite the fact that community engagement is now generally recognized as being essential for disaster response and preparation, relatively little effort is made to define and communicate the concept of community participation. There are many different definitions of community involvement, ranging from the community accepting and executing an outside-imposed program to the community determining its own needs, organizing the necessary resources, and handling the problem on its own initiative. Whether consultation entails participation is a key topic in the discussion. The phrase has lost significance as a result of frequent and ineffective usage. Participation now encompasses a wide range of concepts. Through hasty data collection methods like rapid rural appraisal, more participatory appraisal techniques, and finally much more inclusive participatory processes that involve locally affected groups not only in planning but also in negotiation, implementation, management, monitoring, and evaluation, participatory approaches range from token consultation with affected people.

Full involvement entails negotiated agreements that allow local communities to get results that they are happy with since it indicates that they genuinely have control over the resources and procedures and may reject solutions that do not serve their interests. Effective involvement is hampered not just by the policies and biases of representatives from the public and nonprofit sectors, but also by the relevant populations' legal frameworks. Due to the absence of acknowledgement of their rights and the discrimination and cultural gap between them and the

decision-makers, indigenous impacted peoples, notably women, Dalits, and tribals, are especially at danger from inefficient participation processes. Engagement, it seems, evolved to entail dialogue in the absence of a well-defined community engagement plan. The populace was presented with a number of choices, primarily relating to different facets of building and/or maintenance, from which they were asked to choose. People began to believe that, although it was their job to contribute to choices about the layout and design of the homes as well as other pertinent matters, the government or NGOs/donor organizations should bear the major responsibility for rebuilding and repair.

Preparing for and Responding to Disasters

The best disaster response and preparation occurs when it is included into development programs. By include them in development programs, catastrophe mitigation might eventually be carried out with little expense. Over time, the money spent on disaster mitigation would lessen the potential losses that catastrophes may generate. Despite the fact that significant advancements in information and communication technology allow quick processing of complicated data and its effective transmission over great distances, this is still a distant cry in many developing countries, especially the poorest ones.

CONCLUSION

India has used tactics including capacity development, risk assessment, technology integration, community-based initiatives, and international partnerships to deal with these issues. The government has made investments in bolstering the infrastructure for disaster response, creating specialized forces for disaster response, and raising public awareness and education. In conclusion, India's disaster response is a comprehensive effort with the dual goals of reducing the effects of catastrophes on vulnerable communities and boosting resilience. India works to strengthen its readiness, response, and recovery capacities via a comprehensive framework, coordination processes, and strategic initiatives. To effectively respond to disasters and construct a more resilient country, ongoing efforts in capacity building, infrastructure development, and community involvement are crucial.

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CHAPTER 14

AN OVERVIEW ON INDIAN NATURAL DISASTER MANAGEMENT

Dr. Varsha Agarwal, Associate Professor,
ISME - School of Management & Entrepreneurship, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: varsha.agarwal@atlasuniversity.edu.in

ABSTRACT:

India is a country vulnerable to a wide range of natural disasters, including cyclones, floods, earthquakes, droughts, landslides, and heatwaves. This study provides an overview of the natural disaster management framework in India, highlighting key aspects, challenges, and strategies employed to mitigate the impacts of such disasters and enhance resilience. Natural disaster management in India is guided by a comprehensive framework that encompasses various phases, including preparedness, response, recovery, and mitigation. The framework is led by the National Disaster Management Authority (NDMA) at the national level, with state disaster management authorities coordinating efforts at the state and district levels. Key elements of India's natural disaster management include early warning systems, risk assessment, evacuation plans, search and rescue operations, medical assistance, relief distribution, infrastructure restoration, and capacity building. These elements are crucial in ensuring a timely and effective response to disasters. Challenges in natural disaster management in India include the vast geographical diversity, high population density, inadequate infrastructure, limited resources, and climate change impacts. The country also faces the task of addressing socio-economic vulnerabilities and ensuring inclusivity in disaster management efforts.

KEYWORDS:

Disaster, Management, Public Safety, Police Response.

INTRODUCTION

The Indian subcontinent is one of the world's areas that is most susceptible to natural catastrophes due to its particular geoclimatic characteristics. Amazingly often, disasters happen, and although society as a whole has adjusted to these frequent occurrences, the financial and social consequences keep rising. Although landslides, avalanches, and bush fires regularly happen in the Himalayan area of northern India, the Indian subcontinent is very susceptible to drought, floods, cyclones, and earthquakes. 22 of the country's 31 States and Union territories are vulnerable to disasters [1]–[3]. River floods are the most common and often the most damaging of all the catastrophes that take place in the nation. The characteristics of the country's rainfall are the main source of floods. 75% of the nation's yearly rainfall falls during a brief monsoon season that lasts three to four months. Due to this, there is a significant release from the rivers at this time, resulting in extensive flooding. The nation's potentially 40 million hectares of flood-prone territory have been identified. Each year, 18.6 million hectares of land are flooded. Most floods occur in the Ganga, Brahmaputra, and Meghna basins, which account for 60% of the nation's total river flow. One of the most hazardous and catastrophic natural dangers is earthquakes. Since this phenomenon has an abrupt and little to no warning, it is simply impossible to foresee or prepare for damages to buildings and other man-made structures, including collapses. The Andaman and Nicobar Islands,

the Himalayan and sub-Himalayan regions, and around 50–60% of the country's total geographical area are vulnerable zones.

Cyclones and Droughts

A recurring problem in various Indian states is drought. Around 50 million people experience droughts every year, and 16% of the nation's total land area is at risk for drought. In actuality, drought is also a serious environmental issue since it results from below normal rainfall over an extended period of time. About 68% of India's entire cultivated land is at risk for drought. The majority of the country's dry, semi-arid, and sub-humid regions have been recognized by the Indian government as drought-prone. India's 5700 km of coastline is vulnerable to tropical cyclones that form in the Arabian Sea and Bay of Bengal. One of the six primary cyclone-prone areas of the planet is the Indian Ocean. Cyclones often hit India between April and May as well as between October and December. Since 80% of all cyclones produced in the area impact the eastern shore, it is more vulnerable to them [4]–[6].

India has a federal structure and is a parliamentary democracy. Within the scope of the government, an integrated disaster management system exists. The State Government in the area where the incident happened has the primary duty for disaster management. However, the Central Government may be necessary to augment suitable steps in the areas of rescue, relief, and readiness in the case of catastrophes that extend across numerous states and reach uncontrolled dimensions. The National Crisis Management Committee (NCMC) is in charge of centralizing all disaster-related activities. The nodal ministry and various support ministries make up the NCMC. The Ministry of Agriculture is the nodal ministry for natural catastrophes. The efficacy of the government's reaction to natural catastrophes has increased in the past. This is primarily attributable to the development of efficient administrative systems, the establishment of Relief Manuals at the district level, the predefined assignment of responsibilities, and acknowledged public-private collaborations. However, the lack of a comprehensive national strategy has caused several important components of disaster management to be ignored. As a result, having a policy aid in continuously outlining the fundamental strategies of the government. In addition to ensuring general national competence and independence in relation to international activities, it provides relevant laws and related regulations in this area.

Centralized Administrative Structure

In India's federal system, the responsible State Government is primarily responsible for developing the Government's response to a natural disaster. The Central Government, with its physical and financial resources, does, however, provide the necessary help and assistance to support relief efforts after major natural disasters. The dimensions of the response at the level of the Central Government are determined in accordance with the current policy of financing the relief expenditure and keeping in mind the factors, like the gravity of a natural calamity, the scale of the necessary relief operation.

Ministry of Agriculture: The Nodal Organization

The main department for all issues relating to natural disaster assistance at the Center is the Department of Agriculture and Co-operation (DAC), which is part of the Agriculture Ministry. The National Contingency Action Plan (CAP) enables the immediate deployment of relief and rescue efforts. The CAP outlines the steps that different Central Ministries and Public agencies

must do in the aftermath of natural disasters, establishes protocols, and chooses the administrative machinery's focal points. The Relief Commissioner serves as the nodal authority in the DAC, coordinating all relief efforts in response to natural catastrophes. The Central Water Commission continuously provides the Director General of the Indian Meteorological Department with information on the prognosis of the natural catastrophe. The Agriculture Department keeps track of current events and communicates any relevant information to the agriculture minister, Prime Minister, and Cabinet via the Agriculture Secretary.

The National Crisis Management Committee (NCMC)

The NCMC has been established under the cabinet secretariat under the leadership of the cabinet secretary. The director of the intelligence bureau and an officer from the cabinet secretariat are also members of this committee, along with the secretaries of the ministries of home affairs, defense, research and analysis, agriculture, and cooperation. When it is judged essential, the NCMC directs the crisis management team.

Group for Crisis Management (CMG)

Every year, a commission led by the Central Relief Commissioner and made up of senior officials from several ministries and other relevant agencies examines the contingency plan developed by central ministries/departments. It examines the numerous steps needed to cope with a natural catastrophe, organizes the efforts of the federal and state governments to prepare for and respond to one, and gathers data from nodal officials on the aforementioned measures. The convenor of CMG is the joint secretary (NDM) and Additional Central Relief Commissioner. Every six months, the CMG meets.

Financial Concessions

When it comes to the mobilization of financial resources, the Center is crucial. The recommendations provided from time to time by the finance commissions on the topic control the policy and mechanism for funding state governments to offer relief and rehabilitation measures in regions impacted by natural catastrophes. The Tenth Finance Commission's proposals served as the foundation for the program that was in place from 1995 to 2000. A Calamity Relief Fund (CRF) has been established for each state under the current plan with contributions from the Central and State Governments to carry out relief and reconstruction efforts. The CRF's yearly allotments to the several states are determined by their historical spending patterns for natural disasters over the previous 10 years. The state governments get the core portion of the CRF in four equal quarterly payments.

A group of experts and state officials has created a list of goods that the CRF will alone be responsible for paying for, as advised by the Tenth Finance Commission. The standards of assistance under each of the authorized programs are determined by a state-level committee led by the chief secretary. If the set standards are noticeably out of date, the Ministry of Agriculture may modify them. Relief Committee, a division of the National Development Council, is presided over by the union's minister of agriculture. The yearly CRF allotments must typically be used by the state governments to implement relief and rehabilitation programs. In the case of an exceptionally severe disaster, they may yet request further support from the NFCR.

State-level Administrative Structure

As was already said, the federal government does little more than support the efforts of the state governments. The state governments are free to plan long-term preparedness/rehabilitation measures as well as relief efforts in the case of a natural catastrophe. Relief Commissioners are in charge of overseeing the relief efforts after natural catastrophes in their respective states. In the event that the Relief Commissioner is not present, the Chief Secretary or a representative chosen by him is in charge of overseeing the relief efforts in the State in question. The State Administration is led by the Chief Secretary. The state's administrative center also has a number of Secretaries who oversee the many divisions dealing with certain topics under the general direction and coordination of the Chief Secretary. Natural catastrophes are often handled by the revenue department or the relief department at the state level of government. Daily choices concerning policy are made or exercised by the department's secretary, while significant policy decisions are made at the state capitol by the state's cabinet, which is led by the chief minister [7], [8].

Group for States' Crisis Management

A State Crisis Management Group (SCMG) is in place, and the Chief Secretary/Relief Commissioner serves as its head. Senior officials from the home, civil supplies, electricity, irrigation, water supply, panchayat (local self-government), agriculture, forestry, rural development, health planning, public works, and finance departments make up this group. The SCMG must develop action plans for coping with various natural catastrophes while taking into account the infrastructure and assistance it sometimes receives from the Government of India. The state's Relief Commission is also obligated to set up an emergency operations center as soon as a catastrophe crisis arises. The Center would serve as the focal point for all interested agencies and have the most recent information on catastrophe predicting and warning.

District-level Administrative Structure

States are further divided into districts, each of which is led by a District Collector (also known as a District Magistrate or Deputy Commissioner), who serves as the district's central authority for planning and developing district-level plans as well as directing, supervising, and monitoring disaster relief efforts. At the district level, the Collector has coordination and oversight responsibilities for all departmental employees. The powers of every Collector are often greatly increased during real activities for disaster mitigation or relief by standing instructions or directives on the topic, or by particular Government regulations, if needed. When there is an emergency, the administrative culture of the concerned state sometimes allows the Collector to act with more authority, although informally. The choices are then approved by the appropriate authorities.

Emergency Plans

At the district level, disaster relief plans are created that outline particular duties and the organizations responsible for carrying them out in response to certain calamities. The Collector/Deputy Commissioner creates a catastrophe preparedness plan for the district, which is then authorized by the state government. In order to prepare the contingency plans, the Collector/Deputy Commissioner also organizes and gets input from the local defense forces unit. These contingency plans include essential individuals, detailed action steps, and contact information for all matters. The district-level relief committee, which is made up of both official

and unofficial members, including members of the parliament and local lawmakers, evaluates the relief measures.

District Command Center

A control center is established up in the district after the natural catastrophe to continuously oversee day-to-day rescue and relief efforts.

Coordination

The district administration's efforts in rescue and relief operations are supplemented by the efforts of the army, air force, navy, ministry of water resources, etc., with whom the Collector/Deputy Commissioner has a strong working relationship. Additionally, the collector/Deputy Commissioner organizes all volunteer activities by enlisting non-governmental groups that may function in such circumstances. The whole hierarchy is linked together by a telecommunications network, starting at the top with the central government (the department of agriculture and cooperation under the ministry of agriculture and irrigation) and extending all the way down to the district and sub-divisional/tehsil levels. In times of stress or if the overland system fails, radio communication is reestablished. Overland telephone and telegraph are the usual modes of communication. The country's police organization typically manages and runs the wireless network. Along with the district authorities, several other organizations, in particular the military forces and non-governmental volunteer groups, support their efforts in times of calamity.

The Military's Function

The nation's military forces have been instrumental in giving immediate aid to victims of disasters, especially in the most difficult-to-reach and isolated regions of the nation. Armed forces are indispensable in such emergency circumstances due to their organizational strength, disciplined and systematized approach, and expertise in managing technological and human resources. Additionally, when disasters affect a vast region, it is sometimes impossible for governments to arrange relief efforts; instead, the military forces are called upon to do so. The civil defense and home guard groups, which support the military forces, are volunteer in nature and function well in emergency circumstances like natural disasters. There is currently a nationwide network of these. They don't participate in real combat operations as the military do, but their primary goals are to preserve lives, reduce property damage, and sustain production. These organizations are thus able to coordinate and support efforts in a disciplined manner, so that both the army and the district officials are to carry out their respective activities efficiently, even though disaster situations frequently lead to chaotic conditions where rescue and relief work is severely affected.

The Function of Nongovernmental Organizations

Non-governmental organizations (NGOs) are one of the most efficient alternative strategies of creating an effective communication connection between the disaster management agency and the affected population, according to emerging trends in handling natural disasters. Various NGOs of various kinds are already active on both a situational and grassroots level. They may assist with preparation, relief and rescue, rehabilitation and rebuilding, as well as monitoring and feedback in a typical catastrophe event. NGOs might play a crucial role in disaster management. NGOs could play a crucial role in disaster management. An appropriate substitute may be found in grassroots NGOs as they have an advantage over governmental organizations in enlisting community support. This is mostly due to the NGO sector's close ties to the community and its capacity for substantial

procedural flexibility as compared to the government. Organized activity by NGOs may be extremely helpful in the actions that follow at various phases of disaster management, depending on the sorts of NGOs that have been identified and their skills. Organized NGO Activities throughout the Disaster Management Process. The NGO sector has recently been very important in preparing the society for calamities. The tendency is founded on a long-term understanding of the need for absolute minimum self-reliance.

The Community's Function

It has now come to light that the community is emerging as the most potent institution in the whole system of disaster management. In the case of real catastrophes, the community may significantly lessen the disaster damage if it is fully informed of the preventative measures that must be taken. Communities' education and awareness campaigns are very helpful in disaster-prone regions. It is really encouraging to see the great work being done in certain regions where communities have established their own groups that act appropriately in such circumstances. The Church Auxiliary for Social Action (CASA), a community-based organization, established the Village Task Force in Andhra Pradesh's rural communities. The Village Task Force has received training in village-wide disaster assistance and evacuation. It is chosen by the citizens themselves, and in times of crisis, it acts as the village's central authority, gathering and disseminating information from outside organizations and mobilizing resources for the community. In spite of the fact that the community as an effective institution has yet to emerge in this nation, mostly as a result of low literacy rates and pervasive poverty, significant efforts are being made to establish and build community-based organizations at the local level [9].

Institutions for Research and Education

Research and development initiatives, in addition to capacity building for all people involved in disaster management, are being given significant focus due to a rise in the attitude towards establishing a culture of prevention in the disaster management scenario. Numerous research institutions in India are actively engaged in the study of catastrophe management. The field is looking at valuable contributions in the technological, social, economic, and managerial sectors. Depending on the nature and degree of research, several ministries are in charge of coordinating its efforts. Universities, which provide courses on disaster management and act as think tanks for the government, also play a significant role in this field. Institutes located all around the nation have specialized in certain geographic areas where the majority of their research is conducted as well as in specific types of catastrophes. The Central Building Research Institute at Roorkee, the Indian Institutes of Technology, and the Anna University are notable universities. The Department of Science (Ministry of Science and Technology), Government of India, coordinates activities through a network of scientific institutes. Through the construction Materials and Technology Promotion Council, the Ministry of Urban Development conducts studies on issues like the best construction materials for disaster-prone locations. These institutions teach field level officials and other key participants in addition to provide technical help to implementation and engineering corporations.

CONCLUSION

An immediate rescue and relief effort is necessary in crisis scenarios. However, if enough levels of readiness are attained, significant harm may be reduced. In fact, it has been seen in the past that the loss of life and property has been significantly decreased as and when attention has been given

to suitable planning measures. The overall disaster management of the region would benefit greatly from preparedness measures such as training of role players, including the community, development of advanced forecasting systems, effective communications, and, above all, a sound national policy and a well-networked institutional structure involving government organizations, academic and research institutions, the armed forces, and NGOs. Later, it would result in the crucial shift in focus from rescue and relief to preparation. In conclusion, disaster management is a dynamic and developing discipline in India with the goal of reducing the effects of diverse natural calamities and boosting resilience. The complete structure of the nation, in conjunction with strategic projects and alliances, is essential for lowering vulnerabilities and enabling a more efficient response to natural catastrophes. For India to become more disaster-resistant, ongoing efforts in risk reduction, infrastructure development, and community involvement are necessary..

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CHAPTER 15

DISASTER MANAGEMENT AND POLICE RESPONSE

Dr. Sweta Kumari, Assistant Professor,
ISME - School of Management & Entrepreneurship, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: sweta.kumari@atlasuniversity.edu.in

ABSTRACT:

Disaster management and police response play integral roles in mitigating the impacts of disasters and ensuring public safety during crisis situations. This study provides an overview of the relationship between disaster management and police response, highlighting their coordination, responsibilities, and strategies employed to effectively handle emergencies. Disaster management involves the systematic approach to prevent, prepare for, respond to, and recover from disasters. Police response, as part of the broader emergency management framework, focuses on maintaining law and order, ensuring public safety, and supporting disaster response efforts. During disasters, the police have crucial responsibilities, including evacuation management, traffic control, crowd management, security, and protection of critical infrastructure. They work closely with other emergency services and agencies to ensure effective coordination and efficient deployment of resources. The collaboration between disaster management and police response involves joint planning, training, and communication to enhance preparedness and response capabilities. This includes developing emergency response protocols, conducting simulation exercises, and establishing command centers for efficient decision-making.

KEYWORDS:

Disaster, Management, Public, Police Response, Safety.

INTRODUCTION

Disaster is defined as sudden or great calamity in the Oxford Dictionary of English Etymology. There is considerable disagreement over one single definition of disaster, with some considering it to be a grave emergency, while others refer to it as catastrophe, while still others describe it as a major incident with a large number of casualties. However, a disaster is commonly understood by the general public as a great misfortune or calamity [1]–[3]. However, for both victims and aid workers, the suffering a disaster brings - the human terror, anguish, and despair - is what is most important. People suffer not only physical damage, but also significant psychological damage in disasters. The Police, who perform rescue operations, often describe disasters in quantitative and statistical terms, including the number of dead and injured, the extent of damage to buildings and other physical resources, the number of homeless, and the ultimate economic costs.

Most major disasters occur largely as unforeseen events.

Any reasonable prediction or anticipation of a catastrophic event usually results in action intended to reduce the 'probable' to at least the 'possible' and ideally to the 'most likely'. The obviousness of the point that disasters are unforeseeable is often overlooked during the process of post-incident enquiry when the clarity provided by hindsight reveals, the specific factors which could/should have been spotted and resolved in order to avoid the onset of the disaster. Given the relative infrequency of major disasters it is unrealistic to expect Police forces to have the necessary

resources, skills and logistics to manage a major disaster. Although Police provides the initial response to an incident and, together with the other emergency services, conducts rescue and first aid activities, the sheer scale of a major disaster means that most of the core management functions involved in the post rescue phase are beyond the experience of most Police forces. This inexperience places high levels of strains on officers in management roles. An efficient management can do much to assist officers to cope with the onerous experiences associated with major disasters by way of planning in respect of predictable/foreseeable disasters and training, in general, for all types of disasters [3], [4].

Different Disasters

All disasters can be broadly divided into two categories: natural disasters and man-made disasters. Natural disasters are uncontrollable because nature itself is uncontrollable; these events are frequently referred to as acts of God. On the other hand, man-made disasters are an increasingly common occurrence in the modern technological society and happen as a result of human error or failure, or when a structure or system designed by man malfunctions. While nuclear pollution from an accident like that at Chernobyl may be catastrophic but cause no visible damage, some technological disasters do not have this effect. While natural disasters are frequently predictable to some extent, technological disaster is not, as technological catastrophes are never supposed to happen and therefore predictability is not an issue. The King's Cross Underground fire in No.

Disaster Preparedness and Response by the Police

The emergency services must maintain a state of readiness so they can provide a rapid response and alert local authorities and other services as soon as possible. All organizations who need to respond quickly to a disaster should have arrangements which can be activated at short notice. These arrangements should be in place as soon as possible. The police must play a key role in disaster management regardless of the type or nature of the disaster and must be very quick in its initial response to a disaster call or situation. If a disaster is predictable or foreseeable, such a response must be made immediately. If a disaster has been caused by severe weather or other natural phenomena, the scene must be treated as the scene of a crime and preserved accordingly. Although involvement of different emergency services like Fire Brigade, Police and Hospital Services is inevitable, some other Public Utility Services, such as local bodies, Railways and Gas Boards, etc., have to be involved also in most cases for dealing with the situation effectively.

All such agencies are very different organisations, with different hierarchies and chains of command and responsibility, all talking different languages with different areas of expertise and priorities. If rescue and recovery work is to be effective, all these different agencies have to work together in a coordinated way All these agencies, therefore, have to be aware of each other's areas of responsibility and systems of working. Comprehensive discussion and agreement among these agencies in the planning, stage and communication of the decisions down the chain of command to the lowest functionary of each agency and their training is, therefore, of utmost importance so that they know as to who is responsible for what and are aware of their roles and responsibility and can appreciate the need for Multi-Service Involvement in such a situation. While the causes of disaster may be sudden and unpredictable, certain industrial activities carry known risks and are subject to legal requirements for emergency planning. Examples of such activities include known chemical or nuclear hazards at fixed locations, where the most likely types of incidents and their likely consequences are largely foreseeable, making it possible to make detailed plans in advance for the appropriate action to be taken.

1. **Mitigation: This** refers to actions taken to either prevent the occurrence of a disaster or to lessen its likelihood or severity. Examples include prohibiting smoking on subway systems, enforcing strict security measures at airports, and building toxic waste processing facilities in remote locations.

2. **Readiness:** This involves making plans, educating the public, issuing alerts, and preparing resources to handle the issue.

(a) **Response** - This includes providing emergency assistance on the scene, such as rescue and evacuation; and

Recovery: This phase will include ongoing tasks required to rebuild the affected area and ensure a quick return to normalcy.

We will also have to accept that if there are any disasters in the future, the emergency services will continue to have to provide the initial response and bear the brunt in the future as well as at present. Is it, therefore, not advisable for people to make efforts aimed at mitigation to help in preventing or mitigating the effects in certain types of disasters? Disasters can happen at any time and can happen as a result of human behavior as well as as a result of an act of nature.

Police's Functions and Role

The following list summarizes the main responsibilities of the Police:

- **i.** Lifesaving efforts alongside other emergency services.
- **ii.** Coordinating with other organizations and the emergency services
- **iii.** Crowd and traffic management.
- **iv.** The examination of the occurrence in collaboration, where necessary, with other investigating organizations.
- **v.** Gathering and disseminating data on casualties.
- **vi.** The victims' identities.
- **vii.** The earliest chance for normalcy to return.

Each of the aforementioned duties, as well as additional duties, are explained below:-

Controlling Access and Crowds

Experience has taught us that when a disaster strikes, the police should immediately cordon off the area and stop people from swarming the scene. The area should also be kept clear of all traffic to ensure that the emergency vehicles do not encounter any obstacles on their way to the site. The obstruction of way to the site of disaster may delay the arrival of emergency vehicles. Immediate traffic arrangements shall be made to divert the traffic away from the scene of disaster. The motorists shall be suitably informed about the traffic diversion through the P.A. system, radio, TV, as well as by the traffic policemen present at the spot. Those who have already arrived there should be asked to leave, and the scene of the disaster shall be cleared of all onlookers whose presence would only obstruct the work of the emergency service personnel. Occasionally, the public also becomes agitated and displays their annoyance against the government, which quickly turns into a law-and-order issue. The police should deal with this.

Rescue and Evacuation Efforts

When a disaster strikes, the police are typically the first to arrive on the scene. Until other emergency service personnel arrive, they should search the area and remove casualties from the scene. They should also give other services and the local authority their full cooperation in the rescue and evacuation operations. Risks to life or health from, among others, the following may need advising the public whether to leave a certain region or remain and seek refuge inside.

i. The dispersion of radioactive substances or other dangerous compounds, whether actual or threatened.
ii. The growth of the fire.
iii. Explosion.
iv. Catastrophic storms.
v. Flooding.
vi. Earthquake.
vii. Pollution of the environment.

It is typically the police who recommend whether or not to evacuate and define the area to be evacuated in the case of the release or threatened release of non-radioactive hazardous materials. Additional information on the nature of the risk may be obtained from the fire service or other accredited sources. One crucial factor in determining the area to be evacuated will be the forecast of speed and direction of the wind which can be obtained from the appropriate weather office.

Coordination and Command

Three layers of police Command and Control may be established, depending on the magnitude and location of the incident:

i. **Forward Control Point:** Usually the first control to be set up, under the supervision of the local area officer who would be in charge of the first deployment and communication lines.
ii. **Event Control Post:** A coordinator should be established with responsibility for the control post, reporting to the local Police Chief or Commander, in order to control and coordinate the management of the event and offer a central point of contact for all emergency and specialised services.

Major Incident Command Center

To co-ordinate resources to a protracted incident under the control of area Police Chief or Commander. Handling of media and setting up of a cell to inform the media about the real situation and casualties and to prevent spread of rumors and dis-information. Co-ordination means the harmonious integration of the expertise of all the agencies involved with the object of effectively and efficiently bringing tile incident to a successful conclusion. It is the police responsibility, in any disaster situation, to co-ordinate the strategic roles of all the emergency services and other organisations involved [5]–[7]. It would be desirable that due to the nature of certain natural disasters or major incidents this coordination role is handed over to another more appropriate service or agency. At all times, however, the personnel and resources of each service should remain under the command of their respective departmental heads. Where appropriate, the formation of a coordinating group from the key service and agency personnel will be quite useful. This group may be normally chaired by the police who will be responsible to maintain written records of its

deliberations. Appropriate members of the group will also ensure that proper records are maintained of the incident.

It may be necessary to assign the control of specific functions to one or more of the emergency services or other agencies in order to fulfill the coordinating role, taking into account the characteristics of each specific disaster, as well as the professional expertise of each emergency service and their statutory duties. For example, the fire service and ambulance service will typically be responsible for the rescue, initial treatment, and medical evacuation. The police would be required to treat the scene at and around a disaster as a scene of crime and preserve it accordingly unless a disaster has been caused by severe weather or other natural phenomena, in which case the police would be required to accept that a large number of police officers will be required to achieve this aim and, therefore, the in charge of the district or incident commander should take early action for the reinforcements.

Visits by VIPs

Visits by VIP's can lift the morale of those affected by the disaster as well as those who are involved with the response. It has been seen that the Ministers, members of Parliament and State legislatures, local councilors, leaders of various political parties, etc. visit the scene of a disaster and the injured to mark public concern and see the disaster response. It may be possible that the scale of a disaster may in addition prompt visits of the Prime Minister, Governor, Chief Minister, etc. Sometimes their visit to the disaster site is likely to adversely affect the rescue operations, particularly if casualties are still trapped. It should be ensured that their visits do not interrupt rescue and lifesaving work and the police, as coordinators of the disaster response, should explain the ground situation to them and try to avoid their visit, if possible. However, in case the visit becomes inevitable, it should fix up the timing of visits. The additional need for their security would also cause a problem. The police and the local services are, however, experienced at handling VIP visits and many of the usual considerations will apply to their visit to a disaster site. The police should coordinate with the government press officer to keep the number of such visits to a minimum if it is desired to limit media coverage of such visits. It may also be necessary for the police to brief the VVIP/VIP in advance about the specifics of casualties, damage, and the nature of the disaster. The police should, therefore, prepare a brief note for such briefings.

Welcome Center

Recent experience of disasters has shown that, if they believe their friends and relatives may have been involved, it is likely that many people will travel to the scene or to meeting points such as travel terminals. If necessary, a reception center for fr1ends and relatives will be established by the police usually in consultation with the local authority and commercial, industrial or other organisations concerned and staffed by the police, local authority and suitably prepared voluntary organisations. The fullest possible information should be given to enquirers seeking news of those involved in a disaster. Experience has shown that this is best done in a controlled way with general enquiries being referred to a specific source. This helps to ensure consistent and non-contradictory information being given out. Friends and relatives who may be feeling intense anxiety, shock or grief, need to be treated with sympathy and understanding. Access to the reception center should be controlled to prevent those insides being disturbed by uninvited media representatives or onlookers.

Notification of Foreigners

According to the Vienna Convention on Consular Relations, the police must immediately notify the Consular authorities of any deaths or injuries to foreign nationals if they have been or are suspected to have been engaged in the tragedy. Disasters, whether natural or human-induced, pose significant threats to the safety, security, and well-being of communities. In such challenging situations, effective disaster management and an efficient police response are crucial for minimizing the impact, ensuring public safety, and facilitating a coordinated and timely recovery process. This detailed description explores the role of police in disaster management, focusing on their preparedness, response strategies, coordination with other stakeholders, and the challenges they face in this critical domain.

Preparedness

Disaster preparedness forms the foundation for an effective response. Police agencies play a pivotal role in ensuring preparedness by conducting risk assessments, developing emergency plans, and providing training to their personnel. This includes equipping officers with knowledge about different types of disasters, their potential consequences, and the necessary response protocols. Police departments also collaborate with other agencies, such as emergency management organizations, fire departments, and medical services, to establish effective communication channels and coordination mechanisms for seamless cooperation during disaster situations.

Response Strategies

When a disaster strikes, the police response is multifaceted and varies depending on the nature and scale of the event. One of the primary roles of the police is to maintain law and order in the affected areas. They establish control and security measures, ensuring the safety of responders and affected individuals. Additionally, the police play a critical role in search and rescue operations, evacuation efforts, and providing immediate assistance to victims. They may also be involved in traffic control, managing crowd movements, and enforcing curfews or restricted areas to ensure public safety during emergencies [8]–[10].

Coordination with Stakeholders

Effective coordination and collaboration with various stakeholders are key aspects of police response in disaster management. Police departments work closely with other emergency response agencies, including fire departments, medical services, and voluntary organizations, to coordinate efforts, share resources, and streamline communication. This collaborative approach enhances the overall response capacity, facilitates resource allocation, and ensures a cohesive and efficient disaster response. The police also engage with community leaders, local government authorities, and other community-based organizations to gather information, address specific needs, and provide timely and accurate updates to the public.

Challenges and Considerations

Disaster management and police response present unique challenges that require careful consideration. Firstly, disasters often stretch police resources and personnel to their limits, necessitating adequate planning and resource allocation to ensure an effective response. Additionally, the dynamic and unpredictable nature of disasters demands flexibility and

adaptability in police strategies. Rapidly changing circumstances, resource constraints, and emotional stress can impact decision-making and operational effectiveness. It is crucial for police agencies to conduct regular training exercises, simulations, and post-disaster evaluations to identify areas for improvement and enhance their response capabilities. Interagency coordination, distinct lines of authority, and efficient communication systems are necessary for seamless cooperation; challenges in the integration of disaster management and police response include resource allocation, information sharing, communication, and addressing the diverse needs of affected communities. Strategies used to improve disaster management and police response include the use of technology for real-time information sharing, community engagement

CONCLUSION

The police play a crucial role in ensuring public safety, maintaining order, and supporting disaster response operations. In conclusion, effective disaster management and police response require close coordination, collaboration, and integration of efforts. By coordinating their strategies, sharing information, and holding joint exercises, disaster management and police response can improve the overall effectiveness of emergency management and better protect communities during disasters. In conclusion, the involvement of police in disaster management is integral to ensuring public safety, maintaining order, and facilitating the overall response efforts. Through preparedness measures, strategic response strategies, and effective coordination with other stakeholders, police agencies contribute significantly to minimizing the impact of disasters and supporting affected communities. Understanding the challenges, they face and continually refining their approaches through training, evaluation, and collaboration will enhance the ability of police departments to effectively respond to disasters and fulfill their critical role in safeguarding the well-being of individuals and communities.

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CHAPTER 16

A FUNDAMENTAL STUDY ON EARTHQUAKES: SCIENCE, IMPACTS AND MITIGATION STRATEGIES

Prof. Bhargavi Deshpande, Assistant Professor,
ISDI - School of Design & Innovation, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: bhargavi.deshpande@atlasuniversity.edu.in

ABSTRACT:

Earthquakes are natural phenomena that have fascinated scientists and posed significant challenges to societies throughout history. This chapter provides a fundamental study on earthquakes, exploring their causes, characteristics, monitoring techniques, and impacts on human populations and infrastructure. Earthquakes occur due to the release of accumulated stress along fault lines in the Earth's crust. The shifting of tectonic plates, volcanic activity, and human-induced activities such as mining or reservoir-induced seismicity can trigger seismic events. Understanding the causes and mechanisms of earthquakes is crucial for predicting and mitigating their effects. Characterizing earthquakes involves measuring their magnitude, which quantifies the energy released, and their intensity, which describes the effects felt at specific locations. Seismology, the study of seismic waves, is central to earthquake monitoring and provides valuable data for research and hazard assessment**.**

KEYWORDS:

Assessment, Earthquakes, Hazard, Mitigation, Seismology.

INTRODUCTION

Earthquakes are natural phenomena that have profound effects on the Earth's surface and human societies. This study presents a comprehensive overview of a fundamental study on earthquakes, focusing on understanding their scientific aspects, exploring their impacts, and discussing strategies for mitigating their destructive consequences. The study begins by highlighting the causes and characteristics of earthquakes. It emphasizes that seismic activity occurs due to the release of accumulated stress along tectonic plate boundaries, resulting in the sudden shaking of the Earth's crust. The different types of seismic waves, including primary (P) waves, secondary (S) waves, and surface waves, are described, highlighting their distinct characteristics and behavior [1]–[3].

Furthermore, the study delves into the impacts of earthquakes, emphasizing the wide-ranging consequences they can have. These include loss of life, structural damage, disruption of critical infrastructure, economic losses, and long-term social and psychological effects. The secondary hazards associated with earthquakes, such as landslides, tsunamis, and aftershocks, are also mentioned, further emphasizing the complexity and severity of their impacts. The study then explores the strategies and approaches employed to mitigate the effects of earthquakes. It highlights the importance of earthquake-resistant building design, early warning systems, public education, and land-use planning in reducing vulnerability and enhancing resilience in earthquake-prone areas. The significance of seismic monitoring networks and the collection of seismic data for better hazard assessments and informed decision-making is also emphasized. Moreover, the study acknowledges that ongoing research and advancements in the field of earthquake studies are

crucial for improving our understanding and response to seismic events. It mentions the use of scientific techniques such as seismology, geodesy, and geophysics to investigate fault behavior, earthquake mechanics, and associated risks. The integration of advanced technologies, including remote sensing and computational modeling, is also recognized as valuable tools for prediction, simulation, and preparedness.

Earthquakes occur due to slippage of rocks along faults inside the earth. Occurrence of the earthquakes, volcanoes and mountain building is due to a common process called plate tectonics. According to this revolutionary theory, the outer surface of the earth called the lithosphere is divided into six major and some minor blocks or plates. Each plate is about 100 km thick and moves relative to the neighboring plates on a layer of softer rocks. Movement of these plates is very small about 2-3 cm per year which is same as the rate of growth of your nails. The main driving force is the heat generated by the radio activity. Plate margins have been defined on the basis of earthquake belts. There are three types of plate margins along which the plates either move away from each other or towards each other or past each other. The mid-oceanic ridges, which are girdling the earth, are the spreading plate margins where the new material in the form of lava is continually upwelling. Large earthquakes do not occur along this type of plate margin. The two sides of the ridge move apart slowly.

The ridge push is carried up to the sites of deep oceanic trenches where the plate is subducted and the material from the oceanic plate, is consumed. Strong earthquakes occur frequently along such margins. Volcanoes are formed over the sinking slabs like those in Indonesia, Japan & Philippines. Some times when the oceanic part of the plate is fully consumed, the continents collide [4]–[6]. In this fashion, about 45 million years ago, the Indian plate collided with the Eurasian plate and Himalaya started forming in between the two continents at a place where there was once an ocean. An example of the third type of plate boundary where two plates slide past each other is in California. Large earthquakes occur in such type of boundaries also. Now we know that large earthquakes occur along certain belts. About 75% earthquakes occur along the Circum-Pacific belt which is known as the ring of fire due to the presence of volcanoes. About 20% earthquakes occur along the Alpine Himalayan belt and rest along the mid-oceanic ridges and intraplate regions. Young mountain regions are seismically more active.

Magnitude, Intensity and Energy of Earthquakes

The point inside the earth where the earthquake originates is called focus and its projection on the surface is called epicenter. The magnitude is estimated at the epicenter and the intensity is assigned to a site. Magnitude is determined by amplitude of seismic waves recorded on a seismograph which is a device to record earthquakes. Due to inhomogeneities in the earth, the amplitude of the seismic waves may be amplified or attenuated giving slightly different values of the magnitude at different stations. The average value from different stations is assigned as a fixed number to be an earthquake magnitude. Intensity is assigned on the basis of damage which depends upon magnitude, depth of focus, distance from epicenter and the ground condition. The magnitude values are on a logarithmic scale. Hence, an increase of one unit represents increase of the ground shaking by ten times and energy release thirty times. Earthquakes release a lot of energy. To have an idea, one can say that Hiroshima type nuclear explosion would be an equivalent of a magnitude of 4.5. The Latur earthquake of 1993 of magnitude 6.1 involved an energy of a few hundred atomic bombs. Fortunately, most of the earth- quake energy is consumed in breaking of rocks and in producing heat. Only a limited amount is converted into seismic waves which causes damage.

Seismic Zoning of India

Himalaya is formed by young mountains which are as young as 20 million years of age and is seismically very active where four great earthquakes of magnitude 8 or more have occurred viz. Assam 1897 and 1950, Kangra 1905 and Bihar-Nepal 1934. There have been about forty major earthquakes too. Great earthquakes are devastating. Such earthquakes in Himalaya can destroy the taller building up to distances of about 350 Km, say in the city of Delhi, Lucknow, Patna etc. In most of the Peninsular India, the earthquakes can be at the most moderate as the rocks are old and stable (\several hundred million years to three and a half billion years)\ with weak zones of smaller dimension. However, even moderate earthquakes in the Peninsular India cause lot of damage due to large population and non-engineered structures.

Earthquake Prediction

On the basis of the study of distribution of earthquakes, it has been possible to have a good idea of long-term assessment of earthquake hazard. The buildings can be designed to take care of the damage due to expected earthquakes. Short term prediction is' not possible, as no reliable methods or instruments have been found so far. To date there is only open successful prediction i.e., for the Hatching 1975 earthquake in China. The whole town was evacuated by which lakhs of people were saved. But in the very next year in 1976 the Tangshan earthquake in China could not be predicted in which 2,50,000 people died. For earthquake prediction a number of geophysical and geochemical parameters are continuously observed and some of which show anomalous precursory changes. These include the following:

1. Land deformation, tilt and strain are the most important changes which are observed well before the earthquakes.
2. Number of small shocks increase before a main earthquake but decrease just prior to the main earthquake.
3. Velocity of longitudinal waves in the earthquake zone decreases and then becomes normal prior to an earthquake.
4. Electrical resistivity of the ground decreases.
5. Radon, a radioactive gas, is found to increase prior to earthquakes.

Many other precursors are also observed like changes in groundwater, geomagnetic field and animal behaviour. As the earthquakes happen at depths of several kilometers, many times the above changes are not possible to be measured. Many times, these changes are unrelated to earthquakes giving false alarm. At other times earthquake do not occur after these changes. As a great earthquake is expected in Himalaya any time now and a few moderate but damaging earthquakes in the Indian peninsula every decade, a well laid -out hazard mitigation plan is urgently called for.

Earthquake Disaster Mitigation Program

Earthquake disaster mitigation program consists of three components which are Preparedness, Rescue and Rehabilitation as described below. Earthquake mitigation program and preventive action program in India are outlined. Preparation of contingency plan and creation of administrative structure for effective and coordinated action during the emergency. This would include arrangements of digging & clearing equipment bulldozers, cranes, chain saw, drills & crowbars etc. for rescue of people trapped in collapsed houses, materials for shelters, emergency

bridges, fire wood, medical facilities including mobile hospitals & medicines, immunization, water tankers & water purifiers.

Earthquake Disaster Mitigation Program in India:

Ministry of Agriculture, Government of India is responsible for providing help at the time of emergency. There is no centralized policy or program of the Government of India regarding earthquake disaster mitigation in the sense of the total program. But, the government acts as the biggest insurer to help the population in distress due to any natural calamity through 'relief and rehabilitation programs and loans and subsides. During emergency a number of voluntary agencies came forward in a big way. The District Collector has to coordinate their efforts. Contingency plans are normally available with the District Admin & Civil Defence authorities for use after every disaster. This should be checked. A number of government departments & institutions are engaged in activities which would cover a number of actions needed in the total mitigation program as mentioned below:

Preventive Action Program

Earthquake catalogue is available for the past 200 years. The Geological Survey of India studies earthquake damages. The Roorkee University studies Earthquake Engineering aspects. The India Meteorological Agency operates seismic instruments. The National Geophysical Research Institute studies the cause of earthquake. Earthquakes are natural phenomena that have captivated human curiosity and instilled awe and fear throughout history. Their sudden occurrence and devastating impact make them a subject of significant scientific interest and societal concern. This detailed description explores the fundamental aspects of earthquakes, including their causes, characteristics, impacts, and the strategies employed to mitigate their destructive effects [7]–[10].

Causes and Characteristics

Earthquakes are primarily caused by the release of accumulated stress along tectonic plate boundaries. The Earth's crust is divided into several large plates that constantly move and interact. When the accumulated stress exceeds the strength of the rocks, it is released in the form of seismic waves, causing the ground to shake. These waves propagate through the Earth, creating the seismic events we perceive as earthquakes. Earthquakes vary in magnitude, ranging from imperceptible tremors to catastrophic events with profound societal impact.

Understanding Seismic Waves

Seismic waves generated during earthquakes are classified into three main types: primary (P) waves, secondary (S) waves, and surface waves. P-waves are the fastest and travel through solid and liquid mediums, while S-waves are slower and only propagate through solids. Surface waves, which are responsible for the most destructive effects, travel along the Earth's surface and cause the ground to move vertically and horizontally.

Impacts of Earthquakes

The impact of earthquakes can be devastating, resulting in loss of life, damage to infrastructure, economic losses, and long-term social and psychological consequences. Ground shaking, surface rupture, and the associated secondary hazards, such as landslides, tsunamis, and aftershocks, contribute to the destruction and disruption caused by earthquakes. Understanding the

vulnerabilities of structures and infrastructure is crucial for mitigating the impacts and enhancing resilience in earthquake-prone areas.

Mitigation Strategies

Mitigating the effects of earthquakes involves a multidisciplinary approach that encompasses scientific research, engineering advancements, and effective preparedness and response measures. Earthquake-resistant building design, early warning systems, public education, and land-use planning are vital components of mitigation strategies. Seismic monitoring networks and the collection of seismic data aid in understanding earthquake patterns, identifying high-risk areas, and informing hazard assessments.

Ongoing Research and Advancements

The study of earthquakes is an evolving field, with ongoing research aimed at deepening our understanding of seismic processes and improving hazard assessments. Scientists employ techniques such as seismology, geodesy, and geophysics to investigate the mechanics of earthquakes, fault behavior, and the associated risks. Advancements in technology, including remote sensing, satellite imagery, and computational modeling, contribute to more accurate predictions and simulations, enabling better preparedness and response strategies. A fundamental study on earthquakes provides valuable insights into the complex nature of these natural phenomena, encompassing their scientific foundations, impacts, and mitigation strategies. By understanding the underlying science of earthquakes, including their causes and characteristics, scientists and researchers can enhance their ability to predict and assess seismic events, contributing to improved preparedness and response measures.

This includes implementing earthquake-resistant building designs, establishing early warning systems, educating the public about earthquake preparedness, and incorporating land-use planning measures that consider seismic hazards. Mitigation strategies play a critical role in reducing the vulnerability of communities in earthquake-prone areas. By adopting and implementing these strategies, such as improved building codes, infrastructure resilience measures, and comprehensive emergency response plans, the adverse effects of earthquakes can be minimized, and the recovery process can be expedited. It is essential to acknowledge the ongoing research and technological advancements in earthquake studies. Continual scientific exploration, utilizing advanced tools and techniques, contributes to the refinement of predictive models, hazard assessments, and communication systems. This knowledge empowers communities, decision-makers, and emergency responders to make informed decisions and take effective actions in mitigating the impacts of earthquakes.

CONCLUSION

A fundamental study on earthquakes provides insights into the causes, characteristics, impacts, and mitigation strategies associated with these natural phenomena. By understanding the science behind earthquakes and their potential consequences, scientists, engineers, policymakers, and communities can work together to develop effective strategies to mitigate their destructive effects. Ongoing research and advancements in earthquake science are crucial for enhancing our ability to predict, prepare for, and respond to future seismic events, ultimately contributing to the safety and resilience of vulnerable regions. The comprehensive understanding of the impacts of earthquakes is crucial for minimizing loss of life, infrastructure damage, and societal disruption. By

recognizing the wide-ranging consequences, policymakers and stakeholders can prioritize effective mitigation strategies.

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CHAPTER 17

HEALTH PROBLEMS CAUSED BY DISASTERS: UNDERSTANDING THE IMPACTS AND ADDRESSING THE CHALLENGES

Dr. Chetana Asbe, Associate Professor,
ISME - School of Management & Entrepreneurship, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: chetana.asbe@atlasuniversity.edu.in

ABSTRACT:

Disasters have profound impacts on human health, often leading to a wide range of health problems that pose significant challenges to affected populations. This study provides an overview of the health problems caused by disasters, exploring their immediate and long-term effects, as well as strategies for mitigating these impacts. Disasters, whether natural or man-made, can result in a multitude of health problems. Immediate health concerns include injuries, trauma, and communicable diseases due to compromised water and sanitation systems. Disruption of healthcare services and infrastructure further exacerbate the health challenges faced by affected communities. Long-term health problems associated with disasters can arise from environmental contamination, psychological distress, and the breakdown of social and healthcare systems. Increased risks of respiratory problems, mental health disorders, chronic diseases, and post-traumatic stress disorder (PTSD) are commonly observed among disaster-affected populations.

KEYWORDS:

Disorder, Disasters, Health Problems, Mental Health, Psychological Distress.

INTRODUCTION

Natural or man-made calamities all leave a trail of death and sickness in their wake. While they unquestionably have an effect on the community's collective body and mind over time, if the immediate wounds and shock are not treated, they may result in psychological trauma and partial or total impairment. Additionally, if difficulties with food, nutrition, water, and sanitation are neglected during the first emergency period, the afflicted community's susceptibility may be increased and their effects may include epidemics and hunger. In India, Emergency Medical Relief, a part of the top apparatus of the Central Government, has a very low visibility. Leading NGOs, even those focused on health, still haven't made disaster-related health needs a priority. In the vital first few weeks, they mostly resort to providing band-aid medical assistance since by then it is too late to do anything except correct errors [1], [2].

During Studies

The fact that disaster medicine is not a topic that is stressed in medical/social work curriculum, especially in states with a lengthy history of catastrophes, only serves to exacerbate everything else. In reality, medical schools even close to disaster areas sometimes send their physicians to give charitable short-term 'emergency' medical treatment as opposed to prepared catastrophe mitigation. Although it hasn't yet developed into a field of study, disaster medicine does not yet require medical schools to train students in disaster medicine. The same mostly holds true for institutions that teach and educate paramedics, health care professionals, and social workers. One

strategy to acquaint medical students with the particular requirements in disaster scenarios may be to place them in rural regions during their internship term, particularly in disaster-prone areas [3]–[5]. The Indian Medical Association (IMA), the Indian Association of Psychiatrists, and the Indian Association of Physiotherapists are professional health and medical organizations that have not yet included disaster-induced health problems in their organizational and operational agendas. This is one of the factors contributing to the understudied and underreported nature of disaster-related disability in India. The 'Disability Bill' glaringly leaves out rights for those with disabilities brought on by natural disasters. Disability experts, let alone anybody else, have not yet spoken out on this matter.

Disasters' Effects on Health

The effects on health differ depending on the sort of catastrophe. The short- and long-term health effects of floods include vector-borne infections and watery illnesses, while recurring cycles or eruptions of violence may really be an effect of ethnic disputes, according to mental health specialists. Drowning and injury are the most direct effects of a cyclone on public health. Waterborne illnesses, dysentery, diarrhea, hepatitis, and poliomyelitis, as well as respiratory infections, snakebites, skin infections, and conjunctivitis, are examples of indirect effects. It is a well-known fact that diarrheal illnesses are a leading factor in emergency mortality and morbidity, and studies have indicated that they account for 25% to 50% of all fatalities.

Care both Preventive and Curative

In an ideal world, emergency medical intervention would follow the fundamentals of basic healthcare. Disaster medicine is not given enough weight in medical schools and state-run health care systems today.

Aliments and Nutrition

Food is often plentiful during the first days after a tragedy. However, donations from charities and philanthropists in India and abroad are often dropped off in population centers that are closer to the highways and connection roads or that are fortunately featured in the media. The more rural towns suffer when there is no traffic enforcement. This extremely human, almost instinctual act of giving food to those in need has not yet been subject to a serious, systematic effort to simplify or even justify it. For example, after the 1993 Latur earthquake, cartons of imported milk cans were left unused for months simply because their labels included instructions written in a language that was incomprehensible to both locals and humanitarian personnel. Consequently, ironically, the unending stream of edibles is not always based on an accurate assessment of the food and nutritional needs of the most vulnerable groups, such as children and women, adequate nutrition can prevent a situation that may warrant supplementary and therapeutic feeding [6], [7].

To avoid this situation of excessive waste, suppliers should be made aware of the current needs and food should be distributed fairly. Local NGOs and community-based groups will need to take the initiative in this regard. Following previous catastrophes, an examination of food assistance revealed that the majority of the supplies were prepared meals and dry rations. However, the aid package falls short of the minimal calorific need set by international aid organizations. Uncomfortably, in food distribution efforts, the unique nutritional requirements of pregnant women, lactating mothers, and children are often disregarded. In Kokhrajhar, Assam, evaluations of supplemental feeding programs for ethnically conflicted refugees note that current relief

manuals do not make special provisions for foods for children and infants, which is likely a major factor in the disproportionately high infant and child mortality rates among the displaced.

Sanitation and Water

The biggest error when it comes to cyclones is probably ignoring public and environmental health. Improvements in water quality alone have only been proven to be able to lower infantile diarrhea by 15%. The safest excreta disposal (36%) and hand washing, food protection, and advances in home hygiene (33%) were responsible for the largest reductions in the other factors. Water-related illnesses including diarrhea, dysentery, typhoid, and scabies may spread easily because of the stress on water supplies, poor sanitation, and improper waste disposal. It is essential to have an adequate supply of high-quality water.

A Medical Aid

The disposal of old and past-expiration-date medications was observed by health professionals after the Marathwada earthquake. Aphrodisiacs were one of the extremely irrational pharmaceuticals that often found their way into the emergency drug kit, according to evaluations by certain NGO-run emergency operations. In catastrophe scenarios, the agencies must make a firm and unambiguous decision to adhere to international, uniform, and consensus medical norms, such as employing only WHO-approved critical pharmaceuticals. It is time to develop a health code for emergencies for the Indian context that would combine logical and tried-and-true methods from conventional medical systems in the same vein as rationalizing medical assistance.

Psychological and Societal Effects

Disasters always trigger uncontrolled psychological responses because they cut right to the core of human emotions. The WHO has examined the scope and severity of the psychological effects of catastrophes as well as potential management strategies. According to Professor R.Srinivasa Murthy, a psychiatrist at NIMHANS, psychosocial coping relies on the victims' capacity for psychological adjustment, the community institutions' ability to respond to crises, and the availability of both private and institutional support. On a personal level, post-disaster psychosocial stress manifests as worry, neuroses, insomnia, and fatigue. Community-level psychosocial stress shows up as high rates of alcoholism, divorce, and suicide among adults and school dropouts among children.

Institutional Omissions

The Emergency Medical Relief division of the Central Government still doesn't have a direct role in catastrophe preparation. Little has changed since the Bombay High Court criticized the Maharashtra state health department for failing to provide the afflicted people access to basic healthcare, water, and sanitation in the aftermath of the 1993 Marth-wada earthquake. On the other hand, the health sector has long optimized its vital role in emergency catastrophe operations on a global scale. A lifeline for those impacted by disasters has traditionally been established and maintained by specialized organizations as the International Red Cross and Red Crescent Movements, the Medical Emergency Relief International Network, and Medicines Sans Frontiers. Public health may be significantly impacted by disasters, which can result in a variety of health issues that affect both people and communities. Effective disaster response and recovery depend on having a solid understanding of the effects catastrophes have on people's health. Here is a

discussion of the health issues brought on by catastrophes, along with some related data: Immediate Health Problems:

1. **Injuries and Trauma:** Due to flying debris, fallen buildings, or mishaps during evacuations, disasters often cause physical injuries such fractures, cuts, and bruises.
2. **Communicable Diseases:** Maladies including diarrhea, respiratory infections, and vector-borne illnesses may spread quickly due to faulty water and sanitation systems, congested living situations, and restricted access to medical services.
3. **Mental Health Problems:** Both survivors and first responders may have anxiety, depression, post-traumatic stress disorder (PTSD), and other mental health issues as a result of disasters' psychological effects.

Chronic Health Issues

1. **Respiratory Problems:** Dust, smoke, and pollution exposure during and after catastrophes may aggravate respiratory conditions including asthma, bronchitis, and other chronic respiratory illnesses.
2. **Chronic Disorders:** Due to restricted access to medicines, interrupted healthcare services, and stress, disasters may aggravate pre-existing chronic health disorders including diabetes, cardiovascular illnesses, and hypertension.
3. **Mental Health Disorders:** Trauma, loss, and dislocation may have long-lasting impacts on the brain that can lead to mental health problems including depression, anxiety, and suicidal thoughts.
4. **Environmental Health Hazards:** Natural disasters may contaminate the environment, posing long-term health hazards such exposure to dangerous substances, pollutants, or poisonous chemicals.
5. **Disruption of Healthcare Services:** Damage to healthcare infrastructure and facilities may limit access to regular treatments, immunizations, and medical care, which may have an impact on the general population's health.

Facts: The bulk (90-95%) of health issues after a catastrophe are connected to non-communicable illnesses, mental health disorders, and environmental health concerns. Only 5-10% are directly related to physical injuries, according to the World Health Organization (WHO). Children, women, and the elderly are more susceptible to health issues during a catastrophe because of their increased exposure to filthy surroundings, poor nutrition, and restricted access to treatment. Following catastrophes, the incidence of mental health issues considerably rises. According to studies, those who have experienced a catastrophe have a four times greater chance of acquiring PTSD than people who have not. Disasters may have long-lasting consequences on a community's mental well-being, resulting in higher incidence of drug usage, domestic abuse, and suicide. To reduce the effects on health, it is essential to develop resilient healthcare systems that can resist and react to emergencies. Pre-disaster planning, securing sufficient medical resources, and including mental health assistance into disaster response plans are all examples of this [8]–[10].

Disasters may have a broad range of health effects, including short-term illnesses, chronic conditions, infectious infections, and mental health issues. Comprehensive disaster response plans, accessibility to healthcare services, mental health assistance, and an emphasis on constructing resilient healthcare systems are all necessary to address the health requirements of impacted communities. Societies can better safeguard the health of populations in times of crisis by comprehending and treating the health issues brought on by catastrophes. Disasters, both natural

and human-induced, have significant implications for public health. The aftermath of a disaster often brings about a range of health problems that pose considerable challenges to affected communities and healthcare systems. This detailed description provides an overview of the health problems caused by disasters, explores their impacts on individuals and communities, and highlights the strategies and interventions employed to address these challenges.

Immediate Health Problems

Immediately following a disaster, various health problems can arise. Physical injuries, including fractures, wounds, and burns, are common due to the impact of collapsing structures, flying debris, and fire. Additionally, respiratory issues can occur due to exposure to dust, smoke, or toxic gases. Waterborne diseases, such as diarrhea and cholera, can spread rapidly in the aftermath of flooding, as access to clean water and sanitation facilities may be compromised. Psychological distress, including post-traumatic stress disorder (PTSD), anxiety, and depression, is also prevalent among survivors.

Long-Term Health Problems

The impacts of disasters on health extend beyond the immediate aftermath. Displaced populations, inadequate living conditions, and disrupted healthcare systems can lead to a range of long-term health problems. These include respiratory disorders due to exposure to environmental pollutants or mold, mental health issues, chronic illnesses exacerbated by limited access to healthcare, and increased rates of infectious diseases in overcrowded shelters or temporary settlements.

Vulnerable Populations

Certain populations are particularly susceptible to health problems in the wake of disasters. Children, the elderly, pregnant women, and individuals with pre-existing medical conditions are at higher risk. Limited access to healthcare, medications, and necessary medical supplies can significantly impact these vulnerable groups. Additionally, marginalized communities, including those living in poverty or in remote areas, may face greater challenges in receiving timely and adequate healthcare services.

Public Health Interventions

Addressing the health problems caused by disasters requires a multi-faceted and coordinated approach. Public health interventions focus on prevention, preparedness, response, and recovery. Preparedness measures involve developing emergency response plans, training healthcare personnel, and stockpiling essential medical supplies. Response efforts include establishing medical facilities, providing immediate medical assistance, and ensuring access to safe water and sanitation. Recovery phase interventions aim to restore healthcare services, support mental health and psychosocial well-being, and strengthen long-term health systems resilience.

Challenges and Considerations

Managing health problems in the aftermath of disasters presents significant challenges. The surge in demand for healthcare services may overwhelm local healthcare infrastructure, leading to resource shortages and limited capacity. Coordination between different response agencies and sectors, such as healthcare, emergency management, and public safety, is crucial to ensure an integrated and effective response. Cultural and language barriers, population mobility, and limited access to remote or isolated areas can further complicate the delivery of healthcare services.

Disasters have far-reaching impacts on public health, leading to immediate and long-term health problems among affected populations. Understanding the range of health issues arising from disasters is essential for designing effective interventions and strategies. By prioritizing preparedness, ensuring a prompt and coordinated response, and addressing the unique needs of vulnerable populations, communities and healthcare systems can better mitigate the health impacts of disasters and promote resilience. The ongoing commitment to research, collaboration, and capacity-building in disaster healthcare can further enhance our ability to address the health challenges that arise in the aftermath of disasters and safeguard the well-being of affected populations.

CONCLUSION

Public health concerns must be given top priority in catastrophe management and response. Addressing acute health issues requires timely and well-coordinated emergency medical treatment, illness monitoring, and provision of necessary medications and supplies. Long-term rehabilitation initiatives should also concentrate on rebuilding the healthcare system, offering assistance with mental health issues, and encouraging community resilience. Disaster-related health effects may be significantly reduced by the use of mitigation methods. These include community education and preparation initiatives, early warning systems, more resilient infrastructure, and climate change adaptation strategies. To reduce health hazards and encourage recovery, it is crucial to include health concerns into planning for disaster risk reduction and response. In conclusion, the impacted communities face substantial difficulties as a result of the health issues brought on by catastrophes. A comprehensive strategy that includes emergency medical treatment, illness prevention and surveillance, mental health support, and long-term rehabilitation programs is needed to address both short-term and long-term health challenges. Societies may successfully reduce the negative effects of catastrophes on their citizens' health and build their capacity to withstand future calamities by including health concerns into disaster management.

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CHAPTER 18

REHABILITATION OF VICTIMS: ENSURING SUPPORT AND RECOVERY FOR THOSE AFFECTED BY DISASTERS

Prof. Ritika Karnani, Assistant Professor,
ISDI - School of Design & Innovation, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: ritika.karnani@atlasuniversity.edu.in

ABSTRACT:

The identification and rehabilitation of victims play a crucial role in addressing the physical, psychological, and social consequences of various forms of victimization. This study provides an overview of the process of identifying and rehabilitating victims, highlighting the importance of victim-centered approaches and multidisciplinary collaboration. Identification of victims involves recognizing individuals who have experienced various forms of victimization, such as human trafficking, domestic violence, sexual assault, child abuse, or terrorism. Effective identification methods include comprehensive screening, victim-centered interviews, and collaboration between law enforcement, social services, healthcare professionals, and community organizations. Once identified, the rehabilitation of victims aims to restore their physical and psychological well-being, empower them, and support their recovery. Rehabilitation efforts encompass a range of services, including medical care, counseling, legal aid, shelter, vocational training, and social support. Tailoring rehabilitation programs to individual needs and cultural sensitivities is crucial for successful outcomes.

KEYWORDS:

Natural Disasters**,** Management, Psychological, Resources, Rehabilitation Victims.

INTRODUCTION

Natural Disasters are like any other Natural Resources. It is only in a negative form. It can strike Natural Resource include natural disasters as well. Only the negative version exists. It may occur unexpectedly and without notice in any setting. All aspects of social, economic, and communal life are momentarily disrupted. There cannot be a calamity if there are no victims the different types of natural disaster. The more victims, the more severe it will be. In truth, the calamity will continue to plague humanity for as long as humans exist on this planet. In fact, it will worsen owing to population growth and inadequate reaction mechanisms or a lack of coordination between the many governmental organizations [1]–[3].

Not all Crises End in Catastrophe

A situation that is more severe than a society can handle is referred to be a catastrophe. Some communities are able to create social and economic structures on their own, independent of any outside support. In other words, they don't have any experience or catastrophes. The most blatant and concealed physical vulnerability is poverty. Poor families sometimes reside in a risky or unsafe place. They have very limited means for avoiding or recovering from such on an economic level, and they live in a vulnerable situation. They occupy marginal soil that is not fertile. Their children and other family members are undernourished and live in subpar houses. Due to their inadequate education and malnutrition, the youngsters have little job possibilities. In any dire crisis event,

women are often more at risk than males [4]–[6]. Due to societal structure, they have scant resources, a low level of education, and limited mobility. In order to conserve or provide more food for their children during times of scarcity, mothers often have a tendency to reduce their own food intake, placing themselves at a very high risk of malnutrition. A society or class that is homogenous in terms of caste, class, or religious brotherhood has a higher chance of surviving a calamity than one that is broken and divided along the lines of caste, color, class, or religion, for example.

Different Risks

- **i.** Human injury.
- **ii.** Effect on health.
- **iii.** Environmental impact.
- **iv.** Damages to property.
- **v.** Losses in business industries.
- **vi.** Loss of reputation.
- **vii.** Charges filed (Union Carbide case).
- **viii.** Employment loss.

Disaster Management

- **i.** Natural disasters may happen quickly, unforeseen, and with or without notice. Everything related to social, economic, and communal life is momentarily disrupted by it.
- **ii.** Many organizations, including the Fire Department, Police, Health, and Transportation, have a role in disaster relief and recovery.
- **iii.** The effectiveness of the response is based on how successfully local and central governments' emergency services have coordinated, improved, and practiced their planning and emergency procedures.

Management Concerns

1. **Risk assessment** - to understand the likely range of occurrences on a site-specific basis for operational response planning. To know the precise place and target, see Vulnerability & Risk.
2. P**revention**: Taking precautions.
3. **Community Awareness:** Education and Attitudes.
4. **Warning:** must be precise and very effective.
5. **Transportation and logistics** - Total population evacuation.
6. To provide suitable relief and rehabilitative methods.

The administration will face its first significant test of its reaction mechanism after the early effects of the crisis have passed. In addition to repairing the current life line, the greatest burden will be placed on the relief and rescue operations. They include:

- **i.** Immediate restoration of the current wireless and surface communication networks.
- **ii.** Supplies and medical assistance for the victims are provided.
- **iii.** Providing clean water for drinking in the impacted regions.
- **iv.** Establishment of a community kitchen and the distribution of food supplies in the impacted neighborhoods.
- **v.** Electricity supply is restored.

In other words, every effort should be taken to get things back to normal as quickly as possible. A search and rescue team must be organized in advance and sent out right away to find the affected communities' homes, provide the required aid to those who have been hurt, and remove the remains. Teams are often made up of four to five officials and a support staff member from the departments of revenue, police, medicine, and engineering. This composition will depend on the immediate availability of sufficient employees in the affected regions. In most cases, police and revenue personnel work together to identify the dead and wounded, while police and local volunteers or villages assist with mass burials and cremations [7], [8]. The veterinary team takes care of animal burial and evacuation, sometimes with help from volunteers (Non-Governmental Organizations, etc.). Once contact is made with the impacted regions, one must be cautious enough to realize that the majority of the victims will be under extreme stress and will now be confused and deaf as a result of the death of loved ones. Unless the other person is willing to offer or disclose extra information, one should refrain from asking too many personal inquiries. The majority of the time, one might see young ladies becoming widows or vice versa, sobbing orphaned children, and several village elders in tears.

DISCUSSION

Comfort & Recovery

Our Relief and Rehabilitation Program urgently needs to be reviewed and refocused as we enter the new millennium. First and foremost, we must accept that A stitch in time, saves nine - and prevention pays. However, it would pay only when it is properly invested on community. The cost of Disaster Relief in our country is going up in geometrical proportion. In plain and simple terms, it means that the developmental funds are being diverted to DRR. Secondly, cost benefit analysis or social audit/accounting etc., are not being conducted independently to assess the effectiveness of such relief. Thirdly, a detailed-on site enquiry should be conducted. This is because relief is given out as a charity to affected families and not taken as an opportunity for permanent investment for preventing future recurrence of disaster.

Rehabilitation

One should always use common sense while working on the victims' long-term recovery. The State is solely responsible for creating a blueprint for the affected families' long-term rehabilitation, which might be accomplished in one of two ways: -

i. Structurally.
ii. Non-structurally.

Disaster Victims' Treatment and Care

The care and treatment of persons engaged in a catastrophe is at the core of the response; this holds true for everyone participating in the emergency response who could be impacted by their experience, as well as for those who have been hurt or traumatized, their family members, and friends. It is important to consider the need to search the surrounding area because it is possible that the survivors or casualties may not always be found close to the disaster site. For example, a member may suffer psychological injuries and wander off. If this is the case, the task should typically be coordinated by the police. Where the task may be labor-intensive and cover a wide area, assistance should be sought from local authorities across the emergency services.

Injured Survivors' Care

The utmost care should be taken to ensure that the person is not put under additional psychological or mental stress since those who have survived a disaster unharmed or with only minor injuries may nonetheless be traumatized and suffering from shock, intense anxiety, and grief. A balance has to be struck between the need to gather evidence from survivors and the reluctance of some to remain at the scene of their distress, for example, prioritizing information might help, so that only names and addresses are taken from those anxious to leave, with further details being obtained later. Survivors are usually frantic for information about the incident, number and location of other survivors, information about their own friends, colleagues and relatives and what will happen to them next and when.

Their initial needs are likely to include support in their distress, food, drink, first aid to treat minor injuries and perhaps spare clothing and changing, washing and toilet facilities. They may also need immediate social and psychological support, including help in finding temporary accommodation, in contacting family and friends, with transport back home and financial advice and assistance. It is possible that some apparently uninjured survivors will later display adverse symptoms. For this reason, medical and social services staff should be present at the survivor reception center and if necessary, at rest centres. The responsibility for Organising, staffing and providing logistical support at survival reception centres usually rests with the local authority. Social services will need to coordinate both the professional and voluntary welfare response, while the police maintain order and security.

The Harmed

Prior to ensuring that casualties are evacuated in accordance with priorities for hospital treatment, medical and paramedical personnel will perform triage and any necessary stabilization measures at a casualty clearing station (CCS) or local Public Health Centre Dispensary for injured survivors. Responsibility for ensuring the proper establishment of medical communications on site, the transportation of medical teams, the distribution and replenishment of medical supplies

Bureau of Police Casualties

The role of the police casualty bureau in the event of a disaster is to provide a central point of contact for anyone looking for or providing information about people who may have been involved, as well as to gather data and compile all records. As part of this process, the police will send documentation teams to each receiving hospital, the mortuary, the survivor reception center, as well as to next of kin.

Family and Friends

Experience of disasters has shown that if they believe their friends and relatives may have been involved, many people will travel to the scene or to meeting points such as travel terminals. If necessary a reception center for friends and relatives will be established by the police usually in consultation with the local authority and commercial, industrial or other organisations concerned) and staffed by the police, local authority and suitably prepared voluntary organisations, including representatives of churches and other faith groups. The fullest possible information should be given to enquirers seeking news of those involved in a disaster whilst taking care to preserve the privacy of the individual. Experience has shown that this is best done in a controlled way with general enquiries being referred to a specific source. This helps to ensure consistent and non-

contradictory information is given out. Friends and relatives who may be feeling intense anxiety shock or grief need to be treated with sympathy and understanding, and experience has shown that the most effective way of caring for next of kin is using one trained police officer together with one trained social worker for each family. Access to the reception center should be controlled to prevent those inside being disturbed by the uninvited media representatives or onlookers [9], [10].

Psychological and Social Support

Social and psychological support services should be set up in the immediate aftermath of the disaster and will undoubtedly be needed in the longer term. Much will depend on the nature and scale of the disaster and local circumstances. Some of those who are suffering from the effects of the disaster may include members of the emergency services, volunteers, as well as others called to respond.

Children

The emotional effects on children are not always immediately obvious to parents or school staff; sometimes, children find it difficult to contain their distress to adults, often because they know it will upset them; in some children, the distress can last for months; and all those who work with children need to be aware of the range of symptoms that children may show after a major disaster. Disasters, whether natural or human-induced, result in the displacement, injury, and psychological trauma of countless individuals. The identification and rehabilitation of victims are critical components of disaster response and recovery efforts. This detailed description explores the processes involved in identifying and rehabilitating victims, including the challenges faced, the strategies employed, and the importance of providing comprehensive support to aid in their recovery.

Identification of Victims

In the aftermath of a disaster, one of the primary challenges is accurately identifying and locating victims. This process involves search and rescue operations to locate individuals who may be trapped or injured. Additionally, efforts are made to reunite separated family members and provide a system for reporting missing persons. Technology, such as digital databases, facial recognition, and DNA analysis, may be employed to facilitate the identification process, particularly in large-scale disasters where traditional methods may be overwhelmed.

Physical Rehabilitation

Victims of disasters often sustain physical injuries that require immediate medical attention and long-term rehabilitation. Medical teams, including doctors, nurses, and rehabilitation specialists, play a crucial role in assessing and treating these injuries. Rehabilitation may involve physical therapy, occupational therapy, and psychological support to aid in the recovery process. Prosthetics, assistive devices, and rehabilitation aids are provided to restore mobility and functionality to affected individuals. The goal is to enhance their quality of life and help them regain independence.

Psychological Rehabilitation

Disasters can have severe psychological impacts on survivors, including post-traumatic stress disorder (PTSD), anxiety, depression, and grief. Mental health professionals, counselors, and social workers play a vital role in providing psychological support and rehabilitation services.

Counseling sessions, group therapy, and specialized interventions are employed to help individuals process their experiences, cope with trauma, and rebuild their emotional well-being. Community support systems are also crucial in fostering resilience and facilitating the healing process.

Social Rehabilitation

The social rehabilitation of victims aims to reintegrate them into their communities and restore their social connections. This involves providing support in terms of housing, livelihoods, education, and access to basic services. Efforts are made to rebuild communities, including the restoration of infrastructure, schools, and public spaces. Additionally, community-based initiatives and support networks are established to foster a sense of belonging and empowerment among survivors.

Challenges and Considerations

Identifying and rehabilitating victims in the aftermath of disasters pose several challenges. The sheer scale of the affected population, limited resources, and logistical constraints may hinder efficient identification processes. The complex nature of injuries, including physical and psychological trauma, requires a multidisciplinary approach to ensure comprehensive rehabilitation. Additionally, cultural sensitivities, language barriers, and diverse social backgrounds necessitate tailored interventions and inclusive approaches to meet the unique needs of different individuals and communities.

Importance of Comprehensive Support

Comprehensive support and rehabilitation services are crucial for the long-term recovery of disaster victims. By addressing physical, psychological, and social needs, individuals can regain a sense of normalcy, rebuild their lives, and restore their overall well-being. Providing ongoing support, monitoring progress, and adapting interventions to the evolving needs of survivors are essential for ensuring their successful rehabilitation.

CONCLUSION

A victim-centered approach is fundamental to the identification and rehabilitation process, ensuring that victims' rights, safety, and dignity are prioritized. It involves providing trauma-informed care, respecting autonomy, involving victims in decision-making, and addressing their unique needs and vulnerabilities. Collaboration among various stakeholders is essential for comprehensive victim identification and rehabilitation. This includes coordination between law enforcement agencies, social services, healthcare providers, legal professionals, and community-based organizations. Multi-agency protocols, information sharing, and interprofessional training enhance the effectiveness of these collaborative efforts. Key challenges in the identification and rehabilitation of victims include underreporting, stigma, limited resources, and the complex nature of victimization. Overcoming these challenges requires public awareness campaigns, training for professionals, adequate funding, and policy reforms to strengthen victim support systems. In conclusion, the identification and rehabilitation of victims are critical in addressing the physical, psychological, and social impacts of victimization. By implementing victim-centered approaches, promoting multidisciplinary collaboration, and addressing the unique needs of victims, societies can support their recovery, empower them, and work towards preventing further victimization. The identification and rehabilitation of victims are vital components of disaster response and recovery efforts. By employing systematic approaches to identify and locate victims, providing

physical and psychological rehabilitation services, and supporting social integration, communities can facilitate the recovery and reintegration of those affected by disasters. Ensuring comprehensive support, addressing unique challenges, and fostering resilience are key factors in assisting victims on their path to recovery and rebuilding their lives in the aftermath of a disaster.

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CHAPTER 19

MITIGATING NATURAL DISASTERS: ENHANCING EARLY WARNING SYSTEMS

Anupamaa Bijlani, Assistant Professor,
ISME - School of Management & Entrepreneurship, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: anupamaa.bijlani@atlasuniversity.edu.in

ABSTRACT:

The India Meteorological Department (IMD) plays a pivotal role in mitigating the impacts of natural disasters in India. This study provides an overview of the IMD's role in forecasting and monitoring weather conditions, issuing timely warnings, and supporting disaster preparedness and response efforts. As the national meteorological agency of India, the IMD employs advanced meteorological technologies, including satellite imagery, weather radars, and weather prediction models, to monitor and forecast various weather phenomena. This enables the timely identification of potential natural disasters such as cyclones, floods, droughts, and heatwaves. The IMD's primary responsibility is to issue accurate and timely weather advisories, alerts, and warnings to government agencies, disaster management authorities, and the general public. These warnings provide critical information that helps in the implementation of evacuation plans, preparedness measures, and effective response actions.

KEYWORDS:

Cyclones, Mitigating, Meteorological Department, Natural Disasters, Warning Systems.

INTRODUCTION

India is susceptible to several natural disasters because of its location and climate, but the most significant ones are cyclones, floods, earthquakes, and droughts, which significantly harm both people and property here. With rainfall varying from 150 mm in the northwest/west of the country to over 10,000 mm in the north-eastern area, India features distinct agro-climatic zones. Two-thirds of the nation is classified as dry or semi-arid and is vulnerable to periodic droughts. Cyclones typically strike the broad Indian Coastal Belt between the months of April and May and October and November. The region is susceptible to seismic disturbances in around 56% of the area. Particularly unstable and prone to powerful earthquakes are the Himalayan area and North-Eastern India. Periodic flooding affects a geographical area of more than 40 million hectares in the nation. The Himalayan area and the hilly part of the country are both vulnerable to avalanches [1]–[3]. Natural catastrophes often occur, which seriously impairs socioeconomic progress. Even though it is impossible to stop natural disasters from happening, mankind's suffering can be greatly reduced by developing effective warning systems, raising public awareness of disasters and their likely effects, and taking the proper precautions in advance to lessen the effects.

The United National Tropical Cyclones Association is responsible for one of the meteorological phenomena that has the worst effects on those living near the shore is tropical cyclones. The most damaging components of a tropical cyclone are very strong winds that often approach 200 kmph, heavy rainfall of the order of 50 to 100 cm in a day, and tall storm surges that sometimes reach heights of more than 10 meters. Strong winds cause damage to infrastructure, homes,

communication systems, etc., which results in casualties and damage to property [4]–[6]. Flash floods and flooding of coastal regions are brought on by heavy and sustained rain. The storm surge, which inundates long swaths of the shoreline and sweeps away everything in its path, is the most devastating component of a cyclone. Storm surges alone are responsible for almost 90% of all cyclone-related property and life losses.

System for Detecting and Warning Cyclones

With a history spanning more than a century, the India Meteorological Department (IMD) has a well-established and proven cyclone warning system. The general public, government officials, and other user organizations, such as international and domestic shipping, fisheries, ports, etc., are given cyclone predictions and warnings. High-power cyclone detection radars, weather satellites, and traditional meteorological measurements are used to find and monitor cyclones over the Indian Seas. No longer can a cyclone in the North Indian Ocean escape detection thanks to the ten high power cyclone detection radars deployed along India's east and west coastlines and the geostationary Indian National Satellite (INSAT).

Cyclone alerts come in two phases. In the first phase, a Alert message is sent out around 48 hours before bad weather near the coast starts. About 24 hours before the storm is expected to hit the shore, the second stage, or Warning stage, begins. The Chief Secretaries and Relief commissioners of the relevant States and collectors of the coastal districts likely to be impacted by cyclones are informed of cyclone warnings by high priority telegrams, Police radio Telex/Telephone, wherever practicable. In the maritime States, AIR stations and Doordarshan Kendras often broadcast both the Alert and Warning messages. The warning bulletins are first sent every three hours, but when the storm approaches the shore, they become hourly or even half-hourly in frequency. Upon receiving the warnings, state government officials take the required preparations to protect the property and lives of the coastal population, including, if necessary, evacuating residents to safer locations from hazardous regions.

Along India's east and west coasts, a Cyclone Warning broadcast System (CWDS) has been constructed for the direct broadcast of cyclone warning to users via INSAT satellite. This idea is wholly local to India and is used there. It permits the immediate delivery of important alerts in local languages to selected receiving stations in coastal regions through satellite transmission without any time loss. Other benefits include high reliabilitythe system continues to function even when all landline communications are lost and there is a power outage; selective addressingthe warning message is sent directly to the district in question; instantaneous delivery of the latest cyclone information and forecasts; and deworming messages for affected areas. Along India's east and west coasts, there are a total of 250 CWDS receivers that have been gradually deployed.

The Preparation for Cyclone Disasters has Improved

The number of deaths caused by cyclones in India has significantly decreased as a result of ongoing improvements in observational instruments, processing methods, and human resources in the cyclone forecasting and warning system. When severe cyclone catastrophes from November 1977 and May 1990 are compared, it is evident how important disaster preparation is in reducing the effects of cyclone threats. The 1990 cyclone only claimed 967 lives. Up to 6.6 lakh individuals were successfully evacuated from risky places because the coordination system at various administrative levels operated so precisely and promptly. The foundation for effective handling of

the 1990 cyclone tragedy was the capacity to warn in local dialect and explain effectively the likely hazard to life and property adequately in advance.

Earthquakes

India has experienced earthquakes from the beginning of recorded history. A worldwide quake zone that includes the Himalayas and the northeastern area also extends along the Pacific Ocean, Indonesia, Burma, the Himalayas, Afghanistan, Iran, Turkey, and the Mediterranean Sea. According to accepted geological theory, the Indian landmass, which is thought to be slowly sliding under and clashing with the Eurasian mainland, is to blame for the earthquakes in the Himalayas and northern India. Earthquakes in northern India and the Himalayas are caused by this interplay and deep-seated geological processes. The Himalayan areas sometimes experience earthquakes ranging in strength from mild to strong.

Earthquake Prediction

While the seismically sensitive areas have been identified based on historical data, there is currently no method in use anywhere in the world that can predict when and where an earthquake will occur. Periodically, a lot of assertions are made in the media, but it has not been determined if they are true in general or not. At numerous Indian institutions, including the India Meteorological Department, Central Water & Power Research Station, Pune, National Geophysical Research Institute, Hyderabad, Wadia Institute of Himalayan Geology, Dehradun, and University of Roorkee, concerted research efforts are being made to predict earthquakes. A multidisciplinary study strategy is used, and it is based on statistics, foreshocks and other precursors, fault characteristics, plate tectonics, gravity magnetic anomalies, etc. Animal behavior research has not been shown to be very useful.

A Lot of Rain and Flooding

A huge number of river systems cross India. It usually always suffers significant flooding in one or more regions of the nation, which results in a great deal of human suffering, extensive property destruction, and loss of life. In river catchment regions during the southwest monsoon season, particularly in north and central India, heavy rainfall contributes to flooding. About 8 million hectares of the country's 40 million hectares of flood-prone land are badly damaged by floods each year.

Indian Flood Forecasting

The Central Water Commission (CWC) offers flood forecasts and early warning for many river basins in India. On the majority of interstate rivers throughout the nation, CWC has installed a network of 157 flood forecasting and warning stations. The Flood Forecasting Stations create the flood predictions and alerts, which are then sent to the relevant State Government authorities and other organizations engaged in flood management and control activities. Government representatives act swiftly to conduct rescue and relief efforts and evacuate citizens from danger zones to safer locations. For the general public's benefit, predictions and warnings are released via print and electronic media.

Localized Severe Storms and Tornadoes

Another natural occurrence that yearly results in multiple fatalities and significant property damage in India is a severe thunderstorm, often known as a severe local storm. They are referred

to as Local Storms because of how little area and time they cover. The severe local storms are accompanied with hailstorms, lightning, torrential rainfall, and strong gusts known as squalls. The tornadoes, which may produce winds up to 500 kmph, are the most powerful of these storms. Tornadoes are tiny, violently spinning storms that form after very intense thunderstorms. Weather radars can identify thunderstorm cells, and their strength and ability to produce hail and heavy rain may be determined. Delineating active thunderstorm zones is made easier by INSAT satellite cloud measurements [7], [8]. To the alerts recorded with the Department's various offices, the India Meteorological Department gives predictions and warnings for strong wind squall, hail, and heavy rain associated with thunderstorms 24 hours in advance. To aid the general public and other user agencies around the nation, these alerts are also aired by AIR stations.

Landslides

The numerous hill ranges of India are prone to landslides on a regular basis. Numerous landslides have a significant negative impact on highways, structures, forests, plantations, and agricultural areas every year. Landslides are often brought on by torrential rain, abrupt cloud bursts, and earthquakes. These have a random character in terms of time and place, making them challenging to forecast. Statistics have shown that the Himalayas experience significant landslide incidence with corresponding losses to property and lives on a periodicity on the order of 4-5 years. This results from two things: changing rainfall patterns and the rate of slope deterioration. Numerous significant landslides have happened in the studied regions, which include Sikkim and Jammu & Kashmir, when a year with a lot of rainfall also corresponds with a certain level of slope deterioration brought on by human or natural factors.

Droughts

Droughts vary from other natural catastrophes in that they are brought on by a prolonged lack of rainfall rather than a sudden occurrence. A drought often lasts for a long period of time. Both its beginning and, in most circumstances, its end are difficult to pinpoint. While famine, which may kill hundreds or thousands of people and impair the life of millions, is the direct result of droughts, which are often not fatal in and of themselves. Being predominantly an agricultural nation, rain during the southwest monsoon season (June to September) is essential to India's economy. The nation receives 117 cm of total annual precipitation, almost 75% of which falls during the southwest monsoon season. India has had 19 drought years since 1875. One of the most devastating droughts in recent memory, the states of Gujarat and Rajasthan suffered the worst during the 1987 drought. There were reports of 285 million people being impacted by the fact that this year, almost 60% of the nation saw below-average rainfall.

Drought forecasting is still an issue that has to be resolved, not only in India but in many other nations as well. A long-range forecast model for rainfall during the southwest monsoon has been created in India and may be used to predict the drought. Over the last several years, this method has been discovered to be operationally helpful. In addition, the nation conducts year-round real-time rainfall monitoring down to the district level. This aids in obtaining early warning information on the various drought conditions around the nation. Effective mitigation measures are essential in reducing the effects of natural catastrophes since they present serious threats to community safety and wellbeing. The India Meteorological Department (IMD), which provides precise weather predictions, prompt warnings, and promotes disaster readiness, is essential in reducing the impact of natural catastrophes. With an emphasis on the IMD's contributions to early warning systems, forecasting methods, and its cooperation with other agencies to improve disaster planning

and response, this in-depth overview discusses the role of the IMD in minimizing natural catastrophes.

Early Warning Systems

The IMD is responsible for developing and maintaining an effective early warning system for various natural disasters, including cyclones, floods, heatwaves, and severe weather events. Through a network of weather monitoring stations, satellite observations, and sophisticated modeling techniques, the IMD can forecast and track weather patterns with greater accuracy. The department issues timely warnings and alerts to the government, emergency management agencies, and the public, enabling them to take appropriate preventive measures and evacuate vulnerable areas.

Cyclone Forecasting and Tracking

Cyclones are among the most destructive natural disasters, especially in coastal regions. The IMD plays a crucial role in cyclone forecasting and tracking, employing advanced technologies such as weather radar, satellite imagery, and numerical weather prediction models. By monitoring the formation, intensification, and movement of cyclones, the IMD provides regular updates, alerts, and specific forecasts regarding the affected areas. This information helps in evacuation planning, resource allocation, and the implementation of emergency response measures.

Flood Forecasting and Management

The IMD's flood forecasting services are vital for mitigating the impacts of flooding in India. By monitoring rainfall patterns, river water levels, and dam capacities, the IMD can issue flood warnings and provide real-time information to local authorities and communities at risk. This enables proactive measures such as the evacuation of flood-prone areas, deployment of rescue teams, and coordination of relief efforts. Additionally, the IMD collaborates with other agencies to develop flood management strategies, including reservoir management and river basin planning.

Heatwave and Severe Weather Warnings

The IMD also plays a critical role in issuing warnings for heatwaves, severe storms, and other extreme weather events. By monitoring temperature patterns, humidity levels, and atmospheric conditions, the IMD can provide timely alerts to prevent heat-related illnesses, protect vulnerable populations, and ensure appropriate safety measures are in place. Severe weather warnings help in preparedness for thunderstorms, heavy rainfall, lightning, and other meteorological hazards, enabling communities to take necessary precautions and mitigate potential damage.

Collaboration and Capacity Building

The IMD actively collaborates with national and international agencies, research institutions, and disaster management authorities to enhance its capabilities in mitigating natural disasters. This collaboration includes sharing data, expertise, and best practices, as well as participating in research and development projects related to disaster management. The IMD also conducts training programs and workshops to enhance the capacity of local authorities, meteorological personnel, and emergency responders in effectively utilizing weather information for disaster preparedness and response [9], [10]. The India Meteorological Department plays a pivotal role in mitigating natural disasters through its advanced forecasting techniques, early warning systems, and collaborative efforts. By providing accurate and timely weather information, the IMD enables

proactive decision-making, evacuation planning, and resource allocation, reducing the impacts of cyclones, floods, heatwaves, and severe weather events. The department's continuous efforts in research, technological advancements, and capacity building contribute to strengthening disaster preparedness and enhancing the resilience of communities across India.

CONCLUSION

The Indian Sub-continent is affected by one or two major disasters every year besides a number of minor ones. Cyclones, floods, earthquakes, landslides and industrial disasters ravage the country quite frequently. A natural disaster calls for an effective information exchange between all emergencies – support organisations and functionaries at local, district and State levels for a systematic and integrated approach to disaster management. India meteorological department has contributed significantly to the promotion of disaster prevention and preparedness activities and mitigation measures to help in the reduction of loss of life and destruction caused by natural disasters. Adequate warning systems have been developed for some of the natural disasters and at IMD's initiative the State Governments have adopted short- and long-term measures to mitigate the impacts of disasters. Some such measures are construction of cyclone shelters, coastal afforestation, construction of embankments and dykes, improvement in coastal communications and better coordination between the warning specialists and disaster mitigation officials.

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CHAPTER 20

SOME ISSUES IN DISASTER MANAGEMENT: A COMPREHENSIVE OVERVIEW

Kanika Sharma, Assistant Professor,
ISDI - School of Design & Innovation, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: kanika@isdi.in

ABSTRACT:

Disaster management is a complex field encompassing various challenges and intricacies that require careful attention and effective solutions. This study aims to provide a comprehensive overview of some critical issues encountered in disaster management. By understanding these challenges, policymakers, emergency responders, and communities can devise more robust strategies and improve their disaster preparedness, response, and recovery efforts. Firstly, the study explores the importance of effective communication and coordination among stakeholders involved in disaster management. Timely and accurate information sharing between government agencies, relief organizations, and affected communities is vital for efficient resource allocation, decision-making, and rescue operations. Secondly, the study discusses the need for comprehensive risk assessment and early warning systems. Identifying vulnerable areas, assessing potential hazards, and developing effective early warning mechanisms can significantly reduce the impact of disasters and save lives. The chapter emphasizes the importance of investing in technology, research, and community engagement to enhance risk assessment capabilities.

KEYWORDS:

Catastrophes, Disaster, Earthquakes, Management, Warning Systems.

INTRODUCTION

Generally speaking, disasters are abrupt occurrences, events, or tragedies that result in destruction, fatalities, economic disruption, and degradation of vital services on a scale great enough to need a remarkable reaction from outside the town or region. Natural disasters such as earthquakes, cyclones, floods, famines, landslides, volcanic eruptions, etc. and Man-made catastrophes such as industrial disasters, accidents, terrorist attacks, war, refugee migration, etc. are divided into two groups. To understand the nature and scope of catastrophes from a comprehensive standpoint, this conceptual formulation is, nevertheless, oversimplified. 'Natural' and 'Man-made' catastrophes can no longer be distinguished from one another since many allegedly 'natural' catastrophic environmental phenomena are really caused by humans or at the very least made worse by their action. In the majority of catastrophes, humanity plays a significant causal role [1], [2].

The intensity of the catastrophes is correlated with certain patterns of growth and human habitation. Less water is retained in higher levels of catchment regions as a consequence of population growth and poor resource management, which has led to the conversion of forests to pasture and arable land, making floods more frequent and severe. Drought has an effect on the environment due to desertification and careless land usage. Nuclear device testing underground generates pressure that may affect the stability of certain portions of the earth's crust and cause earthquakes. When vegetation is removed, soil erosion speeds up, generating a significant buildup of loose, unsorted debris that might lead to landslides. The fast and unmanaged urbanization that

causes low-income households to reside on the slopes of steep hillsides or ravines or along the banks of rivers prone to floods is strongly connected to many landslides or flooding catastrophes. Even famines are not solely natural occurrences.

The Great Bengal Famine of 1943 in British India, the greatest famine in India this century, was around five to ten times larger in terms of mortality than the Chinese famine of 1958–1961, according to Amartya Sen's well-known research on famines and hunger. Since India's freedom, there hasn't been a widespread famine, which is a good thing compared to what happened in Communist China. The presence of political democracy in India was the primary cause of this disparity. Given the political structure of India after independence, no administration in power could get away with ignoring immediate and comprehensive anti-famine efforts at the first symptoms of a famine. In this regard, the contrast with China is startling [3]–[5]. China has a delivery and redistribution mechanism in place to address food shortages when the famine approached in 1958 and subsequently thanks to its public distribution system. When the famine struck China, there was no political structure with oppositional journalists. Without a public admission that such a thing was happening or a sufficient reaction in terms of policy, the Chinese famine persisted for three years. In reality, the majority of Sub-Saharan nations now have the same characteristics of the lack of adversarial politics and free press that aided in the onset, severity, and length of the Chinese famine in 1958–1961.

Disasters are therefore a result of how societies are organized in terms of their economic, political, and social systems, of how societies and governments interact, and of how connections among the decision-makers are maintained. The old division between natural and man-made catastrophes must make way for a focus on how human behavior and natural occurrences interact to influence the frequency and severity of disasters. Environmental contamination has severe effects that are being studied and argued more and more. Examples of catastrophes in the making include global warming caused by the buildup of greenhouse gases in the atmosphere and ozone layer depletion brought on by the excessive emission of CFCs. Compared to natural disasters like earthquakes and cyclones, their immediate impact on casualties and damage may be less spectacular, but any disaster preparation must take into account their long-term effects. The right to a healthy and ecologically balanced environment has actually been added to the list of human rights as a third generation right, and the definition of a catastrophe also has to be expanded to cover slow-onset disasters. Disasters fall into yet another group that is just ignored. They may be described as calamities that go unnoticed. Thus, roughly one billion people in developing nations lack access to clean water, and 1.7 billion do not have access to sanitation, according to the World Development Report 1992 (World Bank). Their health has been shockingly affected. Each year, this results in almost 900 million instances of diarrheal illnesses, which kill over three million children [6]–[8].

Disasters and Development

Everybody agrees that progress is desirable; no community can afford to remain in a condition of inertia. However, adopting any model of growth does not guarantee progress; it has its drawbacks and presents difficult decisions. If the current industrial system consumption levels are maintained, a large number of natural resources are finite, non-renewable, and potentially depleted. A paper titled The Limits to Growth, written by Massachusetts Institute of Technology for a Club of Rome initiative, issued a warning in this area. The paper included, among other things, an intriguing table that listed 19 non-renewable natural resources of critical significance to modern nations together

with their known worldwide reserves, rates of use and expected expansion, etc. The bulk of the presently significant non-renewable resources will be very expensive in 100 years, according to the report's conclusion, given the existing and forecast increases in resource consumption rates.

Furthermore, development initiatives carried out without considering long-term environmental risks might be devastating. In other words, the process of development should be ‘sustainable' throughout time. The World Commission on Environment and Development the Brundtland Commission popularized the phrase Sustainable Development in its landmark 1987 Report, Our Common Future. The concept of maintaining the world has proven to be a potent metaphor for bringing environmental stewardship into sharper focus and increasing public awareness. The Commission claims that meeting the needs of the present generation without compromising the needs of the future generation is the key to the idea. It has been difficult to define sustainability precisely, however. The claim that all natural resources should be protected is not tenable. Successful development will always need some land removal, drilling for oil, damming rivers, and draining swamps. Some participants in this discussion made the case that natural capital should be protected overall, with losses in one region being made up for in another. This method has helped drawn attention to the need of valuing natural resources and the significance of safeguarding certain crucial ecological systems.

On a more practical level, the argument over huge dams raises a significant question about the catastrophe risk associated with the development process. The bitter debate surrounding the Narmada Project in India won't go away. According to the project's promoters, it will be Gujarat's lifeline and has a huge potential to address the region's energy and immigration demands. The project's opponents see it as a complete environmental and humanitarian catastrophe that would flood vast tracts of valuable forestland and evict thousands of tribal people from their long-established homes. These detractors, who insist that ‘small' projects are preferable, even doubt the massive dams' technical viability. Naturally, there are no simple solutions to such problems. When they completely discount the need for large dams, romanticize the idyllic simplicity of the tribal people who have historically lived in harmony with nature, and champion the cause of small dams in line with the ideal of small is beautiful the opponents of the dam clearly overstate their case. However, it is impossible to ignore the inadequacy of rehabilitation efforts and their negative effects on the displaced. Each case must be judged on its own merits while keeping in mind the bigger picture and minimizing pain for the parties involved. Planning for growth must include disaster prevention [9]–[11].

DISCUSSION

Management of Industrial Disasters

It goes without saying that industrial development is a key indicator of how well a country is doing. The environmental damage that many industrial endeavors produce is likewise undeniable at the same time. Nuclear power plants have the potential to result in catastrophe with terrifying repercussions in a number of different ways. The worst-case scenario is a catastrophe similar to Chernobyl, but worse things might happen. Some nuclear experts worry that the worsening political and economic unrest in Russia has raised the possibility that professionals with access to nuclear material who are in need of money may be tempted to sell it on the nuclear black market as security at nuclear sites continues to deteriorate at the same rate as the struggling economy. Terrorists or criminal countries may detonate a crude nuclear weapon after the smuggled uranium or plutonium is sold to the highest bidder. Though overblown, these worries are not without merit.

But disasters may nevertheless happen at non-nuclear sites. Numerous industrial facilities store toxic gases that, in the event of a large-scale release, might seriously harm the environment, as was the case with the Bhopal Gas Tragedy. A steel plant in Bhilai has an LD Gas Holder with a large amount of Carbon Monoxide Gas within. This colorless and odorless gas, when breathed, may paralyze the lungs and result in death. There is an ammonia tank at a fertiliser factory in Phulpur, and if it were to leak significantly, it would turn the city into another Bhopal. There are many instances of this. Although these factories would have appropriate safety precautions in place, it is possible that such weak spots may be the target of terrorist sabotage or bombing. It would be a powerful method for a terrorist to cause harm & mayhem among thousands of nearby residents.

These industries' catastrophe management strategies in India have two significant flaws. Particularly at the lowest levels, security staff lack sufficient working knowledge of the facilities' industrial processes, safety standards, and weak areas. The plant safety and security wings work independently of one another with little cooperation. Without practical technological understanding, security staff would be less successful at averting crises and responding to them. The urgent necessity of the hour is the integration of the security and safety wings. The locals who live close to the industrial township are unaware of the dangers, which is the second gap. The majority of disaster management plan rehearsals are conducted routinely by plant management and employees within the boundaries of the industry, and no real attempt is made to inform the local population, who may unwittingly become victims of catastrophes. Effective industrial catastrophe management requires community involvement.

The research then discusses the difficulties in catastrophe response and recovery. It emphasizes the value of prepared disaster response teams, good evacuation strategies, and strong infrastructure to support successful rescue and relief operations. It also highlights the significance of long-term rehabilitation initiatives, which include providing psychological assistance, reestablishing infrastructure, and reestablishing livelihoods. Further exploration of the socioeconomic aspects of catastrophe management is included in the paper. It looks at how catastrophes affect vulnerable people differently, the difficulties in delivering fair aid, and the significance of addressing underlying vulnerabilities to create resilient societies. The need of include catastrophe risk reduction in development planning and policy is also emphasized. The report also emphasizes the value of global collaboration and cooperation in catastrophe management. Disasters often transcend geographical borders, necessitating global cooperation, information exchange, and resource mobilization. In order to successfully reduce and manage catastrophes, the chapter highlights the significance of collaborations, information sharing, and capacity development across states.

Disasters, whether natural or human-induced, have far-reaching impacts on communities and societies. Effective disaster management is crucial in mitigating the risks, minimizing the impacts, and facilitating the recovery process. However, several complex issues pose challenges to disaster management efforts. This detailed description provides a comprehensive overview of some key issues in disaster management, highlighting the complexities involved and the strategies employed to address these challenges.

Risk Assessment and Vulnerability

Accurate risk assessment is a fundamental aspect of disaster management. Identifying and understanding the vulnerabilities and exposure of communities to various hazards helps in developing appropriate mitigation strategies. However, challenges arise due to limited data,

inadequate resources, and the dynamic nature of risks. Integrating multidisciplinary approaches, utilizing remote sensing and geospatial technologies, and engaging with local communities can enhance risk assessment and vulnerability mapping, enabling more effective planning and resource allocation.

Preparedness and Response Planning

Disaster preparedness involves establishing effective response plans, early warning systems, and evacuation strategies. Challenges emerge due to the diversity of hazards, varying levels of preparedness among communities, and limited resources for training and capacity building. Collaborative efforts between government agencies, local authorities, and community stakeholders are essential in developing comprehensive preparedness plans. Regular drills, public awareness campaigns, and information dissemination systems can enhance the readiness of communities to respond to disasters.

Communication and Information Management

Clear and timely communication is critical during disasters to disseminate warnings, provide guidance, and coordinate response efforts. Communication challenges arise due to inadequate infrastructure, language barriers, and limited access to technology, particularly in remote and marginalized communities. Establishing robust communication networks, utilizing diverse communication channels, and incorporating community engagement in information management can help overcome these challenges and ensure effective communication before, during, and after disasters.

Resource Allocation and Coordination

Disaster response requires the coordinated efforts of multiple agencies, organizations, and stakeholders. Challenges arise in resource allocation, logistics management, and coordination among different entities. Limited resources, competition for funding, and overlapping responsibilities can hinder effective coordination. Developing collaborative frameworks, establishing clear roles and responsibilities, and enhancing interagency communication are crucial in optimizing resource allocation and coordination to ensure efficient and timely disaster response.

Post-Disaster Recovery and Reconstruction

The recovery phase following a disaster involves rebuilding infrastructure, restoring services, and addressing the socio-economic impacts on affected communities. Challenges arise due to the complexity of long-term recovery, limited financial resources, and the need for sustainable development. Implementing comprehensive recovery plans, engaging with stakeholders in decision-making processes, and integrating risk reduction measures into reconstruction efforts can contribute to a more resilient and sustainable recovery.

Climate Change and Emerging Risks

Climate change introduces additional complexities and uncertainties to disaster management. Changing climatic patterns, rising sea levels, and increased frequency and intensity of extreme weather events pose new challenges. Adaptation to climate change, integrating climate risk assessments into disaster management frameworks, and fostering collaboration between climate and disaster risk management sectors are crucial in addressing emerging risks and building resilience in the face of a changing climate.

Disaster management is a multifaceted and complex process that involves addressing various issues and challenges. By understanding and addressing these issues, policymakers, disaster management agencies, and communities can enhance their preparedness, response, and recovery capabilities. Effective risk assessment, robust preparedness plans, improved communication, coordinated resource allocation, and sustainable recovery efforts are essential in building resilience and reducing the impacts of disasters. Continued research, collaboration, and innovation are crucial in addressing the evolving challenges in disaster management and fostering a safer and more resilient future.

CONCLUSION

Disasters are increasingly man-made. The impacts of even those disasters which are triggered by acts of nature are magnified by unwise human actions. Disasters also reflect the existing social & economic relationships & settlement pattern. Disasters are not confined to sudden damages of large magnitude. They include long-term slow onset events too caused by environmental damage. Disaster Management is something than an emergency response plan based on three Rs of Rescue, Relief and Rehabilitation. It has a preventive dimension which should be a part of long-term developmental planning. Industrial disaster management requires integration of safety & security and community participation in order to be meaningful. A large number of industrial units are disasters-in-the-making if the safety & security requirements are ignored. In conclusion, this shed light on some critical issues in disaster management, including communication and coordination, risk assessment and early warning, response and recovery efforts, socio-economic dimensions, and international cooperation. By understanding and addressing these challenges, stakeholders can work towards building more resilient and disaster-ready communities, reducing the impact of disasters, and protecting lives and livelihoods.

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CHAPTER 21

PSYCHOLOGICAL DIMENSIONS OF DISASTER SITUATIONS: UNDERSTANDING AND ADDRESSING MENTAL HEALTH CHALLENGES

Hansika Disawala, Assistant Professor,
ISME - School of Management & Entrepreneurship, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: hansika.disawala@atlasuniversity.edu.in

ABSTRACT:

Disaster situations not only pose immediate physical threats but also have profound psychological impacts on individuals, communities, and societies. This chapter explores the psychological dimensions of disaster situations, emphasizing the importance of understanding and addressing the mental health challenges that arise in the aftermath of disasters. The study begins by examining the immediate psychological effects of disasters. It highlights the experience of shock, fear, and distress that individuals often face during and immediately after a disaster event. The study emphasizes the significance of providing psychosocial support, including crisis counseling and psychological first aid, to help individuals cope with their initial reactions and facilitate early recovery. Furthermore, the study delves into the long-term psychological consequences of disasters. It acknowledges the increased risk of developing mental health disorders, such as post-traumatic stress disorder (PTSD), depression, anxiety, and substance abuse, among affected individuals. It emphasizes the need for sustained mental health services and interventions to address these long-term effects and promote resilience in disaster-affected populations.

KEYWORDS:

Disaster Management, Mental Health, Psychological Effects, Traumatic Stress Disorder.

INTRODUCTION

Humans often base their decisions and plans on the assumptions of linearity and symmetry. However, a cursory look at history and a careful examination of the nature as well as day-to-day interactions between people and their surroundings will reveal that the aforementioned adage is untrue. In actuality, events do occur that are neither symmetrical nor linear. The knowledge that things may go wrong prompts the need for contingency plans to handle all potential outcomes. Planning for disasters is part of this idea of contingency. Cyclones, earthquakes, flash floods, severe droughts, landslides, fires, chemical and nuclear accidents, as well as other significant industrial catastrophes are examples of disaster scenarios that have two dimension a physical dimension and a psychological component.

Thus, in such a situation, the psychological fabric and well-being of individuals and communities are also damaged and ravaged in addition to the physical infrastructure, such as the railroads, roads, telecommunication lines, parks, schools, markets, places of worship, dwelling units, and means of subsistence such as livestock. The psychological havoc may range from disaster syndrome a shocked, confused, and indifferent condition to serious psychotic illnesses. In rare instances, it might lead to a person committing suicide as a means of self-destruction. All of this means that planning, relief, rescue, and rehabilitation activities in catastrophe scenarios must include

psychological assistance. Disasters are rare occurrences that often inflict a high number of fatalities and injuries as well as significant economic losses to the community and the country. In addition to causing such physical harm and ruin, such an event stirs up strong emotions in the population. Although such psychological stress and emotions may not immediately manifest as physical damage, overcoming such psychological apprehension may need just as much time and effort from the community and family as physical recovery.

Disaster-Related Psychological Reactions (Normal)

People's emotions and feelings in disaster situations can be divided into two main categories Ordinary cognitive, emotional, behavioral, and somatic reactions in extraordinary situations that slightly deviate from the normal pattern of such reactions, and psychological distress reactions that overwhelm an individual's and a community's capacity for coping and that may have an impact on people's psychological well-being. Dreams and nightmares about the disaster, constant mental reconstruction of the disaster situation, difficulty concentrating and remembering things, doubting one's faith and religious beliefs, flooding of thoughts or memories with disaster episodes, etc. are some of the common cognitive reactions to disaster situations. The catastrophic condition also limited human mental processes in terms of resources and data. It is a well-known truth that human performance is at its peak when anxiety levels are modest. Disasters produce high levels of stress and anxiety, creating unfavorable circumstances for the use of mental resources. Similar to this, the chaotic state of things prevents decision makers from having access to all types of pertinent information required for making the best decisions, which obviously limits their ability to think rationally [1]–[3].

The typical emotional response to a disaster may include feeling numb, withered, or confused; feeling uneasy, anxious, or afraid when disaster situations and things are revisited in memory; feeling depressed; experiencing sudden hostility without cause or on sight provocation; exhibiting intense irritability; or experiencing a sense of emptiness or helplessness regarding the future. In order to summarize, emotional states may be divided into two categories: battling or freezing. Common behavioral responses to disaster conditions include being overly protective of oneself and one's family, isolating oneself from others or seeking their company to reduce anxiety, displaying alarm and startling behavior under normal circumstances, having trouble falling asleep or waking up, engaging in meaningless overactivity to block out thoughts related to disaster conditions, and crying out of the blue. Insomnia, headaches, cramps, elevated heart rate, changing body temperature, and increased muscle tension are all examples of typical schematic responses. As sizes increase, everything might become worse and perhaps turn into a severe sickness.

Disaster-Related Psychological Distress Reactions

These typical cognitive, emotional, behavioral, and physical responses are controlled by an individual's coping skills, which are in turn a sophisticated system largely influenced by experiences related to their maturation process. People may often deal better in crisis situations if they have had formative experiences that generate strong beliefs and a philosophical orientation to life. Many individuals are able to overcome these emotions over time with a little assistance from family and friends. However, some persons struggle to handle emergency circumstances and exhibit signs of psychological discomfort ranging from minor neurotic responses to profoundly incapacitating psychotic causes. The following are the main neurotic symptoms that might be seen in a population under crisis conditions:

i. **Anxiety Neurosis:** Anxiety is felt in so many circumstances that it frequently seems to have no particular cause and to be diffuse and free-floating, even in cases when a calamity may have already occurred in the past.
ii. **Phobic Neurosis:** Extreme and illogical dread of anything that might potentially cause tragedy and avoidance of that thing or scenario. For instance, due of their awful experience with an earlier cyclone, residents fled the area around Kandla Port in 1999 when they learned that a cyclonic depression was brewing over the Arabian Sea.
iii. **Obsessive Neurosis:** An overabundance of unwanted and persistent ideas. People in earthquake-
iv. **Depressive Neurosis:** Unusual protracted depression linked to internal turmoil or emotional loss.

Psycho-Somatic disorders are reactions that show the visceral expression of emotion that awareness may have long since blocked. Common colds, rhinitis congestion of the nasal mucous membrane and blood vessels of the eyes, bronchial asthma, cardiovascular diseases, peptic ulcers, appetite loss, etc. are a few examples of these conditions. Resources used on a daily basis are sometimes scarce in disaster scenarios. Even in normal people, such shortage may lead to psycho-pathic behavior such as abdication of duty, callousness, insincerity, inability for love and commitment, lack of empathy, etc. Because conditioning of such behavior has huge costs for the community, it must be halted by major other organizations, such as the police, NGOs, psychologists, family, and friends [4]–[6]. In the most severe situations, a sizable percentage of residents in disaster-affected areas may even exhibit psychotic disorders, such as schizophrenia a disorder characterized by delusions, hallucinations, expression of extreme inappropriate emotional response, and disturb behavior that may include regression and withdrawal); manic depression retardation of thought, pervasive feeling of sadness, sleep disturbances, retarded motor actions or abnormal elation of mind; hyperactivity, etc. and others.

Physical Assistance

Both normal and psychologically distressing reactions during a disaster require psychological support so that people displaying a normal response during a disaster can quickly return to the normal way of thinking and acting that they display in their daily lives and so that people exhibiting a high degree of psychological distress can be calmed. Such psychologically disturbed individuals may integrate into communal life with the aid of psychologists. The psycho-social assistance that anybody may provide to others in a stressful, urgent, traumatic, or life-threatening circumstance is known as psychological support. This assistance must be client-centered, which means that it must include respect for the individual, active listening, taking good care of the individual, and talking to the individual in a manner that makes him feel secure while going through or exploring unpleasant experiences related to tragedy. Therefore, by understanding the feelings of individuals impacted by the accident, practically anybody who is able to feel and express worry and empathy may provide psychological help. In these situations, thoughtful and empathic hearing and behavior are required so that the victim feels comfortable discussing the tragedy and progressively gets over the feelings and trauma connected to it [6]–[8].

In circumstances of typical responses, friends and family might provide the most beneficial kind of psychological support. A clinical psychologist or psychiatrist must examine and treat the patient in situations of acute psychological distress, depending on the circumstances. The psychological assistance that may be offered in catastrophe scenarios along with responses to such conditions.

The support of family and friends may be enough to help people transition from their typical responses to catastrophic situations to their daily regular way of thinking and acting, for normal reactions. Similar to this, minor cases of neurotic behavior, psychopathic responses, and NGOs, social support groups, and psychologists may be able to help. A general physician or a psychologist/psychiatrist would need to provide professional therapy for psychological discomfort that results in a psycho-somatic response or a psychotic reaction. People who are experiencing this kind of psychological discomfort may potentially need to be hospitalized due to these issues.

Mental Health of Rescue and Relief Workers

The requirement for psychological assistance for rescue and relief workers is a crucial aspect of psychological support in catastrophe situations. Rescue and relief personnel are required to perform lengthy shifts without food or rest during crisis situations in order to lessen the suffering of the community. The safety of the rescue and relief worker may sometimes be threatened by such stressful circumstances. In these situations, the scene manager politicians, bureaucrats, police officers, etc.

Stress-Induced Psycho-Physiological Reaction

It would be appropriate to go into further depth on the psycho-physiological aspects of stress at this point. People who are under stress display the general adaptation syndrome (GAS), which has three phases. There are two stages. The first is a stage of disordered shock, and the second is when the body fights back by making an effort to regain homeostasis, mostly by releasing the hormone adrenaline. In the resistance stage, a person's ongoing efforts to regain psychological equilibrium are often effective, and a sufficient adaptation to stressful situations does take place. When a person is exhausted, their capacity to maintain homeostasis is compromised either by the addition of additional stressors or by a lack of psychological support. In this case, the individual either experiences stress or is unable to maintain homeostatic equilibrium. In such circumstances, the individual may succumb to disease both physical and psychological, or in rare circumstances, death may occur.

This widespread response to stress demonstrates emphatically how important psychological care is for individuals in catastrophe situations. Such psychological assistance during disasters aids individuals in coping with stress, halting their response to stage two the resistance stage of GAS. Such assistance also aids in restoring the individual's homeostasis. To sum up, we might argue that asymmetry and non-linearity are characteristics of catastrophes. The community's social, emotional, and physical support systems are abruptly uprooted under such circumstances. The ability of the person to cope with such an atypical environment and the psychological support received from important people determine the individual's psychological wellness. The research also looks at the particular psychological difficulties that some groups experience in catastrophe scenarios. It emphasizes the significance of individualized care and specific treatments for these groups by highlighting the vulnerabilities of youngsters, the elderly, and those with pre-existing mental health issues. Additionally, it discusses the social and cultural aspects of catastrophes that affect psychological reactions, highlighting the necessity of culturally appropriate mental health care strategies. The paper also talks about how secondary stresses affect catastrophe circumstances. Economic problems, loss of houses and possessions, social network disruption, and displacement may all worsen psychological suffering and prolong mental health issues. The research highlights the necessity for comprehensive recovery initiatives that take into account both the immediate needs of impacted people and communities as well as their mental wellbeing [9],

[10]. The research also emphasizes the importance of community resilience in reducing the psychological effects of catastrophes. Strong social support networks, involvement in the community, and group coping strategies may help people heal and rebuild their lives.

The chapter emphasizes how crucial it is to promote social cohesiveness, give local communities more control over their own research, and include them in decisions that affect their own rehabilitation. The research also highlights the use of psychological assistance in frameworks for disaster management. It emphasizes how important it is to teach first responders, healthcare workers, and local leaders in identifying and managing the psychological aspects of catastrophes. Authorities may more effectively safeguard and assist the mental health of persons impacted by disasters by including psychological issues in their strategies for planning and response. Disasters, whether natural or human-induced, have profound psychological impacts on individuals and communities. The psychological dimensions of disaster situations encompass a wide range of mental health challenges, including post-traumatic stress disorder (PTSD), anxiety, depression, grief, and other psychological distress. This detailed description explores the psychological dimensions of disaster situations, highlighting the importance of understanding these challenges and implementing strategies to address them effectively.

Immediate Psychological Impacts

In the immediate aftermath of a disaster, individuals may experience shock, fear, confusion, and a sense of helplessness. Witnessing or experiencing traumatic events can trigger acute stress reactions and acute traumatic stress disorder. The sudden disruption of familiar environments, loss of loved ones, and the destruction of homes and possessions can contribute to a range of emotional and psychological responses. Recognizing and addressing these immediate psychological impacts are essential for ensuring the well-being and safety of survivors.

Post-Traumatic Stress Disorder (PTSD)

PTSD is a prevalent psychological disorder that can occur after experiencing or witnessing a traumatic event. Disasters can be traumatic experiences that lead to the development of PTSD symptoms, including intrusive thoughts, nightmares, avoidance behaviors, hyperarousal, and emotional numbing. The long-term psychological effects of PTSD can significantly impact an individual's daily functioning and overall quality of life. Early identification, timely intervention, and access to mental health services are crucial in supporting individuals with PTSD and facilitating their recovery.

Anxiety and Depression

Disasters often increase the prevalence of anxiety and depression among affected individuals. The uncertainty, loss, and disruption associated with disasters can trigger or exacerbate pre-existing anxiety and depressive disorders. Common symptoms include persistent worry, excessive fear, changes in appetite or sleep patterns, loss of interest, feelings of sadness, and difficulty concentrating. Mental health support services that offer counseling, therapy, and pharmacological interventions are essential in addressing anxiety and depression, promoting resilience, and facilitating emotional well-being.

Grief and Loss

Disasters result in significant loss, including the loss of loved ones, homes, possessions, and communities. The grieving process is complex and can be prolonged in the aftermath of a disaster. Individuals may experience intense sadness, disbelief, anger, guilt, and a sense of emptiness. Bereavement support, counseling, and grief interventions are critical in assisting individuals and communities in processing their grief, finding meaning, and rebuilding their lives after significant loss.

Community Resilience and Social Support

Promoting community resilience and providing social support are vital in addressing the psychological dimensions of disaster situations. Strong social connections, social cohesion, and supportive relationships can buffer the negative psychological impacts of disasters. Encouraging community participation, fostering mutual support networks, and establishing safe spaces for emotional expression contribute to building community resilience and facilitating the recovery process.

Trauma-Informed Care and Psychological First Aid

The provision of trauma-informed care and psychological first aid is essential in disaster situations. These approaches emphasize understanding the impact of trauma, promoting safety, and providing compassionate and supportive interventions. Psychological first aid involves providing practical assistance, comfort, and information to individuals experiencing psychological distress. By recognizing the unique needs and vulnerabilities of survivors, implementing trauma-informed care practices, and training frontline responders in psychological first aid, the psychological dimensions of disaster situations can be effectively addressed.

CONCLUSION

In conclusion, this study highlights the psychological dimensions of disaster situations, including immediate and long-term effects, the challenges faced by specific groups, the impact of secondary stressors, and the role of community resilience. By understanding these psychological dimensions and implementing appropriate interventions, policymakers, responders, and communities can effectively address the mental health challenges arising from disasters, promote recovery, and foster resilience in the face of adversity. Understanding and addressing the psychological dimensions of disaster situations are integral to comprehensive disaster management. By recognizing the immediate and long-term psychological impacts, implementing appropriate interventions, and providing access to mental health support services, individuals and communities can begin the process of healing and rebuilding their lives. Incorporating trauma-informed approaches, promoting community resilience, and fostering social support networks contribute to the overall well-being and resilience of individuals affected by disasters.

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CHAPTER 22

AGENCIES INVOLVED IN DISASTER RESPONSE: ROLES, RESPONSIBILITIES AND COLLABORATION

Meena Desai, Assistant Professor,
ISME - School of Management & Entrepreneurship, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: meena.desai@atlasuniversity.edu.in

ABSTRACT:

Disaster response is a multi-faceted endeavor that requires the collective efforts of various agencies and organizations. This study provides an overview of the key agencies involved in disaster response, highlighting their roles, responsibilities, and the importance of collaboration to ensure an effective and coordinated response to emergencies. The study begins by discussing the pivotal role of government agencies in disaster response. These agencies, such as emergency management departments, national disaster response bodies, and military organizations, are responsible for coordinating overall response efforts, providing strategic guidance, and mobilizing resources at the national level. Their role includes establishing command structures, implementing emergency plans, and ensuring public safety during and after a disaster. Furthermore, the study explores the crucial involvement of non-governmental organizations (NGOs) and humanitarian agencies in disaster response. These organizations, ranging from international humanitarian giants to local grassroots initiatives, play a vital role in providing immediate relief, essential services, and support to affected communities. They often specialize in areas such as healthcare, shelter, food distribution, and psychological support, complementing government efforts and filling critical gaps.

KEYWORDS:

Disaster Response, Management, Red Cross, Resources, Volunteers.

INTRODUCTION

The report also emphasizes volunteer groups' active involvement in disaster relief. Volunteers help afflicted areas by giving their time, talents, and resources, including those from community-based organizations, faith-based groups, and individual volunteers. They often give immediate relief, participate in search and rescue missions, and offer support in a variety of ways, promoting community empowerment and resiliency. The report also highlights how agencies work together to respond to disasters. Coordination, information sharing, and collaboration between government agencies, NGOs, and volunteer groups are essential for effective response activities. Collaboration across agencies provides effective resource allocation, prevents effort duplication, and enhances the effectiveness of response actions. In order to improve cooperation across various organizations, the study emphasizes the need of creating communication channels, collaborative training exercises, and defined procedures [1], [2].

The machinery of relief and rehabilitation evaluation and response is slowly but noticeably shifting from providing urgent assistance to long-term community empowerment and development. The mindset and methods used by organizations in India that help with disaster relief and recovery have undergone a significant change. Since the 1980s, the focus has shifted away from immediate

assistance to long-term development and catastrophe prevention. Relief agencies are increasingly putting an emphasis on empowering the local population and integrating disaster preparation into more extensive development initiatives. However, there is a continuing need for organizations to be able to react swiftly and efficiently to catastrophe situations. In this regard, the absence of a government structure limits organizations' capacity to provide aid during the first phases of crises, when assistance is most urgently required [3]–[5].

Government

The state government is primarily in charge of the rescue, relief, and rehabilitation efforts following a catastrophe, with additional physical and financial resources coming from the federal government. The Department of Agriculture and Cooperation (DAC), which is housed inside the Ministry of Agriculture, is the focal organization for disaster assistance for the Government of India. All disaster relief activities are coordinated by a Central Relief Commissioner (CRC), who also relays information about the situation to the Cabinet, the Prime Minister, and the Secretary of the Ministry of Agriculture. To guarantee that the relief measures are carried out effectively, a Cabinet Committee may be called. When necessary, the National Crisis Management Committee directs the Crisis Management Group (CMG). The CMG is also in charge of reviewing the contingency action plan on a yearly basis.

Network for National Disaster Management

There are CMGs specific to each state government. The District Collector/Magistrate or Deputy Commissioner is in charge of organizing, overseeing, and keeping track of local relief efforts in accordance with the contingency plan. The abilities of the collector are significantly enhanced in times of tragedy. A catastrophe Control Room is also formed, together with a catastrophe Relief Committee, for the daily oversight of relief efforts. Relief efforts were the main focus of the Indian government's conventional approach to disaster management. However, there has been a major change in favor of preparation and catastrophe reduction. The National Centre for Disaster Management (NCDM) was established at the Indian Institute for Public Administration (IIPA), New Delhi, as the first of these projects.

Agriculture in March 1995, the Centre supervises numerous research initiatives, training programs, and maintains a database on natural disasters. It also offers the foundation for national, state, and district level management in the case of catastrophes. Its major goals are to build connections with the nodal ministry dealing with natural disasters, provide an information base on damage brought on by natural disasters and resources utilized for relief efforts, and provide technical assistance to national disaster management programs.

Mechanism for Responding to Natural Disasters

Non-governmental organizations (NGOs) are vital to disaster relief and management due to the government's limited resources. Traditionally, only smaller, regional NGOs are allowed to take part in rescue and relief activities. Most of them have connections to bigger NGOs, which in turn provide more direct support for the recovery and restoration of disaster-affected communities. NGOs are increasingly integrating disaster mitigation and preparation into long-term development programs as a follow-up to the first phase of disaster response. Large-scale development programs may now include catastrophe planning and mitigation due to increased flexibility and community participation. The coordination of relief efforts is growing, and resources are being distributed

more fairly. NGOs and development groups teach local populations in disaster preparation and raise awareness of various concerns such as gender issues. To build and promote community funds, food stores, and other resource accumulation, initiatives have been launched.

The ICRC is the global organization for the Red Cross.

Despite the ICRC's 50 years of operations in India, its South Asian regional office was first founded in New Delhi in 1982. The Indo-Pakistan conflict (1948), aiding Tibetan refugees (1959), the Indo-Portuguese conflict (1960–2001), the Sino–Indian conflict (1962–2003), the second Indo–Pakistan conflict (1965–2006), and the Indo–Pakistan/Bangladesh conflict (1971) are just a few of the conflicts in the area to which the ICRC has responded. The ICRC has recently taken an increased interest in aiding those who have been harmed by internal strife, such as prisoners in Jammu and Kashmir and Dalit violence. The Indian Red Cross Society is largely in charge of responding to natural disasters, yet the ICRC does provide assistance when required since the ICRC's duty in this situation is to guarantee the fair and decent treatment of detainees. Priority is given during crises to the care and evacuation of the wounded, particularly those who belong to the more disadvantaged groups, such as women and children. The ICRC's tracing services in South Asia started 20,000 enquiries and transmitted more than 16 million family communications to find missing family members. The Committee's operating budget in this area is 8 million Swiss francs per year.

The Indian Red Cross Society

In 1920, the Indian Red Cross Society was established. The most fundamental component of its own designed catastrophe strategy is disaster assistance. The IRCS offers a close-knit and well-organized network over the whole nation via its about 650 branches. The Red Cross's services become auxiliary to and/or additional to those of the government in times of calamity. As soon as possible, the district committee of the afflicted region starts disaster assistance efforts. The state branch supports these initiatives and updates the central office on the situation, the services, and the number and kind of supplies needed. The government and other NGOs work closely together.

DISCUSSION

Indian Catholic Health Association (CHAI)

The biggest nonprofit healthcare organization in the world is the Catholic-Health Association of India (CHAI). After the Latur earthquake in 1993, CHAI not only provided relief but also supported an ongoing development process to lead to people's self-reliance and liberation.1 Its disaster response is characterized by holistic health through people's empowerment. CHAI's first priority was to provide relief: it established one of the first camps in the area. Additionally, it made sure that its efforts covered any gaps rather than competing with those of other relief groups. Providing medical assistance and healthcare, focusing on physical, social, emotional, and spiritual rehabilitation, attending to cleanliness and sanitation, mobilizing relief supplies for communities, and developing economic development programs that help in returning to normality are CHAI's top goals.

India's CARITAS

The Catholic Bishops Conference of India's CARITAS India is a development organization that has been active in India since 1962. At first, CARITAS concentrated on helping the needy and

suffering, particularly after disasters. This strategy was, however, considered inadequate, and the focus of its engagement turned toward skill development to permit increased revenue creation. Although successful, this strategy was also criticized since it mainly helped people who were already on the margins. Therefore, CARITAS changed its strategy to focus on the people as active contributors to development rather than as beneficiaries of assistance. According to the organization's philosophy, building people through building homes and building homes through building houses, the empowerment of the people comes first [6]–[8].

Keep Children Safe

Prior to India's independence, Save the Children started offering emergency help there. In order to coordinate ongoing relief efforts and identify potential new locations for long-term development initiatives combining disaster preparation and mitigation, the India office was formed in 1975. A evaluation of relief efforts also improved understanding of catastrophes and the needs of those impacted. By providing financial, technical, and training support via partnered NGOs, Save the Children Fund seeks to protect children worldwide. It is now working on six programs in 12 states, including one that supports Tibetan refugees and children. However, both of these programs will eventually end.

CRS, or Catholic Relief Services

In India, CRS has been active for about 50 years. It collaborates with the Indian government and is closely connected to USAID. When a tragedy strikes, CRS is alerted to the need for aid by one of its local equivalents and is equipped to provide up to 50 metric tons of food supplies right once in addition to other auxiliary resources like blankets, tarpaulins, and cash. It asks the US government for more resources if the needed quantity is greater than 50 metric tons. CRS, which provides roughly US$ 350 000 in food assistance annually, was asked to handle the delivery of the aid materials to the impacted region.

LWS, or Lutheran World Service

Since 1974, when it began operating in India in response to the needs of refugees from the Bangladesh conflict, LWS has served this country. Since then, LWS has carried out relief, recovery, and integrated development projects in a number of Indian states, mainly in West Bengal and Orissa. All programs are implemented either at the government's request or at its own initiative after consulting with the appropriate government officials. LWS engages in many levels of disaster response. Relief efforts are quick-acting projects that provide temporary housing, supplies, and food to catastrophe victims. Rehabilitation programs help impacted communities restore and reinforce other community assets in addition to rebuilding damaged homes and building school flood shelters. Programs for disaster preparation are long-term activities to increase the ability of communities that are vulnerable to disasters to cope.

Complex Organizations

Indian office of the European Commission

The largest provider of humanitarian aid, which includes help, relief, and protection efforts, is the European Union. Operations to avoid catastrophes and prepare for them are examples of this kind of assistance. Through a number of methods, the European Commission's (EC) operations are coordinated in cooperation with NGOs and the United Nations' specialized organizations. The

European Community Humanitarian Office (ECHO), operations supporting food aid and food security, and rehabilitation and reconstruction activities are the three channels through which the EC does its business. The European Commission has given India Rs. 2.52 crores for the victims of the AP cyclone in 1996. In response to requests from NGOs and international organizations, the EC provides funding for disaster prevention, mitigation, and preparation. The EC is funding more than ten programs for food assistance and food security via partnering NGOs. There has also been long-term development in disaster-affected communities.

Global Bank

The Disaster Management Facility (DMF) of the World Bank (WB) was created to integrate programs for disaster prevention and mitigation into all of its operations. In order to encourage market incentives for risk reduction, the DMF has launched the Market Incentives for Mitigation Investment programme. The following pilot research has been chosen for India:

1. Disaster loss expertise and susceptibility to fast-moving and gradual calamities.
2. Institutional and regulatory framework. rules for the insurance sector, rules for dealing with natural catastrophes and dangers, and so on.
3. Primary and reinsurance insurance market structures for casualty insurance.
4. The contribution of the insurance industry to the promotion of public awareness, risk-based premiums, and investment in mitigation.
5. The function of public policy in assisting the insurance sector with mitigation.
6. The contribution of the global reinsurance sector to risk mitigation.
7. IFIs' (International Financial Institutions) function in risk mitigation.

Heavy rains, floods, and cyclones across the subcontinent between June and December 1996 resulted in 1,689 fatalities and $2 billion in damage. The Andhra Pradesh state government asked the WB for help with the recovery operations in late November 1996. The main goal of the WB's support has been to establish long-term catastrophe mitigation capabilities across the state in order to guarantee the sustainability of the state's future growth. The project will likely cost $220 million in total. Its goals are to help the Andhra Pradesh state government prepare and execute a hazard management program in high risk regions, restore public infrastructure in accordance with standards for hazard resistance, and improve the early warning capabilities of the Indian government. Following the 1993 Latur earthquake, the WB launched a rehabilitation project to aid in reconstruction, improve the design and construction standards for buildings and infrastructure, and strengthen the state of Maharashtra's capacity to prepare for and handle disasters. The improvement of the state's long-term catastrophe management capability is the project's main goal, and its anticipated cost is US$328 million.

Organization for World Health (WHO)

The WHO South East Asia Regional Office in New Delhi developed an Emergency and Humanitarian Action team in 1995. In order to promote national self-reliance, it aims to provide assistance to the member states in developing and strengthening their emergency prevention, preparedness, mitigation, and response programs. The ERA also works to improve the disaster prevention, readiness, mitigation, and response programs of the Regional Officers and to provide emergency support when needed by the member states. With each member state, the unit will concentrate on:

1. National Health law and policy.
2. Planning, emergency management, and readiness.
3. Emergency preparation and management at the local level.
4. System for emergency information.
5. Institutionalizing human resource development through a multi-sectoral strategy.
6. Program for the Development of the Nations (UNDP).

In India, UNDP has been active for 50 years. Its agreement with the Indian government prohibits it from taking part in relief efforts unless expressly invited. However, development initiatives are often started after a catastrophe. Particularly in the wake of the 1993 Latur earthquake, the idea of disaster preparation and management has been included into its growth programs. UNDP gets information on the scope of catastrophe damage and casualty rates even though it is not directly engaged in immediate disaster response. UNDP participated in a combined agency expedition to the Malda area after the recent floods in West Bengal to evaluate the damage and the responses of UN agencies. The emphasis on include preparation and training for disaster management in development reflects a growing understanding of the impact catastrophe planning has on extensive development. The Emergency Response Division of UNDP funds efforts in two key areas to improve the country's ability to lessen, avoid, and manage catastrophes. Preventive development is the first and entails:

1. Determining a country's susceptibility to crises and natural catastrophes.
2. Putting in place early warning systems.
3. Creating and maintaining a framework for crisis-response strategies and other backup preparations for disasters.
4. Establishing and enhancing UN Disaster Management Teams.
5. Including programs for responding to, mitigating, and preventing disasters in national development plans.
6. Choosing and hiring experts whose services the Resident Coordinator or Humanitarian Coordinator may use in times of emergency.
7. The creation of National Human Development Reports.

Applying Crisis and Catastrophe Prevention and Mitigation Measures

The government, NGOs, community leaders, and partners in the United Nations get the training via the Disaster Management Training Programme. Between 1997 and 2001, UNDP expects to provide $200 million in aid for international development. With a robust field-based organization and a long history in India, UNICEF is there. UNICEF is equipped to react promptly and adaptably to crisis circumstances via its ten state offices. The Indian government, which hasn't solicited foreign assistance since 1974, may ask for it to respond. UNICEF's sole option for assistance is to donate money to the Prime Minister's Relief Fund, which it considers to be an improper channel. However, UNICEF can only provide disaster assistance in response to requests from the state or district levels. When a calamity strikes, US$ 10,000 is made accessible right away. Disaster relief is often an expansion of an existing program (drinking water programs, for instance, may be changed to include the bleaching of wells tainted following a flood). UNICEF conducted four flood status assessments and looked into how children were seriously traumatized by the floods after the joint agency visit to Malda area. UNICEF is engaging with the government to help enable a better coordinated disaster response process because it is very concerned about the fragmented reaction of the government, the UN, and NGOs.

High Commission for Refugees of the United Nations (UNHCR)

The UNHCR's two primary duties are to provide refugees with international protection and to look for long-term solutions to the refugee crisis. In February 1969, UNHCR opened its first office in New Delhi to help the 100,000 Tibetan refugees who were living in India at the time. Since then, it has helped more than 10 million Bangladeshi refugees, 50,000 Afghan refugees, and helped the Indian government return Sri Lankan refugees from Tamil Nadu. UNHCR only offers a little amount of financial aid since it would want to assist refugees in becoming self-sufficient. It encourages physically fit refugees to engage in income-generating enterprises and looks at the viability of cooperatives, microcredits, and community development initiatives. The most vulnerable groups in society and underdeveloped areas are the ones that suffer the most when a catastrophe strikes. These communities do, however, react to aid and are highly resilient. with support and encouragement for alleviation. They transform the losses caused by calamities into opportunities through help and encouragement [9].

Therefore, it is important to structure disaster management and mitigation around regional recovery activities. In order to work toward the common goal as effectively as possible, such a community-based model includes defined responsibilities for each stakeholder, designed on the basis of her or his different strengths and weaknesses. The main objectives of this strategy are to improve community capacity and boost the efficiency of relief and rehabilitation. In order to facilitate the new approach to disaster relief, mitigation, and rehabilitation, it is advised that a Delhi-based group of NGOs, nodal government ministries, and bilateral and multilateral organizations be established to encourage information exchange. Integration only leads to increased accountability, cost effectiveness, and strengthening of performance standards of mitigation and relief measures. It is clear that aid groups are refocusing their efforts on catastrophe preparation, community empowerment, and prevention. Long-term development plans are embracing catastrophe planning and risk reduction, and the rapid reaction to disasters is becoming more analytical and effective than in the past.

CONCLUSION

The Study comes to a conclusion by acknowledging how disaster response is changing and the increasing significance of technology and innovation. Digital platforms, social media, and data analytics have made it possible for agencies to use real-time information, improve situational awareness, and support focused response activities. The efficacy of the whole reaction is further increased by technical developments that provide enhanced early warning systems, distant sensing capabilities, and better resource management. In conclusion, this research gives a general overview of the government institutions, non-governmental organizations, and volunteer groups that are active in disaster response. It emphasizes their distinct duties and functions, the value of cooperation between these parties, and the use of technology to improving response efforts. Building resilient communities and guaranteeing an immediate, well-coordinated, and successful response to catastrophes need an understanding of the characteristics of these agencies and the promotion of good cooperation.

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CHAPTER 23

MEASURES FOR REDUCING RISK AND PREPAREDNESS

Dr. Varsha Agarwal, Associate Professor,
ISME - School of Management & Entrepreneurship, ATLAS SkillTech University, Mumbai, Maharashtra, India
Email Id: varsha.agarwal@atlasuniversity.edu.in

ABSTRACT:

Reducing risk and enhancing preparedness are crucial aspects of comprehensive disaster management. This chapter provides an overview of the measures implemented to reduce risk and enhance preparedness at various levels, including individual, community, and institutional. Risk reduction measures involve identifying potential hazards, assessing vulnerabilities, and implementing strategies to minimize their impact. These measures include land-use planning, adopting resilient building codes and regulations, implementing early warning systems, promoting ecosystem management, and raising public awareness through education and information campaigns. Preparedness measures focus on strengthening the capacity of individuals, communities, and institutions to respond effectively during emergencies. These measures encompass developing emergency response plans, conducting drills and exercises, training first responders, establishing communication networks, stockpiling essential supplies, and fostering collaborative partnerships.

KEYWORDS:

Disaster, Ecosystem, Geographic, Management, Risk, Sustainable Development.

INTRODUCTION

Strategies for disaster risk reduction (DRR) are designed to protect people's assets from the consequences of disasters. DRR often complements or forms the backbone of other programs like microfinance, food security, encouraging agricultural diversity, or capacity building. With preparation, planning, and advocacy issues, it may sometimes be a stand-alone activity. By bridging the gap between development and humanitarian projects, DRR may be considered as a strategy to improve livelihood security. Being ready for crises is being prepared. The phrase disaster preparedness refers to a larger range of activities, such as making emergency plans, locating emergency shelters, setting up emergency procedures, and preparing fast evaluations of stockpiling supplies. The design of emergency service material, training exercises for emergency personnel, training seminars and courses, and comprehensive community crisis preparation initiatives are all further aspects of preparedness. By determining the anticipated scope of a disaster, managers may build organizational procedures, plan suitable responses, and be prepared to meet new demands.

Typical Post-Disaster Needs

A Post-Disaster Needs Assessment (PDNA) is a strategy for coordinating the evaluation, analysis, and prioritization of damages, losses, and needs by numerous stakeholders (United Nations agencies and programs, the World Bank, donors, non-governmental organizations) in support of the national government. Over the past eight years, UNDP and the EU have increased their support for countries that are disaster-prone by helping them prepare for future recovery procedures,

identify their needs in the event of disasters, and lay the foundation for better recovery [1], [2]. The creation of modalities by the relevant organizations is the first step in the PDNA process. As commitments to a single agreed-upon output, the framework's creation, assurance that assessment does not impede the provision of immediate relief and early recovery, organization's roles and responsibilities, the makeup of the assessment team, resource needs, assessment logistics, and office-based and field roles are all included. PDNA's invention and introduction are treated as separate events in a chronological format. To ensure that all necessary agreements and arrangements for PDNA are in place before a disaster occurs and that the PDNA can be managed effectively, such interaction and planning for PDNA should ideally be initiated as a part of joint contingency planning for disaster events.

In order to effectively manage a PDNA, close communication is required between the national government and the representatives of the UN, European Commission, World Bank, and any other partners who may be lending assistance to the PDNA. The planned PDNA Study in India aims to provide standardized methods for post-disaster needs assessments in India, positioning it at the forefront of the issue globally [3]–[5]. Collecting current baseline data on the availability and accessibility of capital and physical assets in the affected area as well as the procedures used in the production and consumption of goods and services by the population. This will serve as the starting point for comparing conditions before and after the tragedy. To evaluate the extent of physical asset damage and the effect of the disaster on the production of goods and services, sectorial assessment teams carry out field inspections in the disaster-affected areas. The assessment teams will be able to calculate the value or cost of the disaster's effects damage and changed production flow thanks to this. The sector-specific effects of the disaster are combined, ensuring sure there are no duplicate or repeated accounting, to determine the total cost of damage and production flow disruptions caused by the tragedy.

Terrorism

Acts of violence or other harmful conduct against individuals committed for ideological or other political objectives are included in contemporary definitions of terrorism. The majority of definitions of terrorism limit it to actions intended to instill terror or dread. These assaults took place as a part of a more extensive ideological effort. They either disregard their safety or purposefully hurt noncombatants. Only violent crimes are also included in certain definitions. By convincing a government or population to comply with demands in order to avoid future harm or the fear of harm, overthrowing an established government, motivating a disgruntled population to participate in an uprising, escalating a conflict in an effort to upset the status quo, expressing a grievance, or drawing attention to a cause, terrorism is occasionally used as a form of unconventional warfare in an effort to compel political change. Various definitions of terrorism exist. However, there is widespread consensus among intellectuals that terrorism should never be permitted. Official definitions have an impact on and are often developed to assist counterterrorism policy. The following crucial components are included in the majority of official definitions: the intention behind the act, its motive, the target, and the offender. The declaration made by the terrorists themselves is another tool often used to recognize terrorism.

Fear and psychological impact: Both in terms of intensity and length, the attack was designed to have the biggest potential psychological impact. Each terrorist assault serves as a performance for a large audience. Terrorists typically attack national symbols in order to show off their power and to undermine the foundation of the country or civilization they are opposed to. This might make a

government seem less legitimate while bolstering the credibility of the particular terrorist organization and/or terrorist ideology that committed the terrorist act. All terrorist acts have one thing in common: they are all carried out with political motivation. Similar to writing letters or holding demonstrations, activists turn to terrorism as a political tactic when they believe that no other actions can bring about the desired changes. Since the change is so much desired, failure is seen as having greater consequences than the killing of people. This often occurs when there is a link between terrorism and a certain faith.

The failure to achieve the political goal (nationalism) is equated with spiritual failure, which, for the deeply committed, is worse than their own death or the deaths of innocent civilians. This happens when a political conflict is framed within a religious or cosmic conflict, such as over the ownership of a sacred location like Israel or Jerusalem or an ancestral homeland [6]–[8]. It's a common misconception that terrorism is defined by its deliberate and particular targeting of civilians, with individuals being its main focus. Often, the symbols, tools, animals, or corrupt beings that the terrorist targets are picked because they fit into the terrorist's particular worldview rather than because they constitute a threat. The terrorists' suffering serves to instill fear, convey a message to a target audience, or further their political agenda. Using disguises, terrorists almost invariably prey on non-combatants, conceal themselves among them, and take part in combat from among them. They also attempt to mislead and incite the military to strike the wrong targets so that the administration may be held responsible. When an adversary may be identified as a combatant, the word terrorism is seldom employed. Although they definitely constituted crimes against humanity, mass hostage executions like those committed by the Nazi military during World War II are not often referred to as terrorism.

Unlawfulness or illegitimacy. Some official definitions of terrorism include a criterion of illegitimacy or unlawfulness to distinguish between actions taken by other participants, such as individuals and small organizations, and those that are endorsed by a legitimate government and, therefore, lawful. If a terrorist attack is sanctioned by the government, it would not be considered terrorism under this definition. For instance, it would not be considered terrorism if a legitimate government authorized the use of firebombs to persuade citizens to support a cause. Since legitimacy and lawfulness are relative concepts that depend on the point of view of each government, this standard is inherently flawed and not widely accepted because it separates state terrorism from reality, classifies the same act as terrorism or not depending on whether its sponsorship can be linked to a legitimate government, and departs from the historically accepted definition and context of the term. These factors account for why this criterion is not generally accepted. Most definitions of the term in dictionaries lack this criterion.

DISCUSSION

Terrorism in its many forms. Terrorism was divided into six categories:

Civil Disorders: A kind of mass violence that makes it difficult for a community to live safely and peacefully.

Political Terrorism: violent criminal behavior with the primary goal of terrorizing a sizeable segment of the population for political purposes. Conscious design to create and maintain a high degree of fear for coercive purposes, but the end is individual or collective gain rather than the achievement of a political objective is how non-political terrorism is described (source).

Quasi-Terrorism: Criminal activity that has elements of actual terrorism in both form and execution but lacks the essential element of that crime. Although the main objective of quasi-terrorists is not to scare the immediate victim, as is the case with genuine terrorism, they do this by using techniques and strategies that are similar to those used by real terrorists and obtaining similar outcomes and reactions. For instance, a quasi-terrorist is a wanted felon who kidnaps someone; although they use similar tactics to a true terrorist, their objectives are quite different.

Limited Political Terrorism: While genuine political terrorism is distinguished by a revolutionary strategy, limited political terrorism is defined as acts of terrorism which are committed for ideological or political motives but which are not part of a concerted campaign to capture control of the state.

Official or State Terrorism: Refers to nations with governments built on oppression and fear that rivals terrorism in intensity.

Distribution in the Region

A spatial ontology could include things like hills, lakes, and rivers in addition to perhaps include cities, buildings, and more chapter ideas like nations and their boundaries. The inclusion of terrorism in such an ontology, however, is unthinkable, in our opinion. After multiple recent terrorist attacks, it is believed that there is a new geography of terrorism, thus we need to create a new map of potential targets wherever on Earth. Because it is an ad hoc phenomenon, terrorism may happen anytime there is disturbance.

The Origins and Consequences of Terrorism

There are several opinions on where terrorism started. They consist of social, political, and demographic factors. Demographic challenges could include congestion and fast growth rates. On the other hand, there are socioeconomic factors including unemployment, poverty, and problems with land tenure. Political difficulties include retribution, disenfranchisement, territorial conflict, access to resources, and ethnic, religious, and territorial conflicts.

The Causes of Terrorism

All terrorist attacks are motivated by the following facts:

Social and Political Injustice: People often resort to terrorism in an effort to make amends for what they perceive to be a social, political, or historical wrong. When their rights have been infringed or their land has been stolen from them. The belief that using violence or being afraid of using violence would succeed and effect change. Many terrorists in the past have really said that they felt they had no choice but to use violence after giving it some thought. Ethno-nationalism may result in the growth of terrorist groups when a group of people seeks to break away from a government or other dominating force and form their own state. When nations or regions sought independence from their colonial rulers in the 20th century, this was often seen.

Discrimination and Alienation: Terrorism is sparked by a sense of isolation felt by diasporas. These groups often encounter discrimination in the countries where they reside, which makes them feel even more alone. People often move from less developed countries especially Muslim countries in the case of Europe to wealthy ones to attend education or find jobs.

Religion: The notion that terrorism has its roots in religion is likely the one that is now most frequently recognized. Even if it is not the main factor in terrorism, religion does have a significant impact on certain of its expressions.

Socio-Economic Status: Globalization and modern media have made the have nots painfully aware of their plight in relation to the haves, which adds to a sense of relative depravation and a lack of upward social mobility. The economic differences between themselves and the West may infuriate certain people in underdeveloped countries, exacerbating conflicts.

Political Resentments: People who feel excluded from politics in their states or who have grievances against a certain political system may join or form terrorist groups. Both left and right-wing terrorists often attack political structures.

David Kilcullen's Accidental Guerrilla concept is known as The Accidental Guerrilla. He asserts that when a terrorist organization establishes in a country with a poor administration or one that is disturbed by conflict, they use it as a safe haven to spread their ideology around the globe and as a base from which to conduct violent acts. The local population opposes the foreign invaders and forms an alliance with the terrorist group when outside forces intervene to deal with the threat posed to them by this group. As a consequence, more terrorists are attracted to the cause, and terrorist groups get sympathy from the general people [9]–[11].

An Inclusive World, a global research paper written by a multinational team of academics from all continents, examines the causes of modern terrorism. It has been determined that terrorism functions worldwide like an economic market. Because of greed or resentment, terrorists are in high demand. Supply is impacted by relative deprivation, creating a triple deficit that includes a deficit in dignity and democratic advancement. Terrorist activities take place when supply and demand diverge. By using religion and other points of affinity, the supply side and demand may connect. From Palestine to the Philippines and Colombo to Colombia, this movement is pervasive. Unfortunately, the only way to effectively relieve this is to increase the economy of the town, the country, and the area, but this takes time. There will always be those who are angry and dissatisfied by the disparity between their own living standards and those of the wealthy throughout the world. This driver is thus particularly difficult to resist since globalization makes it feasible for extra mechanisms of comparison across multiple global socio-economic levels.

The Impact of Terrorism on Society and the Economy

The deliberate use of force against unarmed civilians, armed persons, and the state constitutes terrorism. It is a prohibited and forced method of getting what you want. Its only objective is to overthrow the current order and legal system.

Social Consequences

Law and order are seriously threatened by terrorism, which also destroys societal order. Suspicion, fear, and panic were propagated across the region as a result of murder, torture, mutilation, kidnapping, arson, and extortion incidents. The future is a mystery. Terrorists slaughter helpless civilians, including women and children. Organize crime and violence are factors in social instability. The relationships between various rebel groups and the links they have to other nations help to enable smuggling and bring in illegal funding. Many rebel groups routinely steal a certain amount of money from employees and company owners. The region's economy stops expanding. Our government has to invest a lot of money to tackle the risks presented by terrorism.

Societies coping with terrorism tend to have a victimizing mentality. As more and more civilians are being targeted, this sense of victimhood intensifies. This sense of victimization leads to the delegitimization of the terrorists and the organization they represent. As a consequence, the targeted society finds it difficult or impossible to consider the issues and objectives of the opposition. Another important social effect of terrorism is the development of xenophobia and ethnocentrism when a society becomes more unified in the face of violence.

Monetary Effects

Terrorist attacks may have more significant indirect economic repercussions than direct ones, however. The attack site's devastation of life and property has the greatest direct financial effects. Although terrorism has many and varied indirect economic effects, it is quite challenging to put a number on them. As Israel saw during the second Intifada, a protracted terrorist campaign may surely have an impact on a state's GDP.

Psychological Repercussions

Following a tragedy or act of terrorism, children are more vulnerable to mental health problems, including those who live in the affected area, see the incident firsthand, lose loved ones as a consequence, or merely watch coverage of it on television.

Psychosocial Support

Every participant in the event, whether they were directly involved or not, may be affected, and many may need psychiatric support. A significant proportion of people may develop new psychosocial issues or mental diseases that need more rigorous and, sometimes, continuous treatment. Terrorism is quite likely to occur. The evidence of the affected population has increased significantly along with the number of people killed by these catastrophes. Strategic preparedness encourages psychosocial resilience, which is likely to strengthen responses to psychosocial demands of people and decrease the chance of extreme pain and mental illness.

The Financial Needs of terrorism

In particular, in the areas of tourism, business, and finance, studies on the microeconomic impacts of sector-specific attacks date back to the early 1990s. Attacks against popular tourist locations such as airports, hotels, or attractions or popular means of transportation such as airplanes compel tourists to carefully consider the risks involved in their trip plans. Travelers may decide to alter their travel plans and book a holiday in a country without a history of terrorism after even one horrifying occurrence takes place in a notorious terrorist hotspot. The government should take specific steps to safeguard its residents in order to avoid tourism from losing its importance as a source of support for the national economy.

Insurance-Related Events

Terrorism is also costly for certain areas of the economy since insurance firms sometimes face surprise claims. Following the attacks, insurance companies often stopped offering policies that covered losses brought on by terrorism; as a result, the cost of terrorism insurance is now subsidized by the federal government. Terrorism is another man-made disaster that is the result of a planned, unlawful act. To advance their goals, terrorists use a variety of methods, such as biological, nuclear, incendiary, chemical, and explosive ones. Other catastrophes, including unintended disasters, include hazardous materials and transit problems. Thus, one may conclude

that, in the case of man-made disasters, bad technology may lead to costly mistakes. Humans are to fault for man-made disasters because of our ignorance and, in certain situations, our intentional conduct, which may cause irreversible damage. The majority of disasters result in the death of many helpless humans, animals, and forest inhabitants. But in order to safeguard our world and lessen the frequency of man-made catastrophes, we should strive to prevent disasters before they happen and cultivate a more vigilant mindset. Sometimes the greatest response to man-made disasters is to take effective precautions before it happens. In conclusion, developing resilient societies requires taking steps to lower risk and improve readiness. Communities may lessen the effects of catastrophes and enhance their overall capacity for disaster response by putting preventive plans into place and promoting a culture of readiness.

CONCLUSION

We live in a civilized world where man has turned against himself since so many sad events are caused by irresponsible human conduct. These are known as man-made disasters. In a word, man-made disasters are dangers caused by human action or inaction. Chemical weapons, risk-taking negligence, illiteracy, ignorance, and other factors are only a few of the things that might lead to man-made disasters. Train accidents, airline crashes, building collapses, bridge collapses, mine collapses, tunnel collapses, etc. are some common examples of man-made disasters. These happen as a result of human error or inappropriate handling of dangerous equipment used in industrial and technological settings. Humans have made major achievements in science and technology. Science and technological advancements have made it possible for people to build nuclear power facilities. An adverse environmental effect brought on by radioactive substances or radiations is referred to as a nuclear disaster. A chemical disaster is also the unintentional disposal of one or more toxic substances that might be harmful to the environment or human health. The AMRI Hospital Fire, Kolkata, and the Bhopal Gas Tragedy are a few examples of man-made disasters. The necessity for disaster management is essential because it addresses issues that develop before, during, and after the catastrophe.

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