# Geographical study and exploration of disaster especially earthquake in India and its management

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***Abstract:*** *Natural disasters are calamitous occurrences that put a community's well-being and ability to operate in jeopardy. Significant harm may be done to both public and private assets as a result of it. These catastrophes may take the form of storms, floods, tsunamis, or avalanches, among other things. This should be aware that in addition to natural causes, artificial factors may also be a factor in the occurrence of catastrophes. Landslides may be caused by a variety of human activities, including but not limited to deforestation, agricultural operations, mining, and so on. Wildfires, in addition, pose a threat to the natural habitats of the plants and animals they pass through. An earthquake, also known as a quake, tremor, or temblor, is the shaking of the surface of the Earth that occurs as a consequence of a rapid release of energy in the Earth's lithosphere that generates seismic waves. Other names for an earthquake include quake, tremor, and temblor. There is a wide variety of possible quake intensities, from those that are so mild that they cannot be felt to those that are strong enough to launch items and people into the air and wreak havoc throughout an entire city. An area's seismic activity may be defined by the number of earthquakes, the types of earthquakes that occur there, and the magnitudes of those earthquakes. The average rate of seismic energy release per unit volume may be thought of as a location's seismicity. Seismicity can be measured everywhere on Earth. A seismic rumbling that is not an earthquake is often referred to as a tremor. This paper explores the Geographical study Exploration of disaster Geographical study Exploration of disaster especially earthquake in India and its management.*

***Keywords:*** *Natural disasters, earthquakes, Seismicity, seismic rumbling*

## I. Introduction

Natural disasters are catastrophic events that threaten the safety and function of a community. It can damage both public and personal properties significantly. These disasters can range from hurricanes, floods to tsunamis and avalanches. This should know that apart from natural causes, disasters can occur due to anthropogenic causes. Activities like deforestation, agricultural practices, mining, etc., can cause landslides. In addition, wildfires can again damage the natural habitat of plants and animals. An **earthquake** (also known as a **quake**, **tremor** or **temblor**) is the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves. Earthquakes can range in intensity, from those that are so weak that they cannot be felt, to those violent enough to propel objects and people into the air and wreak destruction across entire cities. The **seismic activity** of an area is the frequency, type, and size of earthquakes experienced over a particular time period. The seismicity at a particular location in the Earth is the average rate of seismic energy release per unit volume. The word tremor is also used for non-earthquake seismic rumbling. At the Earth's surface, earthquakes manifest themselves by shaking and displacing or disrupting the ground. When the epicentre of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides. In its most general sense, the word earthquake is used to describe any seismic event whether natural or caused by humans that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its hypocenter or focus. The epicenter is the point at ground level directly above the hypocentre.

### 1.1 The Worst Indian Earthquakes

It was 26th January 2001, Republic Day in India. Students were on their way to school for celebrations in their classrooms. Those who thought republic day was just another holiday were snoring. Leaders all over the country were hoisting the tricolor flag. As an on-going tradition people were distributing sweets among children. Some were holding flags, some busy attaching a small flag on their shirts. Some were chatting with their friends for planning and enjoying the rest of the day. Suddenly, news struck that an earthquake has taken place in Gujarat. As time passed by, the news come in: a massive earthquake with tremendous loss of life and property. Reportedly 30,000 people died and many others got injured. This is the real story of the Gujarat earthquake. There are 5 majors types of natural disasters. These are following which explain the disaster categories.

### Geological disaster

Changes in the above or underneath the earth's surface cause geological disasters. The effects of natural disasters due to tectonic plates are unpredictable and beyond human control. Earthquakes, volcanic eruptions, landslides, avalanches, etc., are examples of geological disasters.

**Hydrological disaster**

Hydrological disasters are caused due to sudden changes in the quality or distribution of water below the earth's surface or atmospheric conditions. Flood and drought both fall under hydrological disasters. These disasters can cause harm to agriculture and properties. Limnic eruption, Tsunami, Volcano, etc., are examples of Hydrological disasters.

**Meteorological disaster**

Meteorological disasters are mainly caused by extreme weather conditions such as drought, snow, and rain. These disasters affect the weather forming process and atmospheric conditions. Examples of meteorological disasters include blizzards, drought, cold waves, tornadoes, cyclonic storms, etc.

**Space disaster**

This includes disasters caused due to asteroids, meteors, and solar flares.

**Wildfires**

Natural disasters like drought and lightning can lead to wildfires. However, many humans also start fires in forests to create space for agricultural land. This will help us in implementing the needed disaster management techniques.

**Major Causes Natural Disasters**

The major causes of natural disaster include -

- Natural phenomenon
- Moon activities
- Tectonic movement
- Soil erosion
- Deforestation
- Ocean currents
- Air pressure
- Seismic waves
- Pollution
- Global warming
- Mining

**Effects of Natural Disasters in India?**

The common effects of natural disasters include -

- Damages to infrastructure
- Food and water scarcity
- Public health issues and diseases
- Environmental issues
- Economic impact
- Fatalities
- Injuries and emotional impact

**Major Natural Disasters till 2013**

**1. Kashmir Flood**

- **Occurrence**- 2013
- **Fatalities**- 550+

Continuous rainfall and swelling of the Jhelum river caused a major flood in Kashmir. It caused damage worth ₹6000 crores.

**2. Uttarakhand Flood**

- **Occurrence**- 2013
- **Fatalities**- 5700+

A huge cloudburst caused landslides and flash floods in Uttarakhand from 14th June to 17th June. More than 1 lakh pilgrims were struck in the Kedarnath shrine.

**3. Tsunami**

- **Occurrence**- 2004
- **Fatalities**- more than 227,898

An earthquake with a magnitude of 9.1 to 9.3 caused this disaster. The tsunami had a major impact on people's lives. Most households in India, Andaman 7 Nicobar Islands and Sri Lanka were affected.

**4. Gujarat Earthquake**

- **Occurrence**- 2001
- **Fatalities**- more than 20,000

The Richter scale showed 7.6 magnitudes. It damaged nearly 4 lakh homes. This earthquake lasted for 120 seconds.

**5. Odisha Super Cyclone**

- **Occurrence**- 1999
- **Fatalities**- more than 15,000

It was marked as the most dangerous tropical cyclone in the North Indian ocean. The cyclone moved at an intensity of 260 km/h. It destroyed nearly 2.57 lakh houses.

**6. Bengal Famine**

- **Occurrence**- 1770
- **Fatalities**- Approximately 1 crore

This famine was caused due to a failed monsoon in 1769 and continued for two centuries. The British East India company's exploitive policy and weather conditions lead to this disaster.

## II. Literature Review

**Phalkey et al. (2011),** The number of injured far exceeds those dead and the average injury to mortality ratio in earthquakes stands at 3:1. Immediate effective medical response significantly influences injury outcomes and thus the overall health impact of earthquakes. Inadequate or mismanagement of injuries may lead to disabilities. The lack of precise data from immediate aftermath is seen as a remarkable weak point in disaster epidemiology and warrants evidence generation. To analyse the epidemiology of injuries and the treatment imparted at a secondary rural hospital in the Kutch district, Gujarat, India following the January 26, 2001 earthquake. Discharge reports of patients admitted to the hospital over 10 weeks were analysed retrospectively for earthquake-related injuries. Orthopaedic injuries, (particularly fractures of the lower limbs) were predominant and serious injuries like head, chest, abdominal, and crush syndrome were minimal. Wound infections were reported in almost 20% of the admitted cases. Surgical procedures were more common than conservative treatment. The most frequently performed surgical procedures were open reduction with internal fixation and cleaning and debridement of contaminated wounds. Four secondary deaths and 102 transfers to tertiary care due to complications were reported. The injury epidemiology reported in this study is in general agreement with most other studies reporting injury epidemiology except higher incidence of distal orthopaedic injuries particularly to the lower extremities. They also found that young males were more prone to sustaining injuries. These results warrant further research. Inconsistent data reporting procedures against the backdrop of inherent disaster data incompleteness calls for urgent standardization of reporting earthquake injuries for evidence-based response policy planning.

**Zook et al. (2010),** This paper outlines the ways in which information technologies (ITs) were used in the Haiti relief effort, especially with respect to web-based mapping services. Although there were numerous ways in which this took place, this paper focuses on four in particular: CrisisCamp Haiti, OpenStreetMap, Ushahidi, and GeoCommons. This analysis demonstrates that ITs where a key means through which individuals could make a tangible difference in the work of relief and aid agencies without actually being physically present in Haiti. While not without problems, this effort nevertheless represents a remarkable example of the power and crowdsourced online mapping and the potential for new avenues of interaction between physically distant places that vary tremendously.

**Srinivas & Nakagawa (2008),** The impact of disasters, whether natural or man-made, not only has human dimensions, but environmental ones as well. Environmental conditions may exacerbate the impact of a disaster, and vice versa, disasters tend to have an impact on the environment. Deforestation, forest management practices, or agriculture systems can worsen the negative environmental impacts of a storm or typhoon, leading to landslides, flooding, silting, and ground/surface water contamination. They have only now come to understand these cyclical causes and impacts and realize that taking care of our natural resources and managing them wisely not only assures that future generations will be able to live in sustainable ways, but also reduces the risks that natural and man-made hazards pose to people living today. Emphasizing and reinforcing the centrality of environmental concerns in disaster management has become a critical priority, requiring the sound management of natural resources as a tool to prevent disasters and lessen their impacts on people, their homes, and livelihoods. As the horrors of the Asian tsunami of December 2004 continue to be evaluated, and people in the region slowly attempt to build a semblance of normalcy, they have to look to the lessons learnt from the tsunami disaster as an opportunity to prepare ourselves better for future disasters. This article focuses on findings and lessons learnt on the environmental aspects of the tsunami, and its implications on disaster preparedness plans.

**Saatcioglu et al. (2006),** A reconnaissance was conducted in Indonesia to investigate the effects of the 26 December 2004 earthquake and tsunami on buildings, bridges, and other physical infrastructure. The infrastructure in the coastal regions of Banda Aceh was completely devastated by both tsunami wave pressures and seismic ground excitations. The damaging effects of the tsunami were most pronounced in unreinforced masonry walls, nonengineered reinforced

concrete buildings, and low-rise timber-framed buildings. Engineered structures survived the tsunami pressure, but many suffered extensive damage due to seismic forces. The majority of the seismic damage was attributed to poor design and detailing of nonductile buildings. Specific observations made during the reconnaissance indicate the engineering significance of the disaster.

**Rashed & Weeks (2003),** Assessing urban vulnerability to natural hazards such as earthquakes can be regarded as an ill-structured problem (i.e., a problem for which there is no unique, identifiable, objectively optimal solution). A review of the literature indicates a number of contrasting definitions of what vulnerability means, as well as numerous conflicting perspectives on what should or should not be included within the broad assessment of vulnerability in cities. This paper reports on the findings from a project in which a GIS methodology has been developed to assess urban vulnerability through a spatial analytical procedure. First, they highlight the deficiencies of current GIS approaches to urban vulnerability analysis and discuss the ill-structured nature of the vulnerability problem. They then propose a working definition for vulnerability assessment in which vulnerability is thought of as a spatial decision problem under the conditions of uncertainty. Next, they present a methodology to incorporate this definition into a GIS framework that combines elements from the techniques of spatial multicriteria analysis and fuzzy logic. The application of this methodology is then illustrated with a case study from Los Angeles County. The results suggest that the proposed methodology may provide a new approach for analysing vulnerability that can add to our understanding of human/hazards interaction.

**Shaw (2003),** Asia is regarded as a high hazard and highly vulnerable are in the world, with respect of natural disasters. Earthquakes are one of the most challenging among other disasters, because of its low frequency and high consequence nature. While there are different role players in earthquake disaster management, the paper focuses on the role of non-government organizations in earthquake disaster management with emphasis on Asia. A situation analysis shows that different parts of Asia is characterized by different levels of NGO participation, out of which south Asia is the most dominant area in NGO activities. NGOs play important roles in different stages of Disaster Cycle, and different elements are attributed for its successful operation. While technical skills are important for rescue, coordination is the essential for relief activities. Commitment is the key word for reconstruction and rehabilitation and cooperation of different stakeholders is important for preparedness. Role of NGOs should be viewed in the perspective of multistakeholder cooperation, and sustainability, flexibility and motivation are the key words for the successful NGO operation in the field of earthquake disaster management.

**Van Westen (2000),** Natural disasters are extreme events within the earth's system that result in death or injury to humans, and damage or loss of valuable goods, such as buildings, communication systems, agricultural land, forest, natural environment etc. The economic losses due to natural disasters have shown an increase with a factor of eight over the past four decades, caused by the increased vulnerability of the global society, but also due to an increase in the number of weather-related disasters. For the management of natural disasters, a large amount of multi -temporal spatial data is required. Satellite remote sensing is the ideal tool for disaster management, since it offers information over large areas, and at short time intervals. Although it can be utilised in the various phases of disaster management, such as prevention, preparedness, relief, and reconstruction, in practice up till now it is mostly used for warning and monitoring. During the last decades remote sensing has become an operational tool in the disaster preparedness and warning phases for cyclones, droughts and floods. The use of remote sensing data is not possible without a proper tool to handle the large amounts of data and combine it with data coming from other sources, such as maps or measurement stations. Therefore, together with the growth of the remote sensing applications, Geographic Information Systems have become increasingly important for disaster management. This chapter gives a review of the use of remote sensing and GIS for a number of major disaster types.

## III. Preventive Measures to Follow During Natural Disasters

Since it is impossible to stop the occurrence of natural disasters, it is crucial to find ways to alleviate the adverse effects

These are some methods to reduce the effects of major natural disasters in India -

- Preparing emergency measures- medical kits, keeping a tab over weather updates
- Reforestation
- Risk reduction methods- building shelters and stocking food supplies
- Information sharing
- Investing in technology for accurate weather predictions
- Economic support
- Evacuating areas closer to disaster

### 3.1 Preventive Measure During Natural Disasters

The dos have been already mentioned under the preventive measures. So now, let’s check at the don'ts.

- Move around or outruns a disaster
- Go near-live wire or debris

- Don't take shelter under a flimsy structure
- Avoid standing under the trees
- Stay away from river or sea areas during cyclones and floods
- Avoid using gas stoves or electronic gadgets during a disaster.

Follow these measures to protect from the major impact caused by natural disasters. However, a catastrophe causes major damages to property and livestock. Managing the repair cost and funds can be problematic for many. In this regard, ensuring the valuables would compensate for the losses.

### 3.2 Insurance Products People Residing in the Natural Disaster-Prone Areas Should Buy

These are some insurance policies individuals residing in natural disaster-prone areas should check.

- **Home Insurance**: Insuring a house can be helpful during disasters. The policy covers the damage caused by natural events like floods, cyclones and storms. Additionally, it also gives coverage against theft and burglary.

- **Life Insurance**: A life insurance policy is a contract between a policyholder and insurance company that promises to pay a sum after the death of an insured person. It offers an insured and his/her family financial protection during unforeseen events. This can also find some policies that offer additional add on options like accidental death benefit, critical ill benefit, etc.

- **Vehicle Insurance**: Vehicle insurance gives protection against natural calamities and disasters. It also covers accidents and theft. Individuals can avail the policy against their vehicle and get compensation for damages caused by natural disasters.

Additionally, individuals can check disaster specific insurance policies for a sustainable solution. There has been much technological advancement to calculate the occurrence of natural calamities. However, preventing the damages caused by these calamities is impossible. Hence, detailed knowledge of the types of natural disasters and the ways of disaster management can help individuals combat such situations better. In addition, check the weather forecast or radio for updates on disasters in India.

### 3.3 Most powerful earthquakes of India

| Sr. No. | Place | Deaths | Date, Time, and Year | Magnitude | Epicentre |
|---|---|---|---|---|---|
| 1 | Indian Ocean | > 283,106 | 08:50, December 26, 2004 | 9.1–9.3 | West coast of Sumatra, Indonesia |
| 2 | Kashmir | 130,000 | 08:50:38, October 8, 2005 | 7.6 | Muzaffarabad, Pakistan-administered Kashmir |
| 3 | Bihar and Nepal | > 30,000 | 14 :13, January 15, 1934 | 8.7 | South of Mount Everest |
| 4 | Gujarat | 20,000 | 08:50:00, January 26, 2001 | 7.7 | Kutch, Gujarat |
| 5 | Kangra | > 20,000 | 06:10, April 4, 1905 | 7.8 | Himalayas |
| 6 | Latur | > 9,748 | 22:25, September 30, 1993 | 6.4 | Killari, Latur |

| Sr. No. | Place | Deaths | Date, Time, and Year | Magnitude | Epicentre |
|---|---|---|---|---|---|
| 7 | Assam | 1,526 | 19:39, August 15, 1950 | 8.6 | Rima, Tibet |
| 8 | Assam | 1,500 | 17 :11, June 12, 1897 | 8.1 | Exact location not known |
| 9 | Uttarkashi | >1,000 | Unknown time, October 20, 1991 | 6.8 | Garhwal, Uttarakhand |
| 10 | Koynanagar | 180 | 04:21, December 11, 1967 | 6.5 | Koyna |

## IV. Conclusion

Dangers to human life and economic stability are exacerbated by natural catastrophes. It poses a serious threat to both public and private property. Storms, floods, tsunamis, and avalanches are only few examples of the kinds of natural disasters that might occur. This should be aware that manmade variables, in addition to natural ones, may contribute to the incidence of disasters. Human activities like clearing land for farming or mining increase the risk of landslides. Furthermore, wildfires endanger the natural environments of the plants and animals they consume. Quakes, tremors, and temblors are all names for the same thing: the shaking of the Earth's surface brought on by seismic waves caused by a sudden release of energy in the planet's lithosphere. Quake, tremor, and temblor are all alternative terms for an earthquake. Earthquakes may range in strength from barely perceptible tremors to devastating events that can shake a whole city to its foundations and send buildings down. The seismic activity of a region may be measured in terms of the frequency and intensity of earthquakes as well as the kinds of earthquakes that occur there. Seismicity may be conceived of as a region's typical rate of seismic energy release per volume. We have the technology to measure seismic activity all around the planet. A tremor is a seismic rumbling that does not qualify as an earthquake. The geographical research Exploration of catastrophe is the subject of this work. Geographers delve into the aftermath of natural disasters in India, with a focus on the country's response to the devastating 2004 earthquake.

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