

Disaster management: An empirical study of earthquakes in India

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Abstract

Disasters and their management implies to the planning and preparing the strategy to tackle and handle the disaster in a responsible and effective. It aims at safeguarding maximum number of lives from the disaster. This paper aims at analyzing the loss that has been caused by disaster such as earthquake and also highlights the steps that can be taken to save life during and after disaster. The paper is an attempt to understand the root causes and hazards of Earthquakes in India.

Keywords: Disaster, Management of disasters, Earthquakes

Introduction

A sudden, calamitous event bringing great damage, loss, and destruction and devastation to life and property is known as Disaster. The damage caused by disasters is immeasurable and varies with the geographical location, climate and the type of the earth surface/degree of vulnerability. This influences the mental, socio-economic, political and cultural state of the affected area.

Types of disasters in India

Many regions in India are highly vulnerable to natural and other disasters on account of geological conditions. About 65% of the total area of the country is vulnerable to seismic damage of buildings in varying degrees. The most prone areas, according to the present seismic zone map of India, are located in the Himalayan and sub-Himalayan regions. Kutch and the Andaman and Nicobar Islands, which are particularly earthquake hazard prone. Over 8% Indian area of 40 million hectares is prone to floods, and the average area affected by floods annually is about 8 million hectares of the nearly 7,550 kilometers long coastline, approximately 5,700 kilometers is prone to cyclones.

prediction of earthquakes is difficult, seismic safety of built environments that will ensure that structures do not collapse, forms an important cornerstone of earthquake disaster mitigation efforts.

Earthquakes

Earthquake is one of the most destructive natural hazard. They may occur at any time of the year, day or night, with sudden impact and little warning. They can destroy buildings and infrastructure in seconds, killing or injuring the inhabitants. Earthquakes not only destroy the entire habitation but may destabilize the government, economy and social structure of the country. Earthquakes are the manifestations of sudden release of strain energy accumulated in the rocks over extensive periods of time in the upper part of the Earth.

Cause of Earthquake

The earth's crust is a rocky layer of varying thickness ranging from a depth of about 10kilometers under the sea to 65 kilometers under the continents. The crust is not one piece but consists of portions called 'plates' which vary in size from a few hundred to thousands of kilometers. The 'theory of plate tectonics' holds that the plates ride up on the more mobile mantle, and are driven by some yet unconfirmed mechanisms, perhaps thermal convection currents. When these plates contact each other, stress arises in the crust. These stresses can be classified according to the type of movement along the plate's boundaries:

- a) Pulling away from each other,
- b) Pushing against one another and
- c) Sliding sideways relative to each other.

All these movements are associated with earthquakes. The areas of stress at plate boundaries which release accumulated energy by slipping or rupturing are known as 'faults'. The theory of 'elasticity' says that the crusts continuously stressed by the movement of the tectonic plates; it eventually reaches a point of maximum supportable strain. A rupture then occurs along the fault and the rock rebounds under its own elastic stresses until the strain is relieved. The fault rupture generates vibration called seismic (from the Greek 'seismos' meaning shock or earthquake) waves, which radiates from the focus in all directions. The point of rupture is called the 'focus' and

Table 1: Natural Disaster Categories, Types, and Subtypes

Geophysical	Hydrological	Meteorological
Earthquake	Flood General flood	Storm Tropical cyclone
Volcano	Storm surge/coastal	Extra-tropical cyclone Local
Mass movement	flood Mass	storm Climatological
(dry) Rock-fall	movement (wet)	Extreme temperature Heat
Landslide	Rock-fall Landslide	Waves Cold Waves Extreme
Avalanche	Avalanche	winter condition Drought/
Subsidence	Subsidence	wildfire Forest Fire Land
		Fire

Disaster management- The Management of earthquakes

India is highly vulnerable to earthquakes, with more than 65% of the land being prone to tremors of Richter Intensity 7.0 and greater, that can cause structural damage. Earthquakes continue to cause large-scale human fatalities, most of which are due to collapse of man-made structures. Recent earthquakes have revealed the under-preparedness of the country in facing its impacts. Since short-or mid-term

may be located near the surface or deep below it. The point on the surface directly above the focus is termed as the epicenter' of the earthquake

Measure of Earthquake

Richter scale is a quantity to measure the size of an earthquake and is independent of the place of the observation.

Classification of earthquakes	
Category	Magnitude on Richter Scale
Slight	Upto 4.9
Moderate	5.0 to 6.9
Great	7.0 to 7.9
Very Great	8.0 and more

Source: www.imd.gov.in

The Earthquake Risk in India

India's increasing population and extensive unscientific constructions mushrooming all over, including multistoried luxury apartments, huge factory buildings, gigantic malls, supermarkets as well as warehouses and masonry buildings keep - India at high risk. During the last 15 years, the country has experienced 10 major earthquakes that have resulted in over 20,000 deaths. As per the current seismic zone map of the country (IS 1893: 2002), over 59 per cent of India's land area is under threat of moderate to severe seismic hazard-; that means it is prone to shaking of MSK Intensity VII and above (BMTPC, 2006). In fact, the entire Himalayan belt is considered prone to great earthquakes of magnitude exceeding 8.0-; and in a relatively short span of about 50 years, four such earthquakes have occurred: 1897 Shillong (M8.7); 1905 Kangra (M8.0); 1934 Bihar-Nepal (M8.3); and 1950 Assam-Tibet (M8.6). Scientific publications have warned of the likelihood of the occurrence of very severe earthquakes in the Himalayan region, which could adversely affect the lives of several million people in India.

At one time regions of the country away from the Himalayas and other inter-plate boundaries were considered to be relatively safe from damaging earthquakes. However, in the recent past, even these areas have experienced devastating earthquakes, albeit of lower magnitude than the Himalayan earthquakes. The occurrence of the Killari earthquake in 1993 resulted in further revision of the seismic zoning map in which the low hazard zone or Seismic Zone I was merged with Seismic Zone II, and some parts of Deccan and Peninsular India were brought under Seismic Zone III consisting of areas designated as moderate hazard zone areas.

The North-Eastern part of the country continues to experience moderate to large earthquakes at frequent intervals including the two great earthquakes mentioned above. Since 1950, the region has experienced several moderate earthquakes. On an average, the region experiences an earthquake with a magnitude greater than 6.0 every year. The Andaman and Nicobar Islands are also situated on an inter-plate boundary and frequently experience damaging earthquakes.

The increase in earthquake risk is due to a spurt in developmental activities driven by urbanization, economic development and the globalization of India's economy. The increase in use of high-technology equipment and tools in manufacturing and service industries has also made them susceptible to disruption due to relatively moderate ground shaking. As a result, loss of human life is not the only

determinant of earthquake risk any more. Severe economic losses leading to the collapse of the local or regional economy after an earthquake may have long-term adverse consequences for the entire country. This effect would be further magnified if an earthquake affects a mega-city, such as Delhi or Mumbai.

Earthquakes in India

- January 3, 2016; 6.7, North East India, Regional event that affected India, Myanmar, and Bangladesh.
- October 26, 2015: 7.7, Northern India, Pakistan, Afghanistan, 260 in Pakistan and Afghanistan till 01.34 am on 27 Oct'15
- May 12, 2015: 7.3, Northern India, North East India, Epicentre 17 km S of Kodari, Nepal; Felt in Delhi, West Bengal, Bihar, U.P.; 44 killed in India
- April 26, 2015: 6.7 ^[2], Northern India, North East India, (Epicentre 17 km S of Kodari, Nepal)
- April 25, 2015: 7.8 ^[5], Northern India, North East India, Epicentre 34 km ESE of Lamjung, Nepal. Felt in eastern, northern, northeastern India and parts of Gujarat ^[4]
- Aug 21, 2014: 5.0 magnitude, Himachal Pradesh, India, no casualties
- Oct 8, 2005: Pakistan-occupied Kashmir; 7.6 magnitude; 73,000 dead
- In January 2001, more than 20,000 people died in an earthquake in Gujarat. About 16 million people were affected and the loss was more than Rs 200 billion. The magnitude of the earthquake was 6.9 on the Richter scale.
- In May 1997, Jabalpur (Madhya Pradesh) suffered an earthquake of magnitude 6.0. More than 8000 houses collapsed and 40,000 were damaged. The death toll was 39.
- In October 1991, an earthquake of magnitude 6.6 on the Richter scale struck Uttarkashi (in Uttarakhand). More than 750 people died and 5000 people were injured. Earthquakes of similar magnitude occur in this earthquake-prone zone every 8 or 9 years.
- In 1988, 1004 were killed and 16,000 were injured in an earthquake of magnitude 6.6 in Bihar. Many were saved because they were sleeping outdoors.
- India has suffered some of the greatest (more than 8.0 on the Richter scale) earthquakes in the world. There were four such (Assam: 1897, Kangra: 1905, Bihar-Nepal: 1934 and Assam-Tibet: 1950) from 1897 to 1950. Fortunately we have not had such great earthquakes since then.

Preparedness of Earthquakes

- Re-framing buildings' codes, guidelines, manuals and byelaws and their strict implementation. Tougher legislation for highly seismic areas.
- Incorporating earthquake resistant features in all buildings at high-risk areas.
- Making all public utilities like water supply systems, communication networks, electricity lines etc. earthquake-proof. Creating alternative arrangements to reduce damages to infrastructure facilities.
- Constructing earthquake-resistant community buildings and buildings (used to gather large groups during or after an earthquake) like schools, dharamshalas, hospitals, prayer halls, etc., especially in seismic zones of moderate to higher intensities.

- Supporting R&D in various aspects of disaster mitigation, preparedness and prevention and post-disaster management.
- Evolving educational curricula in architecture and engineering institutions and technical training in polytechnics and schools to include disaster related topics.
- Retrofitting of weak structures in highly seismic zones.
- Preparation of disaster related literature in local languages with dos and don'ts for construction.
- Getting communities involved in the process of disaster mitigation through education and awareness.
- Networking of local NGOs working in the area of disaster management

Responses of Earthquakes

It becomes difficult to carry out rescue and relief operations after an earthquake because of the destruction of roads, railways, bridges and communication lines. Hospitals and health centres get overcrowded.

Diseases spread due to the shortage of basic amenities like drinking water (water pipes get damaged) and the crowding of shelters where the homeless are accommodated. The cleaning up of debris, reconstruction of buildings and rehabilitation of people can take months or even longer.

Protection from Earthquakes

- **Protecting buildings:** The greatest damage caused by an earthquake is usually due to the destruction of buildings. There are two ways of protecting buildings—strengthening them or allowing them to move with the vibrations of the ground.
- **Strengthening buildings:** There are many ways of strengthening buildings. One way is to divide the walls into rectangular areas and insert diagonal pieces in them. This stops the walls from getting 'squashed' when a sideways force acts on them.
Try to squash an empty matchbox sideways. Then insert matches into the box as shown in Figure 14.7(a) and try to squash it again. Is it more difficult to squash it this time? This is how diagonal pieces protect walls. They are used to protect roofs too.
- **Allowing movement:** Since stresses arise in buildings because the bottom is fixed, the best way to protect them is to allow the bottom to move. This can be done by placing bearings between the foundation and the bottom of a building. A building placed on bearings can move back and forth and sideways with the vibrations of the ground. Bearings can be of different types. A type used often has layers of rubber with a stiff steel plate in between.

Safety measures

Some steps to be take to stay as safe as possible during an earthquake:

1. Stay away from windows, glass objects, mirrors and things that can fall like book cases and cabinets.
2. Crawl under a table or bed or crouch near an inner wall or doorway and protect your head and face with your arms. Hold on to something that is unlikely to fall [drop, cover, hold).
3. Not to use the lift.
4. Turn off the power supply.

Conclusion

Disaster management is a difficult task. Disaster happens all of a sudden. Thus, the suddenness of a disaster and its destruction, especially during a very serious natural disaster, it becomes very difficult to cope with a normal administrative set up and limited funds and resources. Despite of the various problems, appropriate policy measures could help to solve the problems. As public awareness is one of the vital problem in managing the disaster, it is felt necessary to work at increasing the literacy rate. Moreover, disaster management course should be included in the school and university curriculum. It is also necessary to train school teachers, selected students, women leaders, health workers and social workers to educate others in measures to prevent or mitigate the natural disasters. To attain all this, there is the need of the strong political determination, pragmatic policy formulation and quick decision making. Moreover, active people's participation is also very necessary. On the other hand it will be better to include disaster management component in the development plans and programs of concerned agencies for the effective implementation of disaster mitigation programs.

It is also needed very much to improve road infrastructure, transportation and communication facilities to carry out rescue and relief works effectively and efficiently. In order to prevent inappropriate construction of buildings, the building code should be strictly implemented.

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