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EARTHQUAKE HAZARDS IN INDIA

DR. JAGBIR SINGH, Associate Professor, Department of Geography, Swami Shardhanand College, University of Delhi, Delhi-110036, (India).

Introduction:

Natural disasters like earthquake, landslide, flood, drought, cyclone, forest fire, volcanic eruption, epidemic and major accidents are quite common in different parts of the globe. These lead to the loss of life, property damage and socio-economic disruption. Such losses have grown over the years due to increase in population and physical resources. It is believed that the natural disasters have claimed more than 2.8 million lives during the past two decades only and have adversely affected 820 million people with a financial loss of about 25-100 million dollars. These losses are not evenly distributed and are more prevalent in the developing countries due to higher population concentration and low level of economic growth.

Nearly three million people worldwide may have been killed in the past 20 years due to natural disasters such as landslides, earthquakes, floods, snow avalanches, cyclones etc. Ninety per cent of the natural disasters and ninety five percent of the total disaster related deaths worldwide occur in developing countries in which India has the second largest share. India with diverse hypsographic and climatologically conditions has 70 per cent of the cultivable land is prone to drought, 60 per cent of the land area is prone to earthquake, 12 per cent to floods, 8 per cent to cyclones, 85 per cent of the land area is vulnerable to number of natural hazards and 22 states are categorized as multi hazards states. Tens of thousands of people are affected by these natural and man made disasters.

Earthquakes are one of the worst among the natural disasters. About 1 lakh earthquakes of magnitude more than three hit the earth every year. According to a conservative estimate more than 15 million human lives have been lost and damage worth hundred billions of dollars has been inflicted in the recorded history due to these.

Like any other natural disaster, it is not possible to prevent earthquakes from occurring. The disastrous effects of these, however, can be minimised considerably through scientific understanding of their nature, causes, frequency, magnitude and areas of influence. The key word in this context is "Mitigation and Preparedness". Earthquake disaster mitigation and preparedness strategies are the need of the hour to fight and reduce its miseries to mankind. Comprehensive mitigation and preparedness planning includes avoiding hazard for instance, by providing warning to enable evacuation preceding the hazard, determining the location and nature of the earthquake hazard, identifying the population and structures vulnerable for hazards and adopting strategies to combat the menace of these.

Background on Earthquake Magnitude and Intensity

When reviewing the past earthquakes it is important to have the correct perspective on earthquake magnitude and earthquake intensity: two terms often misunderstood. Earthquake magnitude is a measure of the size of the earthquake reflecting the elastic energy released by the earthquake. It is referred by a certain real number on the Richter scale (e.g., magnitude 6.5 earthquake). On the other hand, earthquake intensity indicates the extent of shaking

experienced at a given location due to a particular earthquake. It is referred by a Roman numeral (e.g., VIII on MSK scale). The concept of earthquake magnitude was first developed by Richter (e.g., Richter 1958), and hence, the term "Richter scale". The value of magnitude is obtained on the basis of recordings of earthquake ground motion on seismographs. In practice, there are several different definitions of magnitude; each could give a slightly different value of the magnitude. Hence, magnitude is not a very precise number. Earthquake magnitude is measured on a log scale, and a small difference in earthquake recording on the instruments leads to a much smaller error in the magnitude.

Earthquake Hazards in India

The annual global loss reform natural disasters give for concern. A single hazard event can cause injuries, destroy crops and building totally disrupting community. Two-thirds of the world's population lives in developing countries and 95 per cent of disaster-related deaths occur in these countries. Disasters do not only affect development; there is also a significant relationship between development strategies and the extent to which a country is prepared to respond in the event of a disaster. Through sustained efforts, including those of Hazards and Vulnerability Analyses, Prevention and Mitigation, Preparedness Planning, Education and Training, it is possible to avert some disasters, and in others to minimize the number of injuries and deaths, and also reduce the resulting socio-economic burden and loss.

India has had a number of the world's greatest earthquakes in the last century. In fact, more than 50% area in the country is considered prone to damaging earthquakes. The north-eastern region of the country as well as the entire Himalayan belt is susceptible to great earthquakes of magnitude more than 8.0. The main cause of earthquakes in these regions is due to the movement of the Indian plate towards the Eurasian plate at the rate of about 50 mm per year. Besides the Himalayan region and the Indo-Gangetic plains, even the peninsular India is prone to damaging earthquakes as clearly illustrated by the Koyna (1967), Latur (1993), and the Jabalpur (1997) earthquakes. Indian earthquakes have shown some remarkable features which have implications on strategies for reducing earthquake disasters in the country. This paper attempts to provide an overall perspective of past Indian earthquakes and the interesting features of the same.

Seismic zonation map shows that India is highly vulnerable for earthquake hazards. India has witnessed more than 650 earthquakes of Magnitude >5 during the last hundred years and earthquake disaster is increasing alarmingly here. In addition to very active northern and northeastern seismicity, the recent events in Killari (Maharastra) and Jabalpur (Madhya Pradesh) in the Peninsular India have raised many problems to seismologists.

The occurrence of earthquakes can be explained with the concept of "Plate Tectonics" Based on this three broad categories of earthquakes can be recognized. (1) those occurring at the subduction/collision zones (Inter-plates), (2) those at mid-oceanic ridges and (3) those at intra-plates (Acharrya, 1999). Seismic events in India mainly belong to the first category though a few third category events are also known. Earthquake events are reported from the Himalayan mountain range including Andaman and Nicobar Islands, Indo-Gangetic plain and Peninsular region of India.

Indian earthquake problem cannot be overemphasized. More than about 60% of the land area is considered prone to shaking of intensity VII and above (MMI scale). In fact, the entire

Himalayan belt is considered prone to great earthquakes of magnitude exceeding 8.0, and in a short span of about 50 years, four such earthquakes have occurred: 1897 Assam (M8.7), 1905 Kangra (M8.6), 1934 Bihar-Nepal (M8.4), and 1950 Assam-Tibet (M8.7). The below map shows the sesmic zones of India.

Facts about the Earthquake

1. Natural events such as volcanic eruptions and meteor impacts can cause earthquakes, but the majority of naturally-occurring earthquakes are triggered by movement of the earth's plates.

2. The surface of the earth is made up of 20 constantly moving plates. As the plates shift, tension is created, and as its strength increases it can cause the crust to break. When a break occurs, the stress is released as energy that moves through the Earth in the form of waves. These waves are earthquakes.

3. The National Earthquake Information Center (NEIC),USA, records an average of 20,000 earthquakes every year (about 50 a day) around the world. There are, however, millions of earthquakes estimated to occur every year that are too weak to be recorded.

4. Almost 80 percent of all the planet's earthquakes occur along the rim of the Pacific Ocean, called the "Ring of Fire"; a region that encircles the Pacific Ocean and is home to 452 volcanoes (over 75 percent of the world's active and dormant volcanoes).

5. The largest recorded earthquake in the world was a magnitude 9.5 in Chile on May 22, 1960.

6. When the Chilean earthquake occurred in 1960, seismographs recorded seismic waves that traveled around the world. These seismic waves shook the entire earth for many days.

7. Normally, it's not the shaking ground itself that claims lives during an earthquake; it's the associated destruction of man-made structures and the instigation of other natural disasters such as tsunamis, avalanches, and landslides.

8. An undersea earthquake in the Indian Ocean triggered a series of devastating tsunamis on Dec. 26, 2004. The tsunamis struck along the coasts of most landmasses bordering the Indian Ocean, killing more than 225,000 people in 11 countries and inundating coastal communities with waves up to 100 feet high.

9. Alaska is the most earthquake-prone state and one of the most seismically active regions in the world, experiencing a magnitude 7.0 earthquake almost every year, and a magnitude 8.0 or greater earthquake approximately once every 14 years.

Earthquake Prediction

Research on earthquake prediction started since early sixties. Intensive work is going on all over the world in this regard involving expenditure of billions of dollars. The precise prediction of seismic events remains elusive and unattainable goal as yet in spite of these efforts. According to R.R. Kelkar, Director General of Indian Meteorological Department (IMD), "Earthquake cannot be predicted by anyone, anywhere, in any country. This is a scientific truth". But seismologists continue their efforts in the hope of a major breakthrough in prediction technology in the near future. The seismologists are, however, in a position to indicate the possibility of recurrence of earthquakes in potentially large areas based on palaeoseismicity, micro seismic activities and precursors.

In India also efforts are going on for predicting earthquakes based on the statistical analysis of past events and their recurrence intervals, swarms activity and seismic gap. However, meaningful prediction is still alluding the seismologists. Khatri (1999) identified three seismic gaps in the Himalayan region, namely, the Kashmir gap, the Central gap and the Assam gap. The Kashmir gap lies west of Kangra event, the Central gap between Kangra and Bihar-Nepal events and the Assam gap between the two great earthquakes of Assam. He further said that the great event may occur in these gaps in near future.

Conclusion

India has relatively high frequency of great earthquakes and relatively low frequency of moderate earthquakes. Moderate earthquakes create awareness and lead to improvements in constructions at relatively low human costs, which could be very effective in the long run. Due to rather infrequent moderate earthquakes, the Indian earthquake problem does not receive the attention of the country that it deserves considering our overall seismic potential, and this is a tragedy. For a poor country, the focus of political priorities anyway remains on day-to-day problems of poverty, shelter, law and order, health, sanitation, and it is as such difficult to seek priorities to once-in-a-while problems of natural disasters. Nevertheless, just like one takes a life insurance policy for unexpected disasters, the country needs to invest a small fraction of priorities towards earthquake disaster mitigation; the consequences otherwise could be truly unimaginable should a major earthquake cause severe shaking in highly populated areas of the country.

Selected Reference:

Atkinson, G.M. & Boore, D.M. (2006). Earthquake Ground-Motion Prediction Equations for Eastern North America. Bulletin of the Seismological Society of America 96:6,2181- 2205.

Boore, D.M. & Atkinson, G.M. (2007). Boore-Atkinson New Generation Attenuation (NGA) Ground Motion Relations for the Geometric Mean Horizontal Component of Peak and Spectral Ground Motion Parameters. Pacific Earthquake Engineering Research Center, USA.

Campbell, K.W. & Bozorgnia, Y. (2007). Campbell-Bozorgnia New Generation Attenuation (NGA) Ground Motion Relations for the Geometric Mean Horizontal Component of Peak and Spectral Ground Motion Parameters. Pacific Earthquake Engineering Research Center, USA.
Gardener, J.K. & Knopoff, L. (1974). Is the sequence of earthquakes in Southern California, with aftershocks removed, Poissonian? Bulletin of the Seismological Society of America 64:5,1363-1367.
Khattri K N, Rogers A M, Perkins D M (1983) Estimates of seismic hazard in northwestern India and neighbourhood. Bull. Inst. Seismol. Earthquake Technol. 20:1-22
Khattri K N, Rogers A M, Perkins D M, Algermissen S T (1984) A seismic hazard map of India and adjacent areas. Tectonophysics 108:93-134