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Study on Social, Economic and Environmental Effect of Earthquake

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Abstract:

India's is at high risk due to population increasing in an exponential style and unscientific constructions is mushrooming all over India. Floods, cyclone, earthquakes and landslides are the frequent phenomenon. India has experienced numerous major earthquakes that have resulted in over 20,000 deaths. One of the most overwhelming natural disaster is earthquake which is caused by sudden shaking of the earth surface. This paper present review on the socio-economic and environmental effect of earthquake in order to learn from this event and understand what are the relevant steps required to improve the condition after earthquake.

Keywords: *Earthquake, Social Effect, Economical Effect, Environmental Effect*

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Introduction

India is one of the world's most disaster prone area, in which out of 28 states and 7 union territories, 22 are most effect areas. Wind storms, earthquake, and floods are few of the very common disasters in India. Around 57% of the land is vulnerable to earthquake, in which 12% is prone to very severe earthquakes, 18% to severe earthquakes and 25% to damageable earthquakes (http://www.yourarticlelibrary.com). Major earthquake occurred in Kangara (1905), Bihar-Nepal (1934), Latur (1993), Bhuj (2001), and Sumatra (2004) (Patil, 2012). According to the National Disaster Management Authority, Government of India emergency kit for earthquake management must include Battery Operated Torch, Extra Batteries, Battery Operated Radio, First Aid Kit and Manual, Emergency Food (Dry Items) and Water (Packed And Sealed), Candles And Matches in a Waterproof Container, Knife, Chlorine Tablets or Powdered Water Purifiers, Can Opener, Essential Medicines, Cash, Aadhar Card and Ration Card, Thick Ropes And Cords, And Sturdy Shoes (https://ndma.gov.in)

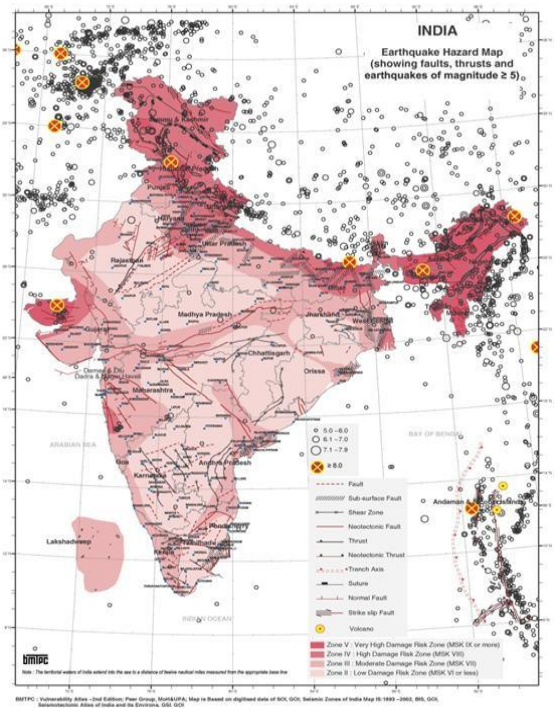

Figure 1: Earthquake Hazard Map (Source: https://ndma.gov.in)

Earthquake is one of the most overwhelming natural disaster caused by sudden movement of the ground. Different changes in the environment is observed due to earthquake, which is classified as Primary and Secondary Effects commonly known as earthquake environmental effects (EEE). These primary and secondary effects is further classified into subsidence, surface faulting and displaced rocks, tsunami, ground cracks, liquefactions, landslides respectively (Choudhury *et al.* 2016).

An earthquake can be easily understood by an example i.e. effect observed when a stone is thrown into water. When the stone hits the water, series of concentric waves will move outwards from the center, similar event occur in earthquake also. During earthquake, sudden movement occur within the crust and concentric shock waves move outward from that center point. And origin of the earthquake is commonly known as focus and the point just above the focus is known as epicentre. Basically earthquakes are three dimensional events in which the waves may move towards outward from the focus and can travel in both horizontal and vertical plains. Following are the three different types of waves are produced which have their own characteristics and move through certain layers within the earth.

1. **P-Waves** – P-Waves or Primary Waves are similar in character to sound waves. In this the ground is forced to move forwards and backwards and produces small displacements of the ground.

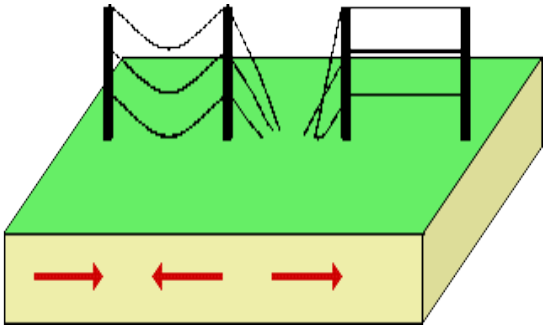

Figure 2: Example of P-Waves

2. **S-Waves –** S-Waves or Secondary Waves travel more slowly in comparison to P-Waves and reach at given point *after* the P-Waves. It moves in all directions from their center point at speeds which will depend upon the density of the rocks at which they are moving.

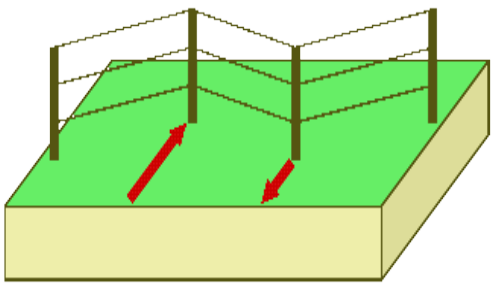

Figure 3: Example of S-Waves

3. **L-Waves –** L-Waves or Surface Waves are low frequency transverse vibrations with a long wavelength. L-Waves are created at the point just above the focus and travel through the outer part of the crust. This type of waves are mainly responsible for the damage caused (www.geography-site.co.uk).

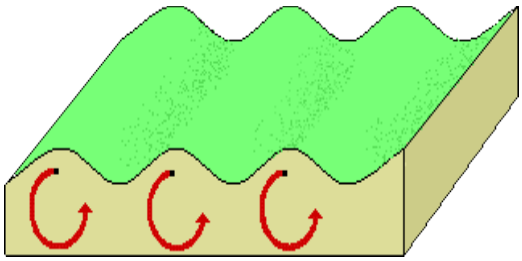

Figure 4: Example of S-Waves

Richter scale are used to measure the amount of force or energy produced by earthquakes. Richter scale was developed by Charles F. Richter of the California Institute of Technology. For calculating the magnitude of the earthquake, Richter scale uses the info provided by seismograph. On Richter scale if earthquake occur above 7, it is known as devastating effect where as if it is occurring below 3 then it can't be felt. And if it is between 3 and 6 then it is known as mild type (https://www.conserve-energy-future.com).

Earthquake Prediction

Earthquake cannot be predicted neither by USGS nor by any other scientists as it cannot define the basic three elements that is the date and time, location, and magnitude. Still there are few people who says that they can predict earthquakes but their statement are false on the basis of following reason:

- Do not based on scientific evidence
- Do not define all 3 of the elements.
- Predictions are always general.

If luckily earthquake happens as per their prediction they claim it as their success even though 1-3 of prediction is different, therefore it can conclusively said that earthquake ca never be possible (https://www.usgs.gov).

Effects of Earthquake

Natural disasters either mild or moderate will adversely effects the socio-economic and environmental impacts in developed or undeveloped regions due to lack of preventive action and resources. Earthquakes can happen anytime as it cannot be predicted. It can caused by numerous reason whose effects can be clearly seen and observed socially, economically and environmentally, which is shown in table 1:

Table 1: Effects of Earthquake (Source: http://www.bbc.co.uk)

	Social Impacts	Economic Impacts	Environmental Impacts
Short-term (immediate) Impacts	• Loss of human life. • Destruction of homes. • Disturbed transportation system • Disturbed communication links. • Contaminated Water supplies.	• Shops and business may be demolished. • Looting • Disturbed transport and communication links make trade difficult	• Destroyed built landscape. • Gas pipe explosions may cause destruction. • Landslides may occur. • Flooding in coastal areas may cause *Tsunamis*.
Long-term Impacts	• May spread disease. • People may have to be in refugee camps.	• Cost of rebuilding is high. • Focused only on repairing the damage area. • Income could be lost.	• Important natural and human landmarks may be lost.

Causes of Earthquake

Firstly, they can be linked to explosive volcanic eruptions; they are in fact very common in areas of volcanic activity where they either proceed or accompany eruptions.

Secondly, they can be triggered by Tectonic activity associated with plate margins and faults. The majority of earthquakes worldwide are of this type.

Earthquake are caused by numerous reasons, in which few of the causes are mentioned below.

- Tectonic Movement
- Volcanic Activity
- Dislocation of the Earth's Crust
- Adjustment in inner Rock Beds
- Pressure of Gases in the interior
- Landslides and Avalanches

- Denudation of the Landmasses and depositions of materials
- Faulting and folding in the rock beds (https://www.importantindia.com).

Review of Literature

Jain (1988), studied about the Indian earthquake and found that the India has a very high frequency of earthquakes i.e. magnitude greater than 8.0 during 1897 to 1950. For example, Cutch Earthquake of 1819, Assam Earthquake of 1897, Bihar - Nepal Earthquake of 1934, Koyna Earthquake of 1967, Bihar - Nepal Earthquake of 1988, Uttarkashi Earthquake of 1991, Killari (Latur) Earthquake of 1993, Jabalpur Earthquake of 1997. The country must focus on daily issues of poverty, shelter, law and order, health etc. effected after earthquake otherwise the effects will be unimaginable.

Gupta (2001), focused on the Gujarat earthquake 2001 and learned that earthquake can't be predicted therefore, there is need of safe construction in the earthquake prone areas. With the help of proper awareness program make people aware about the recovery and reconstruction program for appropriate steps for disaster reduction, prevention, and mitigation.

Patil (2012), studied about Disaster profile and Management of India and recommended that by creating awareness and providing proper training we can help in disaster preparation and response. There is also need to change in perception of people. Proper coordination between different departments and stakeholders must be done for more effective disaster management system.

Doocy, *et al.* (2013), reviewed the impact of earthquake on human from 1980-2009 with an aim to discuss the impact of earthquakes on human in terms of injury, mortality and displacement and, to the extent possible, identify risk factors related with these results. After their study, they found that from 1980 through 2009, there were a total of 372,634 deaths, 995,219 injuries and around 61 million people affected by earthquakes. According to the systematic review of the literature the primary cause of death during earthquake was trauma. Conclusively they said that different strategies must be used to mitigate the impact of future earthquakes and improvements to the built environment.

Mata-Lima, *et al.* (2013), addresses the socioeconomic and environmental impacts of natural calamities with an objective to identify key variables in the reduction of susceptibility, mitigation and prevention of the impacts of natural disasters.

Mohan and Kumar (2013), discussed about the earthquakes and dams in India. There are around numerous number of large dams and active faults covering 57% of land mass and making prone to earthquakes. Severe earthquake might affect the performance of these dams therefore, a discrete element modeling has to be carried out to study the behavior of structure from zero loading, crack initiation to complete collapse of structure.

Martha, *et al.* (2015), studied about the landslides in Sikkim triggered by the Mw 6.9 earthquake on 18 September 2011 by using Post-disaster very high resolution (VHR) satellite. The earthquake-affected area was out-of-reach, VHR data from these satellites helped in getting the quick and synoptic assessment of the damage of an area of 4105 km2 in Sikkim.

Dey (2015), presented a case study of Nepal earthquake and its impact on humans to examine the causes, nature, consequences, extent, and causes of the earthquake. For the study, maps of Indian Meteorological Department (IMD) and Google images have been used and found that the effects of Nepal earthquakes depends on their magnitude but also on geology of the earth crust, design of buildings, etc.

Jain (2016), talked about the earthquake safety in India covering the achievements, challenges and opportunities which includes the development of early codes and earthquake-resistant housing. Further National Information Centre of Earthquake Engineering was developed and 4-year National Programme on Earthquake Engineering was carried out by different Indian Institutes of Technology and the Indian Institute of Science. From the different source of information it was clear that the construction of building is also one of the major issue. Therefore, there is need for creating an environment for safe construction. Few work has been done in the country to improve this construction process are competence-based licensing for engineers; enforcement of building codes by the municipal authorities; development and propagation of building typologies that are inherently earthquake-resistant.

Shakya (2016), studied the impact of earthquake on Nepalese economy and women in Nepal on secondary information available on internet. A discussion was done on the historical background of the earthquake and follows to identify the impact of earthquake on people and properties. Further focused prerequisite of resources for reconstruction and recovering of the lost sectors.

Sinha and Kumar (2017), studied about economic losses and made a comparative study to understand the differences in the losses during three major earthquakes of India i.e. Sikkim Earthquake; Gujarat Earthquake; and Maharashtra Earthquake. In their study they found that the damage primarily due to poor design and construction practices and lack of quality control which ultimately result in very high economic loss. Conclusively they found that solution lies in opting safer construction by selecting appropriate construction system.

Conclusion

After going through the available research, it can be said that earthquake can't be predicted therefore, the government must create proper awareness program make people aware about the recovery and reconstruction program. Earthquake affects the socio-economic and environmental condition of the earthquake prone areas. It not only effect the human lives but also affect the mental growth of the populations. Therefore, every state government must take the precautionary measure to mitigate the impact of earthquakes and improvements to the social and economic status of the earthquake prone area.

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