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# Earthquake Effects on Bangladesh: Procedures to Appearance the Challenge

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## ABSTRACT

Bangladesh is one of the most densely populated countries in the world. The majority of the populations live in the fertile Ganges- Brahmaputra delta, an area swept by frequent cyclones, tidal surges, floods and river erosion. Along with these natural calamities, earthquake has emerged as a new ecological concern for Bangladesh as the country situated in the danger seismic zone. But our government or other organizations including military hardly has got any preparation to face the earthquake hazards. Even after repeated warning given by various specialist in this field it seems that the government has got no preparation to face the catastrophe. Therefore it is very important, at this moment for us to analyse the causes and its effect in Bangladesh and evolve a comprehensive plan integrating all the resources to face the challenge.

Keywords: Earthquake, disaster, effects, densely, disaster, damage, landslide, effect,

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## 1. Introduction

1.1 Of the tightening things of the nature, none is as frightful as an earthquake. Bangladesh perhaps had begun to feel that they had finally escaped from earthquake disaster because they have had enough deaths, suffering, and devastation caused by other natural calamities like flood, cyclone, and drought. Earthquakes are the most destructive among all the natural hazards. Most of the time, they occur without any warning, which makes them most feared and unpredictable natural phenomena. Globally, on an average two earthquakes of magnitude eight are known to occur every year. Some of the countries like Japan, China and United States have suffered several damaging earthquakes in the past.

1.2 Bangladesh is one of the most densely populated countries in the world. Its population of 130 million is crammed into 147,570 square kilometers. The growing rate is 1.54 percent per annum. The majority of the populations live in the fertile Ganges- Brahmaputra delta, an area swept by frequent cyclones, tidal surges, floods and river erosion. Along with these natural calamities, earthquake has emerged as a new ecological concern for Bangladesh as the country situated in the danger seismic zone.

1.3 Bangladesh is located near the Alpide- Himalayan earthquake belt and lies along the border of Eurasian and India-Australian plates. There were several earthquakes in the past that severely affected the landmass. Bangladesh has occupied a crucial geodynamic part of the Indo-Burmese seismic belt that has generated number of world ranking earthquake in the past. It is now an established fact that Bangladesh is located in high earthquake prone zone of the world. But our government or other organisations including armed forces hardly has got any preparation to face the earthquake hazards. Even after repeated warning given by various specialists in this field it seems that the government has got no preparation to face the catastrophe. Therefore, it is very important, at this moment for us to analyse the causes and its effect in Bangladesh and evolve a comprehensive plan integrating all the resources to face the challenge.

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## 2. Basics of Earthquake

2.1 An earthquake is the ground shaking caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up and the rocks slips suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that we feel during an earthquake. Few definitions related with earthquake have given below:

- a. **Focus.** Focus is the location within the earth where underground rock moves and sends out earthquake waves.
- b. **Epicenter.** It is the location on the surface of the earth directly above the focus, or place where an earthquake originates. This point is expressed by geographical latitude and longitude.
- c. **Seismograph.** A seismograph is a device that records earthquake waves.
- d. **Plate Tectonics.** The edges of the plates, where it moves against each other, are sites of intense geologic activity, such as earthquakes, volcanoes, and mountain building. Plate tectonics is a relatively new theory and it wasn't until the 1960's that Geologists, with the help of ocean surveys, began to understand what goes on beneath our feet.

2.2 **Measure the Earthquake.** Earthquake can be measured by following ways:

- a. **Richter Magnitude and Mercali Scale.** The Richter scale measures the energy released in an earthquake by measuring the size of the seismic waves. The Mercali scale measures the results of an earthquake, such as the shaking and damage that people actually feel and see.
- b. **Intensity.** It is the rating of the effect of an earthquake at a particular place, based on the observations of the damaged areas, using a descriptive scale like Modified Mercalli Scale.

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### 3. Causes of Earthquake

3.1 **There are two main causes of earthquake.** Firstly, they can be linked to explosive volcanic eruptions and secondly, they can be triggered by tectonic activity associated with plate margins and faults. Earthquakes originate due to various reasons, which fall into two major categories, first non-tectonic and secondly tectonic. Earthquakes are distributed unevenly on the globe. However, it has been observed that most of the destructive earthquakes originate within two well-defined zones or belts namely, 'the Circum-Pacific belt' and 'the Mediterranean-Himalayan seismic belt'.

3.2 **Major Causes of Earthquake.** Most earthquakes are caused by the sudden slip along geologic faults. Geologist and founder chairman of Geology Department of *Chittagong University* Professor Shahidul Islam identified three major causes for the earthquakes. These are large-scale landslide in the seabed, volcanic eruption and plate movement. Professor Islam said, "Plate movement is the major cause of earthquakes in this region as Chittagong, and Assam in India, is located on the plate boundary." The plates always move slowly and the earth jolts when those plates suddenly release tension following collision with each other during their movements, based on intensity or strength of clash. Following may be the main causes for earthquake in Bangladesh:

- a. Endangering the ecological balance through hill razing,
- b. Unplanned urbanization and industrialization.
- c. Massive mining.
- d. Indiscriminate exploration of mineral resources.

3.3 **Endangering the Ecological Balance through Hill Razing.** There are ten different types of terrestrial ecosystems in Bangladesh. The encroachers for the sake of urbanization, leaving no open space for the city dwellers, destroy these areas. Unplanned hill razing imbalances the soil system, which can be one of the causes of earthquake.

3.4 **Unplanned Urbanization and Industrialization.** One major transformation that is bound to occur in Bangladesh over the next 25 years is the spread of urbanization. Whereas approximately 4 out of 5 inhabitants are now country people, by 2020 nearly every other man, woman and child will live in an urban area. Seismologists say, "Dhaka lies on fault lines and according to experts at least 50 percent of the buildings can't resist quakes."

3.5 **Massive Mining.** Rapid withdrawal of water, mining or exploration of oil and gas were the possible causes behind earthquakes.

3.6 **Historical/ Human Activities.** Vinod Gaur of the Indian Institute of Astrophysics said, "As far the Himalayan belt is concerned we expect that a major earthquake may occur in one of the regions, which has not ruptured for at least six or seven hundred years". Whilst this is still only estimation, Roger Bilham backs up this suggestion with the details of the expected force and timescale.

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### 4. Earthquake Zone/Risk in Bangladesh

4.1 Bangladesh is surrounded by the regions of high seismicity, which include the Himalayan Arc and shillong plateau in the north, the Burmese Arc, ArakanYoma fault in the east and complex Naga-Disang-Jaflong thrust zones in the northeast. India has been divided into five seismic zones with respect to severity of earthquakes. Of these Zone V is the seismically most active region where earthquakes of magnitude 8 or more could occur. In the generalised tectonic map of Bangladesh the distribution of epicenters is found to be linear along the Dauki Fault system and random in other regions of Bangladesh. The investigation of the map demonstrates that the epicenters are lying in the weak zones comprising surface or subsurface faults. Most of the events are of moderate rank (magnitude 4-6) and lie at a shallow depth, which suggests that the recent movements occurred in the sediments overlying the basement rocks. In the northeastern region (Surma Basin), major events are controlled by the Dauki Fault system.

## 5. Effects Of Earthquake

**5.1 Probable Damage Caused by Earthquake.** The extent of damage is dependent on a number of factors, the intensity of the earthquake, distance from the epicenter, soil condition, type of structure design of building and quality of construction. Additional factors registering above four (IV) on the Richter scale is likely to cause following damage.

- a. Structural Collapse.
- b. Fires.
- c. Gas Leaks.
- d. Power Disruption.
- e. Water and Sanitation Collapse.
- f. Severance of Communication.
- g. Hospital Collapse.
- h. Deaths.
- i. Multiple Injuries.
- j. Explosive/ chemical Release.
- k. Persons trapped in structures.
- l. Block of Access routes to emergency vehicles/ambulances.
- m. Collapse of bridges/road/railway.
- n. Course of some rivers/pond may change.
- o. Some river or pond may dry up.
- p. Tsunami waves and flooding.
- q. Land slides.

**5.2 Some Secondary Effect of Earthquake.** Most of the damage done by earthquakes is due to their secondary effects, those not directly caused by fault movement, but resulting instead from the propagation of seismic waves away from the fault rupture. Secondary effects result from the very temporary passage of seismic waves, but can occur over very large regions, causing widespread damage. Such effects include: seismic shaking, landslides, liquefaction, fissuring, settlement, and the triggering of aftershocks and additional earthquakes.

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## 6. Present Earthquake Preparation Plan

**6.1** The country seems woefully unprepared to handle an earthquake emergency. Its lone geophysical observatory in Chittagong can just about confirm that a quake has occurred but nothing more. India Meteorological Department (IMD) operates a network of seismological observatories spread all over the country. There are 45 national seismological stations and 13 special purpose observatories. Successive governments have sat on the plan, despite the near certainty that a quake measuring seven or more on the Richter scale would level hundreds of buildings in Chittagong and the capital, Dhaka. The existing observatory is also unable to determine the direction. So, when it is told that an earthquake has hit 300 kilometers away from Chittagong, Bangladesh will never know from the observatory whether the quake has hit Dhaka (which is 300 kilometers from Chittagong) or anywhere 300 kilometers away from Chittagong in the Bay of Bengal.

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## 7. Different Limitations for Earthquake

7.1 Following are the probable constraint in earthquake preparation:

- a. **Lack of Reporting Station.** Bangladesh does not have adequate earthquake reporting station. The only Ambagan Metrological Reporting Station with poor staff is providing the earthquake information.
- b. **Lack of Immediate Response.** Immediate response to earthquake is very important. Japan has a well-integrated chain of command to face such catastrophe. But in our case any shaking report flows to chief metrologist from lone reporting station at Ambagan, Chittagong. After this there is no prescribed system followed to pass this information to government highest body.
- c. **Lack of Mitigation Plan.** In earthquake prone areas, mitigation of the disaster due to future shocks is an essential consideration for effective land use and proper town planning. The government has taken up a contingency plan for responding to major earthquakes with a view to helping minimise loss and damage in the event of such a disaster.
- d. **Lack of Preparedness.** Records show that the strongest earthquake on record measuring 8.7 on the Richter Scale (Great Indian Earth-

quake of June 12, 1897) had its epicenter only 50 kilometers from the northwest border of Bangladesh and 230 kilometers from Dhaka.

e. **Non-Adherence to Building Code.** In Bangladesh nobody is following the building code. Earthquake vulnerability of any place largely depends on its geology and topography, population density, building density and quality, and finally the coping strategy of its people.

f. **Lack of Training and Public Awareness.** Most of the city dwellers do not have any idea or training on earthquake mitigation. General mass is not aware of the dangerous effect of this natural disaster. Construction works everywhere, including residential and non-residential buildings, industrial plants, ports, roads and telecommunications facilities, power supply, gas and oil resources explorations, are going on without taking any measures against earthquakes.

g. **Lack of Resources.** In Bangladesh various public organisation are not ready to mitigate the basic need of human life during earthquake. Fire service department does not have adequate training and equipment to face the earthquake.

h. **Lack of Earthquake Prone Zone Map and Data.** The Geological Survey of India compiled the first seismic zoning map of the subcontinent in 1935. The Bangladesh Meteorological Department adopted a seismic zoning map in 1972. In 1977, the Government of Bangladesh constituted a committee of experts to examine the seismic problem and make appropriate recommendations.

j. **Poor Engineering.** Due to lack of engineering knowledge constructed building /infrastructure cannot sustain the ground shaking. Recent incident in Shkari Bazar is one of the examples of this nature. The majority of the destructed buildings in the city were masonry and adobe structures, without seismic design.

i. **Lack of Data.** We do not have adequate data regarding earthquake. Poor data management system is also a major constraint for quick earthquake study about its prediction and effects. A well-coordinated data computerized system may be evolved in this regard.

## 8. Resources Available

8.1 In order to fight back this catastrophe first of all we have to broadly categories our available resources. These are:

### a. **Armed Forces.**

- (1) Bangladesh Army.
- (2) Bangladesh Navy.
- (3) Bangladesh Air Force.

### b. **Para Military Forces.**

- (1) Bangladesh Rifles.
- (2) Bangladesh Police.
- (3) Ansar & Village Defence Party.
- (4) Fire Service and Civil Defence.
- (5) Coast Guard.

### c. **Government Organisations.**

- (1) Ministry Of Local Government.
- (2) Ministry Of Finance.
- (3) Ministry Of Water and Mineral Resources.
- (4) Ministry Of Home Affairs.
- (5) Ministry Of Communication.
- (6) Ministry Of Health and Family Planning.
- (7) Ministry Of Housing, Settlement and Works.
- (8) Red Crescent.
- (9) Ministry of Disaster Management and Relief.
- (10) NGOs.

## 9. Plan To Face The Challenge

9.1 Measures in Various Phases of Earthquake. Following measures can be taken in various phase of earthquake:

a. Pre-Earthquake Phase.

- (1) Train all citizen's to increase earthquake awareness and to mitigate the earthquake hazard.
- (2) Periodical review of the state of preparedness by Ministry Of Disaster Management and Relief (MDMR).
- (3) Forming of teams/groups/ sections with required technical and non-technical personnel in each district level.
- (4) Earmarking of probable employment areas in post earthquake period.
- (5) MDMR and Armed Forces should carry out survey of the area and designation of facilities those can be utilized for disaster management by using Geological Information System (GIS) system.
- (6) Preparation of Standing Operating Procedure (SOP) for all types of preparations and pre- designation of emergence rescue team/personnel, which can be included in the existing DMB publication.
- (7) Periodical conduct of exercise on earthquake preparedness and response where possible by all concerned agencies.
- (8) Conduct seminar/symposium/workshop on earthquake.
- (9) Coordination with various city corporations to identify infrastructures, which are prone to earthquake for prioritizing rescue operations in post earthquake phase.
- (10) Grow awareness among the citizens through electronic and news media.
- (11) Preparation of seismicity map of earthquake prone zone.

b. Post Earthquake Phase.

- (1) Coordinate voluntary services of different voluntary organization.
- (2) Coordinate restoration of emergency services as soon as possible.
- (3) Maintenance of casualty / survivor related information and liaise with local and foreign media.
- (4) Assess the damage.
- (5) Establish control cell and field control organisation for round the clock in affected areas, which should be monitored by different cell.

c. Rehabilitation Phase.

- a. Re-establishing of pure drinking water supply system in the affected area.
- b. Provide necessary medical support to prevent epidemic.
- c. Provision of temporary shelters.
- d. Awareness training on scientifically sound building practices.
- e. Provision of food rations.
- f. Emergency livelihood security measures.
- g. Establish alternate communication system.
- h. Establish monitoring cell.

9.2. Responsibility of Various Organisations.

- a. Armed Forces. Armed forces have already earned the confidence of the people by having commendable contribution in all past disaster relief operations.
- b. Fire Service. Every district headquarters have fire service department in Bangladesh. Due to the resources limitation fire service department can't provide adequate services at all times.
- c. Power Development Board (PDB). PDB is the authority for planning, construction and operations of power generation and transmission facilities throughout Bangladesh and for distribution in urban areas except Dhaka city. During any natural disaster PDB maintains power supply system. Followings services are provided by the PDB during earthquake.
- d. Rural Electrification Board (REB). Development plans of Bangladesh have identified rural electrification as one of the major components of overall infrastructure. REB can work as an alternative means of power supply during earthquake.
- e. NGO. Immediately after the earthquake, the rescue of distressed people gets the priority over all other human assistance. For smooth conduct of rescue operations Various NGOs liaise with governmental organisations.
- f. Disaster Management Bureau. This has established in 1993 under MDMR. They coordinate all disaster relief operations. This bureau coordinates NGOs activities during disaster. The national disaster management committee, headed by the Prime Minister, the inter-ministerial standing committee headed by the Minister for Disaster Management and Relief are the national level bodies to coordinate disaster mitigation activities.

- g. Telephone and Telegraph. One of the important aspects in any disasters is the communication. Bangladesh does not have adequate communication facilities to face this challenge. During earthquake relief operation may be hampered due to lack of communication facilities.
- h. Roads and Highway Department. To clear the debris, roads and highways can play a major role during earthquake. They can utilize their heavy construction material to clear the debris.
- j. Water and Sewerage Authority (WASA). The WASA cannot fulfill the requirement for the normal dwellers in the city areas. During earthquake water supply will be disrupted due to the collapse of building and others factors.

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## 10. Conclusions

10.1 Earthquakes are the most destructive among all the natural hazards. Bangladesh had begun to feel the disastrous effects of earthquake. Most of the time, they occur without any warning, which makes them most feared and unpredictable natural phenomena. The recently occurred Bhuj earthquake of Gujarat State (India), Bam earthquake at Iran and earthquake at Japan has once again exposed our limitations in earthquake science and also our preparedness against such natural disasters. Bangladesh is one of the most densely populated countries in the world. The majority of the populations live in the fertile Ganges- Brahmaputra delta, an area swept by frequent cyclones, tidal surges, floods and river erosion. Along with these natural calamities, earthquake has emerged as a new ecological concern for Bangladesh as the country situated in the danger seismic zone.

10.2 Bangladesh has occupied a crucial geodynamic part of the indo-Burmese seismic belt that has generated number of world ranking earthquake in the past. From the past history of several severe and extreme earthquakes that affected today's Bangladesh, it is quite alarming that the country is highly seismically active. The height of the Himalayas is gradually rising and Bangladesh, Afghanistan, Iran and India have been facing numbers of tremor because the Indian and Burmese plate moved towards north and east direction. Therefore, the country has been recognised as an earthquake prone zone by many research reports. Many of the earthquakes have occurred in the northeastern part of the country and in the southeastern area. Southern parts of Khulna division have the lowest hazard in the country, while Sylhet, Chittagong divisions, Hill Tracts area have the highest hazard.

10.3 Bangladesh is surrounded by the regions of high seismicity, which include the Himalayan Arc and Shillong Plateau in the north, the Burmese Arc, ArakanYoma anticlinorium's in the east and complex Naga-Disang-Jaflong thrust zones in the northeast. Scientists say new evidence shows that India and nearby countries are in danger of suffering a huge earthquake. A recent study found rock activity and pressure under the Himalayan Mountains and the Tibetan plateau. The researchers say there is evidence that such pressure has been eased in the past only through great earthquakes. The extent of damage is dependent on a number of factors, the intensity of the earthquake, distance from the epicenter, soil condition, type of structure design of building and quality of construction.

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## 11. Recommendations

11.1 I would like to forward following suggestions/recommendations on those fields where government and other concerned agencies may work together:

- a. **Standardized SOP and Joint Exercise.** A standardized regional SOP on earthquake like cyclone would save time and increase efficiency. Joint exercise on disaster management involving friendly nations could be a better choice in this regard.
- b. **Computerized Data Warning System.** A computer based earthquake predication modeling system needs to be developed to obtain a more accurate forecast of the earthquake.
- c. **Medical Team.** Separate mobile medical teams need to be earmarked in each district level. Ministry of Disaster and Relief can coordinate with Health Ministry in this regard.
- d. **Simulation Exercises.** Armed Forces Division has planned to carry out exercises simulating battlefield scenarios. Similar exercises may be conducted to check and improve the state of preparedness of the agencies concerned on earthquake.
- e. **Availability Engineering Equipment.** Appropriate authority of the government needs to earmark that equipment availability during earthquake. Fire Service Department and other rescue department should be given this equipment at priority basis.
- f. **Media Coverage.** Radio, Television should take appropriate measures to broadcast earthquake preparedness programme and basic do's and don't during earthquake.
- g. **Separate Department For Earthquake Study.** In any of the university or any educational institution separate earthquake research department can be planned. Students and scientist can carry out research on this.

h. **Earthquake Publication and Lessons.** As part of public awareness activities, booklets containing information about earthquake can be regularly printed and distributed in the schools and colleges.

j. **Good Warning System.** There should be number of warning system in the form of reporting centre established in the district and thana level.

k. **Establishment of Shelter.** Government should establish few shelters in the earthquake prone zone area.

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