

EARTHQUAKE AND DHAKA CITY-AN APPROACH TO MANAGE THE IMPACT

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ABSTRACT

Dhaka city, the soul of Bangladesh is highly vulnerable to the earthquake disaster due to high density of population, unplanned infrastructure and close proximity with India and Myanmar's active seismic area, poor economic condition, poor emergency preparation and recovery capability. A major earthquake might kill about 88,000 people and demolish 72,000 buildings and damage 86,000 others and economic loss due to damage of structures will be from US \$ 650 million to US \$ 1,075 million in the capital Dhaka [9]. The government organizations and strategies and community based organizations is important for the management of devastating impact of earthquake in Dhaka city. By introducing proper policy and planning for disaster management, community awareness build up and training, proper implementation of national building code, well coordination among government organizations and infrastructures and nongovernment organizations, enrichment of well equipped rescue team can limit the impact in a manageable boundary. The policy issues regarding disaster like earthquake could be handled mostly at the national level but planning and implementation issues are to be handled at the local community level. The earthquake hazards can never be resisted but the severe damages of earthquake disaster in Dhaka city can be reduced by increasing capacity as it reduces the risk and vulnerability.

INTRODUCTION

Megacities are something new on the planet but Earthquakes are something very old [23]. The two are a lethal combination, as seen in the history of earthquake around the world for example the tragedy happened in Port-au-Prince, where more than 200,000 people perished -- a catastrophe that scientists say is certain to be repeated somewhere and probably soon, with death tolls that once again stagger the mind [23]. The next Big One could devastate Dhaka, a potential seismic vulnerable city where people are effectively stacked on top of one another in buildings designed as if earthquakes don't happen [23]. It is not the tremor that kills people in an earthquake but the buildings, that constructed by using faulty design, cheap quality materials and the negligence of the authority to implement the national building code. By considering the increasing seismicity in this region and vulnerability of earthquake disaster especially in Dhaka city due to high density of population, unplanned infrastructure and close proximity with India and Myanmar's active seismic area [1]. A major earthquake 7.5 on the Richter scale might kill about 88,000 people and demolish 72,000 buildings and damage 86,000 others in the capital Dhaka [9]. Some 78,323 buildings will be destroyed completely if a 6-magnitude earthquake

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shakes Dhaka originating from it's beneath, in case of a 7.5-magnitude earthquake originating from Madhupur Fault, some 72,316 buildings in the city will be damaged totally while 53,166 partially and if an 8.5-magnitude of tremor from the plate boundary of Fault-2 hits the region, some 238,164 buildings will be destroyed completely across the country [19]. There will be an economic loss of about US \$ 1,112, US \$ 650 and US \$ 1,075 million for only structural damage in case of a 7.5-magnitude earthquake from the Madhupur Fault, 8-magnitude earthquake from the plate boundary-2 and a 6-magnitude earthquake from under Dhaka city respectively [19]. Some 30 million tonnes of debris, equal to 2,880,000 truckloads (25 tonnes for per truck), will be generated if a 6-magnitude earthquake jolts the city from beneath of it and a 7.5-magnitude tremor from the Madhupur Fault will generate a total of 30 million tonnes of debris, killing some 131,029 people instantly and injuring 32,948 others [19]. The history of earthquake in Bangladesh and surrounding areas [3; 4; 24] indicates that many severe earthquakes have occurred in this land mass in the past. It is believed that for being located near the syntax of three tectonic plates and Himalayan Mountain building system the country is neotectonically active. The last large earthquake of magnitude 8.7 (the great Indian earthquake) occurred in this region just about 113 years ago back on June 12, 1897, which caused huge damage in Dhaka city [2]. Referring to three major earthquakes of the region, a powerful earthquake needs at least 100-150 years to be originated for a particular region [19] and in that sense it is overdue for Bangladesh and parts of Assam, as 113 years have passed by since a heavy tremor from Dawki Fault hit the region. "So, Bangladesh is highly vulnerable to a powerful earthquake

STUDY AREA

The study area (Fig. 1) is located between the latitude 23°35'N - 23°54'N and the longitudes 90°19' E- 90°30' E. the expansion of the city is restricted by the Buriganga River in the south, Turag River in the west and Balu River in the east [24]. The city lies on the lower reaches of the Ganges Delta and consists of eight principal thanas– Lalbagh, Kotwali, Sutrapur, Ramna, Motijheel, Paltan, Dhanmondi, Mohammadpur, Tejgaon – and 16 auxiliary thanas – Gulshan, Mirpur, Pallabi, Shah Ali, Turaag, Sabujbagh, Dhaka Cantonment, Demra, Hazaribagh, Shyampur, Badda, Kafrul, Kamrangir char, Khilgaon and Uttara [5]. In total the city has 130 wards and 725 mohallas [5]. The city, in combination with localities forming the wider metropolitan area, is home to an estimated 12.8 million as of 2008 and the population is growing by an estimated 4.2% per annum, one of the highest rates amongst Asian cities [6]. The population of Dhaka city (areas under the jurisdiction of the Dhaka city corporation) stands at approximately 15.0 million and will be 30 million in 2020 and from the pressure of the new arrivals, the physical size of the city is expected to increase to nearly 1,250 square kilometer from the present over 590 square kilometers [20]. Dhaka has a tropical wet and dry climate [7]. The city has a distinct monsoonal season, with an annual average temperature of 25 °C (77 °F) and monthly means varying between 18 °C (64 °F) in January and 29 °C (84 °F) in August [7]. Nearly 80% of the annual average rainfall of 1,854 millimeters (73 in) occurs between May and September [7].

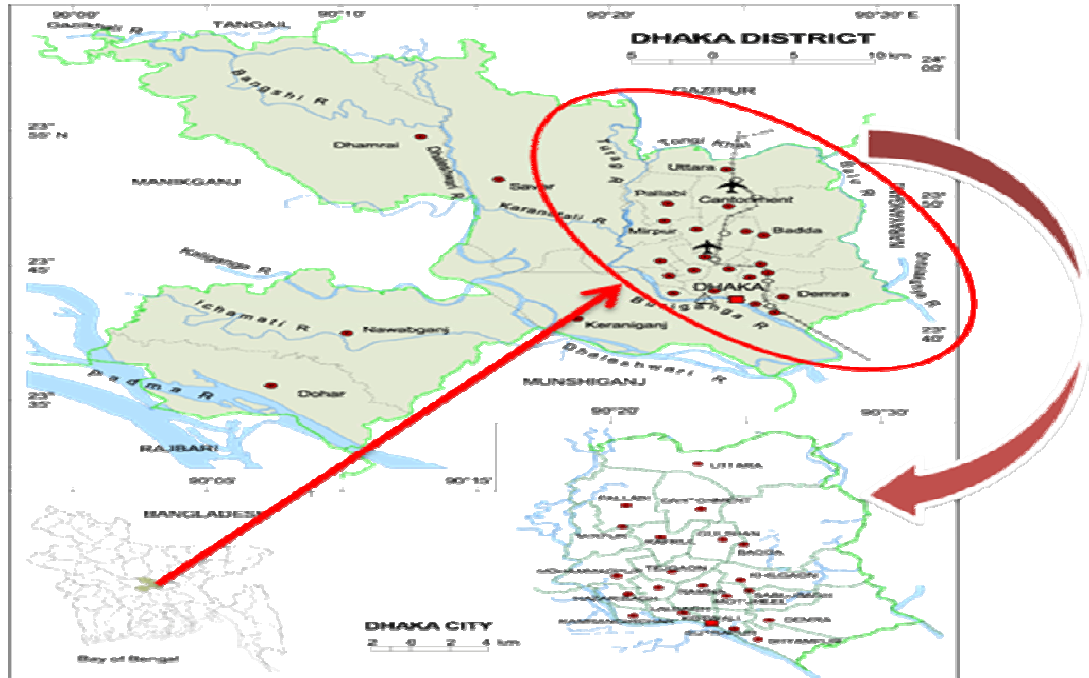


Fig. 1: Map of the study area (modified after [11]).

Objectives of the Study

1. To determine organization and strategy for earthquake disaster prevention and rescue.
2. To compile guidelines to reduce earthquake damage for individuals.

Methodology

Methodology guides scientific study in a logical way. The present study followed the descriptive type of research where secondary data were used. The methodology of this study covers some sequential steps including conceptualization of the problem and the concerning study area selection, collection of data from various websites and published journals, then analysis and arrangement of the information according to the study objectives. After that the study output was formulated as important consideration for earthquake impact management.

RESULTS AND DISCUSSION

Organizations and Strategy for Earthquake Disaster Prevention and Rescue

Organization for catastrophic disaster prevention and rescue

In order to mitigate the threat from an earthquake, all levels of the government in the world will generally raise the importance of damage prevention before the quake, emergency response and rescue during the quake and the recovery after the quake. Bangladesh is frequently visited by natural hazards of which floods, cyclones with accompanying storm surges, droughts, tornadoes, river-bank erosions and earthquake are the most disastrous to mention. Bangladesh, which is also in close

proximity with the Himalayas, has a long history of seismic tremors. Four great earthquakes of magnitude exceeding eight during 1897, 1905, 1934, 1950 and another 10 earthquakes exceeding magnitude eight have occurred during the last 100 years. The colossal losses of lives and properties caused by natural disasters with repeated frequency in short intervals make Bangladesh as one of the most disaster prone countries in the world. DMB (Disaster Management Bureau) is a small dynamic professional unit at national level to perform specialist support functions working in close collaboration with District and Thana-level authorities, and the concerned line ministries under the overall authority of high-level inter-ministerial committee (IMDMCC) [12]. It is a technical arm to the Ministry of Food and Disaster Management (MoFDM) to overview and co-ordinate all activities related to disaster management from national down to the grass-root level [12]. The main role of the Disaster Management Bureau (DMB) is to provide support to disaster management decision makers, planners and practitioners at all levels in Bangladesh by acting as a small dynamic professional unit at a national level to perform specialist functions in the field of disaster preparedness, local level disaster action and contingency planning, awareness training, facilitating improved information collection [12]. So this working unit also responsible for the meeting which is regularly held by each level of government to propose the plans for disaster prevention and rescue [12]. These plans can be considered as the guidelines for the disaster prevention before an earthquake, for the emergency response and rescue in an earthquake and for the recovery after an earthquake. As a catastrophic disaster occurs, the procedure to damage prevention and rescue will be preceded by the government as follows:

The government infrastructure for disaster prevention and rescue

The government infrastructure for disaster prevention and rescue such as the fire fighting department and the police department should collect the information about the emergency faced and go to the rescue immediately.

Damage reporting to the government agencies

Report the damage to the authorized government agencies. Then, they will organize a team to respond with rescue and recovery operations according to the plan for emergency response

Establishment of emergency response centre

The authorized government agency should report to the responsibilities of the district administrator to establish the “Emergency Response Center” for the emergency management and rescue.

Assistance from higher level of government

If the local government infrastructure cannot handle the disaster rescue or recovery it should make a request for assistance from the higher level of government. The level of government to assist the emergency response and rescue is dependent upon the actual need of emergency faced.

Community organization for disaster prevention and rescue

Disaster prevention and rescue involves every one, family and community. In addition, community organizations for disaster prevention and rescue are the basis of the national organization for disaster prevention and rescue. They can reduce the causes to disasters in the usual time and in a disaster they will go to rescue first. In fact, in case of disaster the elected district administrators, such as town supervisors or village executives, should assemble their members to involve the immediate rescue. This may include emergency medical services, fire fighting, shelter, food, water and essential services. A well-coordinated emergency response to an earthquake is likely to save many lives and prevent earthquake-induced hazards escalating the magnitude of the disaster. Community organizations can promote participation in emergency preparedness activities and help organize practice drills and exercises to raise awareness and ensure that everyone knows what to do. In addition, a community disaster plan can also be drawn up, involving fire-fighting, search and rescue, first aid, making contact with authorities, supervision of food, water and power provisions. Pre-earthquake emergency planning is one of the best ways to ensure that the earthquake disaster can be handled effectively.

Guidelines to Reduce Earthquake Damage for Individuals

Before the earthquake

Become familiar with geologic hazards of the area where we live and work.

At Home

- Reinforcing shelving, fixing tall furniture to the wall and keeping items low and safe
- Recognizing the shelters and their routes both at home and nearby.
- Recognizing the place of switch for gas and electricity and how to turn off.
- Preparing an emergency box (First aid) and fire extinguishers.
- In case of any problem in the building, ask licensed engineers or agencies to check and retrofit it.
- Check the equipments for fire fighting and exercise the plan for disaster prevention and rescue regularly

In the Public Place

- Propose an emergency plan and assign the staffs or servers to take in charge of the disaster prevention and emergency response.
- Check the equipments for fire fighting regularly.
- Exercise the disaster prevention regularly.
- Check the billboard and the shelter from the sun or any other potentially dislodged item constantly.

During the earthquake

Indoors

- Keep calm and do not rush out in panic.

- Turn off gas, electricity and water supplies.
- Using an appropriate exit to keep away from any congestion in a public place.
- Open the door in order to avoid that the door is jammed by the large deformation in an earthquake.
- Stay away from the glass window and find a safe shelter.
- Sit or lie down beside or underneath a table or bed to protect against possible objects falling from above.
- In case of fire put it out right away.
- Do not use the elevators but use the stairs.

Outdoors

- If you are driving a car or riding a bike do not stop immediately.
- If you are walking in the street, run into an open space or the pedestrian corridor.
- Keep away from the gas station, glass curtain wall, vending machine, electric pole and construction site, etc.
- Look out for any possible objects falling from above and put your arms on your head.
- If you are on a bus or a train, do not panic and jump outside.
- If you are in a suburb, stay away from the hill, riverside and seaside and find an open space for shelter.
- If you are on a viaduct or an underground passage, walk away calmly and immediately.

After the earthquake

Be aware about the effect of **after shock**

- Help each other for the disaster rescue.
- Check electric power and gas supply
- Listening to the radio or watching TV any time and escaping from any rumor.
- Do not use the telephone unless somebody has been injured or a building is damaged or burning. The emergency services may need all lines for the rescue.
- Inspect the house for cracks.
- If the gas pipeline is damaged or there is a smell of gas, do not use any gas or electric devices. Open the doors - leave the house immediately and report to the authority.

Action after Earthquake Disaster

Post earthquake quick damage inspection of buildings is the first essential step immediately after a major earthquake disaster to mitigate the secondary disaster caused by aftershocks. The purpose of this inspection is to quickly inspect and judge the risk of collapse of damaged buildings or falling of building components due to after shocks and to inform the habitants about the safety of their houses as soon as possible to prevent secondary disaster due to aftershocks. The result of quick inspection also provides the basic information to estimate the number of temporary houses and refuge centers necessary for the displaced people. Figure 2 shows the time table of typical actions after an earthquake disaster.

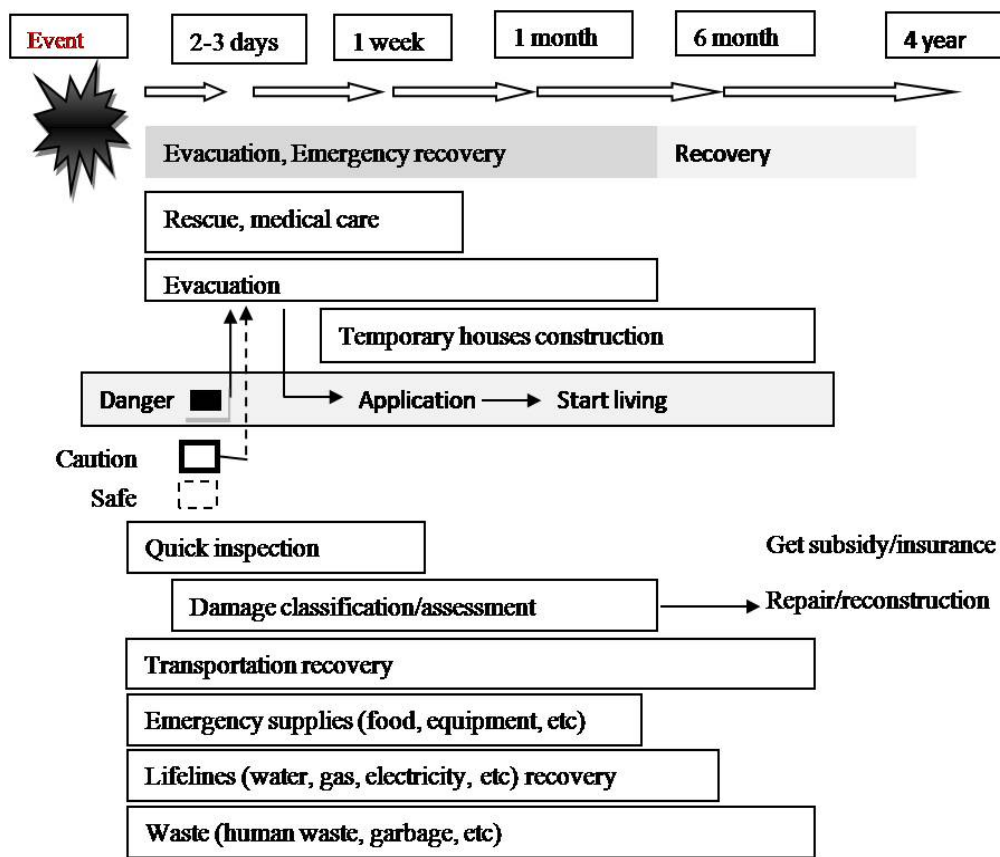


Fig 2: Time table of actions after an earthquake disaster (modified after Taiki SAITO, Chief Research Engineer, Building Research Institute, Japan).

Humanitarian mission

To minimize the greater impacts of the strong earthquake on the affected communities, a 5-8 month humanitarian mission will be needed. Following will be the main activities of the humanitarian mission:

1. Establishing emergency schools and providing school kits and facilities
2. Providing counseling and psychosocial services for children living in camps
3. Protecting children and women from trafficking and other forms of sexual exploitation
4. Establishing special post for mothers and children under the age of five and setting up a safe camps for children and women
5. Establishing health posts for mothers and children in those camps which are far from health facilities.

Few Important Considerations for Earthquake Impact Management

Community awareness buildup and training

The government of Bangladesh should set up a special body comprising of representative from the ministry of health, finance, food and disaster management, housing, Fire brigade and to take lead and coordination role. They will prepare and disseminate special guidelines and launch extensive mass awareness programs for earthquake; the awareness must include city dwellers, government officials, municipality officials, politicians, engineers, architects, designers, builders, medical people, etc. They

will develop appropriate training materials for different groups, such as planners, engineers, contractors, masons, bar binders, volunteers, fire fighters, doctors, nurses; first aid providers, etc. take training programs at the appropriate levels to impart these trainings.

Local voluntary disaster management organizations and volunteer activities

The local community should recognize the need for getting organized and capacitated. It is necessary to reform the Ward Disaster Preparedness Committee (WDPC). The WDPC was consisted of 11 members and 12-15 volunteers. The WDPC members were respected people of the community such as teachers, Imams, social workers, local elite and businessmen, while the volunteers groups were from the younger generation including scouts and guides. Training is necessary for proper volunteer activities focusing on

- improving their knowledge on earthquake disaster
- motivating them for preparedness to cope with earthquake
- Producing a work-plan for WDPC.

Preparation of data base and seismic hazard maps

Develop a comprehensive regional catalogue of all recorded historical earthquake in Bangladesh and adjacent regions that influence the country's seismic hazards. Prepare a comprehensive regional seismic hazard map of Bangladesh using the existing information and incorporate appropriate building code. Develop Bangladeshi scientists including seismologists, engineers, architects, geologists, GIS and remote sensing experts and other technicians through training and higher education programs to assume leadership in all aspects of earthquake hazards assessment studies in Bangladesh. In context of Dhaka city appropriate data should be prepared to provide information about various zone and vulnerability.

Building code and vulnerability zoning

Earthquakes might be viewed as acts of nature, but their lethality is often a function of masonry. In recent earthquakes, buildings have acted as weapons of mass destruction [23]. So it is necessary to update the Bangladesh National Building Code (BNBC) and make the document legal, make it binding for all construction activities. Demonstrate retrofitting and introduce motivation program of retrofitting through municipality leadership (for Dhaka city may be RAJUK). Install and operate seismic instrument at suitable locations in the country. Proper measure should be taken on the basis of vulnerability zoning of earthquake. The government should strictly implement building codes as well as identify and retrofit the vulnerable buildings. The government should retrofit all public buildings as soon as possible and can offer soft loan to the people as they could retrofit their old buildings.

Emergency preparedness master plan:

It is necessary to formulate a comprehensive disaster management master plan by considering the devastating seismic hazards for cities and towns of Dhaka. The master plan should emphasize the followings; community awareness buildup, vulnerability zoning, necessary rescue and recovery equipments and man power, fire extinguishing equipments, well coordination among information communication and critical services, standing order on disaster (SOD), coordination between local and central government activities.

Risk transfer and predetermined place to provide emergency services

Earthquake never be resisted but we can transfer risk in monetary unit by creating insurance policy and government should take initiatives for that. After earthquake the emergency services should the

operated from preselected area of a specific zone. Community must be informed about the service point before earthquake.

Plan for slum area

In the near future Dhaka would be one of the top five cities in the world in terms of its population size [20]. But there are valid fears that in the future it could be a megalopolis due to unplanned growth of slums or shanty towns. At present there are numerous slums in Dhaka city. Earthquake will also affect in these slum areas but the damage of structures will be less than that of buildings. Economic damage of slum dwellers will be more because they depend on the people who live in buildings. So there should be introduced plan for slum community.

Civil-military cooperation

Civil- military collaboration is an important consideration in the field of emergency response. Community volunteers, Bangladesh armed forces and civil defense perform jointly in rescue and recovery operations and also responsible to provide emergency services.

Equipment for rescue and recovery

Equipments are necessary to meet the needs of emergency response. Without the collection of proper equipments rescue and recovery is unimaginable. So Bangladesh government should take necessary steps to collect the modern equipment for proper management of earthquake impact. It is important to assess the rescue equipment stock and their usability at the time of response.

Partial decentralization

Whole economic, political and cultural activities are centered in Dhaka. In the context of earthquake the economy, politics and culture of Bangladesh are very much vulnerable. So it requires partial decentralization for smooth motion of economic, organizational and political activities if Dhaka faces any disaster.

Planning for water and air ways

The existing road communication system in and around Dhaka will be affected by earthquake but the effect will be less in water ways. So there should be plan to restore the existing water ways (canals, rivers in and around Dhaka) for the use during earthquake emergency period. Dhaka city has three rivers around it -- Buriganga, Sitalakhya and Turag. These rivers can be again turned into life blood for the city. These rivers need extensive dredging to ensure navigability round the year. The city circular river way can be a very useful communication route. Air craft will also performed during emergency response. This will be an effective way in the field of rescue and emergency services distribution. Special care should be taken for international airport in Dhaka.

Assessment of government facilities

It is necessary to assess the fire fighting strengths and take appropriate training, provisioning of appropriate fire fighting equipment, and personnel for individual cities. Assessment should be done to determine the capacity of hospitals and others medical centers, doctors, nurses, other technical personnel, medicine and equipment stock to deal with large casualties. It is important to assess the capacity of the existing blood banks and development of a large blood donors list including database of their contact address and blood groups.

Information, communication and critical services

Government authority is responsible for the transmission of information to the local community about disaster. Wireless communication system may play significant role. Mass awareness among the general people regarding earthquake, not to get panic, what to do if an earthquake hits, where to get shelter, where to phone for help etc should be undertaken daily in different television, radio, newspaper, talk show. There should be well communication system among government and community level organization. The availability of critical services should be ensured by the government to manage the impact of earthquake.

Relationship with foreign government and organization

The government of Bangladesh should maintain friendly relation with government of developed and developing countries and donor organizations. That will be helpful in the field of disaster management. Government can able to recover the impact within short period if there is any agreement for disaster management assistance among techno trade countries like India, China, Japan and USA.

Conclusion

Dhaka (Bangladesh) is situated at high risk zone for earthquake and an unprecedented human disaster may occur in the city anytime for even a moderate to heavy tremor. It is apparent that the preparedness to face a major earth quake in Bangladesh is very poor. This is because of lack of coordination among various agencies like ministry of finance, health, food and disaster management, housing and NGO's. More over there is little awareness among the people on how to face such calamities. Lack of support facilities like improved fire brigade and civil defense activities, establishment of multidisciplinary hospital to accommodate large number of earthquake victims, physical and mental support, communication by ambulances, transport vehicles, adequate number of drilling equipment, bulldozers etc. So it is obvious that if a major earthquake hits Bangladesh it will create havoc and damage in terms of life, properties that is unimaginable. It is evident from the above that we are facing a great challenge to adequately manage a major earthquake which may happen anytime in Bangladesh. To minimize suffering of the people, loss of properties and major casualties the government media, doctors, engineers, lawyer's people's representatives and mass media and all level of people should come forward with strong voice to formulate a central body to monitor this disaster, buy necessary equipments to cope, arrange establishment of multidisciplinary hospitals in the outside of danger zone immediately. Also mass awareness among the general people regarding earthquake, what to do if an earthquake hits, where to get shelter, where to phone for help etc should be undertaken daily in different television, radio, newspaper, talk show. The policy issues regarding disaster like earthquake could be handled mostly at the national level but planning and implementation issues are to be handled at the local level. Finally proper implementation of national building code and capacity building can reduce the vulnerability and risk of earthquake hazard in Dhaka city.

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