CAPACITY NEED ASSESSMENT FOR EARTHQUAKE RESPONSE IN DHAKA CITY

Thesis submitted in fulfillment of the requirements for the Degree

of

DOCTOR OF BUSINESS ADMINISTRATION

by

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Registration No.: 10/2013-2014, Session: 2013-2014
Re-registration No.: 18/2018-2019, Session: 2018-2019

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March, 2020

DECLARATION

I hereby declare that this thesis is a presentation of my original research work and has been entirely composed by myself. The contents of this paper have not been submitted, in whole or in part, in any previous application for a degree. Except where it is explicitly stated through reference or acknowledgement, the work presented within this thesis is entirely my own.

The work was done under the guidance of Dr. Muhammad ZiaulhaqMamun, at the Institute of Business Administration, University of Dhaka.

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CERTIFICATE OF THE SUPERVISOR

This is to certify that the thesis entitled "Capacity Need Assessment for Earthquake Response in Dhaka City" submitted by Md. Mahbub Jahan Khan to the University of Dhaka, is a record of original research work carried out by him under my supervision in the Institute of Business Administration, University of Dhaka. MahbubJahan Khan has worked sincerely for preparing his thesis and the thesis is, in my opinion, worthy of consideration for the award of degree of Doctor of Business Administration in Operations Management in accordance with the rules and regulations of this University. I believe that this research work is a unique one and has not been submitted elsewhere for the award of any degree.

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ACKNOWLEDGEMENTS

All praises and thanks are due to the Almighty Allah, the Merciful, who allowed me to remain in good health and helped me to complete this thesis. There are many people whom I have to acknowledge for their enormous support, assistance and encouragement during the journey of completing my study and preparing this thesis. So, I shall attempt to acknowledge their contribution here, and I sincerely apologize for anyone's contribution I might have missed.

For the completion of the dissertation,I oweeverything to my supervisor, Dr. ZiaulhaqMamun, who left no stone unturned to enhance the quality of my work, while maintaining the norms of research as far as possible. His expertise, interest, and understanding about the research problem added considerable value to conceptualize my study. I proudly appreciate his vast knowledge and mastery on the subject matter concerned. Ever encouraging, when I was falling behind, he nudged me in the right direction and led me through this journey. It was a great privilege and honor to work and study under his guidance. I would like to sincerely thank him for his friendship, empathy, and great sense of humour.

I am highly indebted to Professor Dr. Syed Ferhat Anwar, Director, IBA;who introduced me to the exciting discipline of Research Methodology in general and Research Philosophy in particular. Truly, his early encouragement has been especially valuable in comprehending the study.I am thankful to Professor Dr. A. K. M. SaifulMajid, Former Director, IBA; University of Dhaka for his invaluable suggestions, constructive reviews and inspiration topursuethis long endeavour.

It is with immense gratitude that I acknowledge the support and help of Dr. A. S. M. Maksud Kamal, Professor and Dean, Faculty of Earth and Environmental Sciences, University of Dhaka. He has always been kind to spare his valuable time for providing useful insights on earthquake management even beyond his regular work hour.

I express my gratefulness to Dr. Mehedi Ahmed Ansary, professor of BUET for his kind direction at different levels of the research work. He has always been kind to help and encourage me in conducting my research work with great patience and immense care, especially at the initial stage back in 2015-16.

Field research was not only exhaustive and tiring but wondrous too. Colleagues and friends in the Bangladesh Armed Forces and in the civil services spared no effort to ensure that I was able to interview the key personnel of all major stakeholders of earthquake response. My special mention is for Brigadier General Azazul Bar Chowdhury, DG Operations of AFD, who kindly facilitated my collection of invaluable information from different organizations. Besides, a number of senior officers from Bangladesh Army, Bangladesh Navy, Bangladesh Air Force, Border Guards Bangladesh, Civil Aviation Authority of Bangladesh, Biman Bangladesh Airlines, Customs, City Corporations, Bangladesh Meteorological Department, Space Research and Remote Sensing Organization of Bangladesh, Department of Disaster Management and Director General of Health Services and many others went out of their ways to facilitate my study. I remain ever grateful to all of them.

I have dedicated this piece of research work to my parents, late RowshonJahan Khan and Abdul Ahad Khan, for their unconditional love unwavering support and prayer in all my academic pursuits. My only regret is my beloved mother is not around to share this moment. My grateful acknowledgements are also to three other lovelypeople in my life. Farzana, my wife, was the bedrock of my family in alldifficult times, especially in the pursuit of my study and for studies of our two sons. She took over the wheel and, with it the family burden of caring and providing, leaving me to doctoral study even in my mid-fifties. My elder boy, abusiness graduate, Mashroor, was steadfast in providing invaluable support, and even checked my voluminous workdespite his busywork hours. Mahdee, my younger son, has always been special in his thoughts and deeds while supporting my work. He also worked for giving finishing touches to some figures I used in this piece of work.

I am especially thankful to all my DBA course mates. I have always been able to turn to them when I have needed some listening ears, some dissenting opinions to ultimately keep my journey in the right track and bring an end to this long 5-years academic expedition. Here, I would like to make a special mention about DrJaved Mahmud, who was always very sporting to keep his all batch mates on the track.

I remain ever grateful to all of you.

LIST OF ABBREVIATIONS

46 IIB:	46 Independent Infantry Brigade
ACAPS:	Assessment Capacities Project
ACCN:	Accommodation
ADB:	Asian Development Bank
AD:	Assistant Director/ Air Defence
ADPC:	Asian Disaster Preparedness Centre
AFD:	Armed Forces Division
AHQ:	Army Head Quarters
AOC:	Air Officer Commanding (BAF Base)
AOR:	Area of Responsibility
APU:	Auxiliary Power Unit
ASEAN:	Association of South East Asian Nations
ASYCUDA:	Automated System for Customs Data
ASYREC:	Automated System for Customs Relief Emergency Consignments
ATR:	Aerei Da TrasportoRegionale
ATS:	Air Traffic Services
BA:	Bangladesh Army
BACI:	Bangladesh Association of Construction Industry
BAF:	Bangladesh Air Force
BBC:	British Broadcasting Corporation
BBD:	Bangladesh Air Force Base Bangabandhu
BBS:	Bangladesh Bureau of Statistics
BD:	Bangladesh
Bde:	Brigade
BDPC:	Bangladesh Disaster Preparedness Centre
BDRCS:	Bangladesh Red Crescent Society
BGB:	Border Guards Bangladesh
BIPSOT:	Bangladesh Institute of Peace Support Operation Training
BIR:	Bangladesh Infantry Regiment
BLDGS:	Buildings

BMD:	Bangladesh Meteorological Department
BN:	Bangladesh Navy
BNS:	Bangladesh Naval Ship
BNBC:	Bangladesh National Building Code
BNCC:	Bangladesh National Cadet Corps
BNDV:	Bangladesh National Disaster Volunteers
BRCS:	British Red Cross Society
BSMMU:	Bangabandhu Sheikh Mujib Medical University
BSR:	Bangladesh Air Force Base Bashar
BTCL:	Bangladesh Telecommunication Company Limited
BTRC:	Bangladesh Telecommunication Regulatory Commission
BTV:	Bangladesh Television
BUET:	Bangladesh University of Engineering and Technology
CA:	Capacity Assessment
CAAB:	Civil Aviation Authority of Bangladesh
CAAN:	Civil Aviation Authority of Nepal
C & E:	Communication & Electronics
CARD:	Community Agencies Responding to Disaster
CARE:	Cooperative for American Relief Everywhere
CASEVAC:	Casualty Evacuation
CBDM:	Community Based Disaster Management
CBO:	Community Based Organization
CBS:	Columbian Broadcasting System
CCCC:	City Corporation Coordination Centre
CCDMC:	City Corporation Disaster Management Committee
CCDRCG:	City Corporation Disaster Response Coordination Group
CD:	Capacity Development
CDDWS:	Civil Defense and Disaster Warning System
CDMP:	Comprehensive Disaster Management Programme
CERT:	Community Emergency-Response Team
CIMIC:	Civil and Military Cooperation

CMH:	Combined Military Hospital
CMSD:	Central Medical Store Depot
CO:	Commanding Officer
Col:	Colonel
COMBAN:	Commodore Commanding Bangladesh Navy Flotilla
COMCHIT;	Commodore Commanding Chittagong
COMKHUL:	Commodore Commanding Khulna
CPP:	Cyclone Preparedness Programme
CPPIB:	Cyclone PreparednessProgramme Implementation Board
CRF:	Calamity Relief Fund
CSS:	Casualties Surgical Station
CSDDWS:	Committee for Speedy Dissemination of Disaster Related Warning/Signals
DAO:	Directorate of Air Operation
DCC:	Dhaka City Corporations
DDM:	Department of Disaster Management
DDMC:	District Disaster Management Committee
DESA:	Dhaka Electric Supply Authority
DESCO:	Dhaka Electric Supply Company
DG:	Director General
DGHS:	Directorate General Health Services
DGM:	Deputy General Manager
DGMS:	Directorate General Medical Services
DIMT:	Disaster Incident Management Team
DM:	Disaster Management
DMCH:	Dhaka Medical College Hospital
DMD:	Disaster Management Database
DM&RD:	Disaster management & Relief Division
DMS:	Director Medical Services
DMTATF:	Disaster Management Training and Public Awareness Building Task Force
DNCC:	Dhaka North City Corporation
DNI:	Director Naval Intelligence

DOHS:	Defense Officers Housing Society
DPDC:	Dhaka Power Distribution Company
DPHE:	Department of Public Health Engineering
DREE:	Disaster Response Exercise & Exchange
DRM:	Disaster Risk Management
DRR:	Disaster Risk Reduction
DSCC:	Dhaka South City Corporation
DSCCC:	Dhaka South City Corporation Coordination Centre
DUEO:	Dhaka University Earth Observatory
EB:	East Bengal
ECDPM:	European Centre for Development Policy Management
ECHO:	European Commission Humanitarian Aid
ECOWAS:	Economic Community of West African States
EDCL:	Essential Drug Company Limited
EDRC:	Emergency Disaster Response Centre
EDRI:	Earth Quake Disaster Risk Index
EMTCC:	Emergency Medical Team Coordination Centre
EOC:	Emergency Operations Center
EPAC:	Earthquake Preparedness Awareness Committee
EPR:	Emergency Preparedness and Response
EQPTS:	Equipment
ERC:	Emergency Response Capacity
ESA:	European Space Agency
FAO:	Food and Agriculture Organization
FC:	Field Control
FCC:	Field Coordination Cell
FCO:	Field Control Organization
FDI:	Foreign Direct Investment
FEMA:	Federal Emergency Management Agency
FFW:	Food For Work
FGD:	Focus Group Discussion

FPOCG:	Focal Point Operation Coordination Group
FSCD:	Fire Service & Civil Defense
FTX:	Field Training Exercise
FY2;	Feng-Yun 2 (Satellite)
GAO:	Government Accountability Office
GARD:	Get Airports Ready for Disaster
GM:	General Manager
GPS:	Global Positioning System
GPU:	Ground Power Unit
GSB:	Geological Survey of Bangladesh
GSE:	Ground Support Equipment
HSA:	Humanitarian Staging Area
HOCAI:	Holistic Organizational Capacity Assessment
HQ:	Head Quarter
HR:	Human Resource
HSIA:	HazratShahjalal International Airport
IAB:	Independent Air Defence Brigade
ICAO:	International Civil Aviation Organization
ICRC:	International Committee for Red Crescent
ICS:	Incident Command System
ICU:	Intensive Care Unit
IDP:	Internally Displaced People
IDRL:	International Disaster Response Law
IEB:	Independent Engineering Brigade
IFR:	Instrument Flight Rules
IFRCRCS:	International Federation of Red Cross and Red Crescent Societies
IHC:	International Humanitarian Communities
IIB:	Independent Infantry Brigade
ILS:	Instrument Landing System
IMDMCC:	Inter-Ministerial Disaster Management Coordination Committee
IMF:	International Monetary Fund

INGO:	International Non-Government Organization
INSARAG:	International Search And Rescue Advisory Group
IOSA:	IATA Operational Safety Audit
IRIN:	IRIN News now renamed as The New Humanitarian
ISB:	Independent Signal Brigade
ISPR:	Inter Service Public Relations
JAXA:	Japan Exploration Agency
JCO:	Junior Commissioned Officer
JICA:	Japan International Cooperation Agency
KII:	Key Informant Interview
KOICA:	Korean International Cooperation Agency
LC:	Letter of Credit
LenCD;	Learning Network on Capacity Development
LT:	Lieutenant
Ltd:	Limited
MAF:	Mission Aviation Fellow
MAJ:	Major
MDMC:	Municipal Disaster Management Committee
MEDEVAC:	Medical Evacuation
MI:	Medical Inspection
MIM:	Monitoring and Information Management
MIST:	Military Institute of Science & Technology
MMS:	Margin Money Scheme
MNMCC:	Multi-National Military Coordination Centre
MNCC:	Multi-National Coordination Centre
MoCAT:	Ministry of Civil Aviation and Tourism
MOD:	Ministry of Defense
MoDMR:	Ministry of Disaster Management and Relief
MoFA:	Ministry of Foreign Affairs
MoFDM:	Ministry of Food and Disaster Management
MoHA:	Ministry of Home Affairs

MoHFW: Ministry of Health and Family Welfare
MOOTW: Military Operations Other Than War
MSF: Medicine Sans Frontiers
MT: Metric Ton
MTSAT: Multifunctional Transport Satellites
Mw: Moment Magnitude
NAM: Non-Alliance Movement
NARRI: National Alliance for Risk Reduction and Response Initiatives
NASA: National Aeronautics and Space Administration
NAV: Navigation
NBR: National Board of Revenue
NCCF: National Calamity Contingency Fund
NCDC: Non-Communicable Disease Control
NCO: Non Commissioned Officer
NDB: Non- Directional (Radio) Beacon
NDMA: National Disaster Management Authority
NDMC: National Disaster Management Council
NDMAC: National Disaster Management Advisory Committee
NPDM: National Plan for Disaster Management
NDRCC: National Disaster Response Coordination Center
NDRF: National Disaster Response Force
NEOC: National Emergency Operation Center
NGO: Non-Government Organization
NGOCC: Non-Government Organization Coordinating Council
NHQ: Naval Headquarter
NHCMC&CR: National Health Crisis Management Centre and Control Room
NIDM: National Institute of Disaster Management
NIMS: National Incident Management System
NNE: North North-East
NOAA: National Oceanic and Atmospheric Administration
NPDC: National Policy on Development Cooperation

NPDM:	National Plan for Disaster Management
NPDRR:	National Platform for Disaster Risk Reduction
NRF:	National Response Framework
NSD:	Naval Store Depot
OC:	Officer Commanding
OCA:	Organizational Capacity Assessment
OCHA:	Office for the Coordination of Humanitarian Affairs
ODA:	Overseas Development Assistance
OECD:	Organization for Economic Cooperation and Development
OIC:	Officer In Charge
OR:	Other Rank
OSOCC:	On-Site Operations Coordination Centre
OT:	Operation Theatre
QRF:	Quick Reaction Force
PA:	Personal Assistant
PCN:	Pavement Classification Number
PIA:	Pakistan International Airlines
PDB:	Power Development Board
POL:	Petrol Oil Lubricant
PSO:	Principal Staff Officer
PWD:	Public Works Department
RAB:	Rapid Action Battalion
RAJUK:	RajdhaniUnnayanKortepokkho
RHD:	Roads and Highway Department
RMG:	Ready Made Garments
RNAV:	Area Navigation
RRR:	Rapid Runway Repair
SAR:	Search and Rescue
SARAID:	Search and Rescue Assistance in Disaster
SAARC:	South Asian Association for Regional Cooperation
SDG's:	Sustainable Development Goals

SDMC:	SAARC Disaster Management Centre
SFDRR:	Sendai Framework for Disaster Risk Redution
SPARRSO:	Space Research and Remote Sensing Organization
SOP:	Standing Opening Procedure
SOD:	Standing Order on Disaster
SMEE:	Subject Matter Expert Exchange
SRO:	Statutory Regulatory Order
SSO:	Senior Staff Officer
STX:	Situation Training Exercise
TGTDCL:	Titas Gas Transmission and Distribution Company Limited
TIA:	Trivuban International Airport
T&T:	Telephone & Telegraph
TTX:	Table Top Exercise
UCC:	USAR Coordination Centre
UDMC:	Upazilla Disaster Management Committee
UHF:	Ultra High Frequency
UK:	United Kingdom
UN:	United Nations
UNCRD:	United Nations Centre for Regional Development
UNDG:	United Nations Development Group
UNDP:	United Nations Development Programme
UNGA:	United Nations General Assembly
UNICEF:	United Nations Children's Fund
UNISDR:	United Nations International Strategy for Disaster Reduction
UNCTAD:	United Nations Conference on Trade and Development
UPS:	United Parcel Service
US:	United States
USA:	United States of America
USAID:	United States Agency for International Development
USAR:	Urban Search And Rescue
USARPAC:	United States ARMY Pacific

USGS:	United States Geological Survey
UDMC:	Union Disaster Management Committee
UZDMC:	UpazillaDisaster Management Committee
VDP:	Village Defence Party
VFR:	Visual Flight Rules
VHF:	Very High Frequency
VOR:	VHF Omni-directional Radio Range
WASA:	Water And Sewerage Authority
WB:	World Bank
WBI:	World Bank Institute
WDMC:	Ward Disaster Management Committee
WHO:	World Health Organization
WMO:	World Meteorological Organization

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ABSTRACT

Bangladesh is located close to many active faultsand it has not experienced a major earthquake since long. Nonetheless, countries around Bangladesh namely China, India and Nepal have witnessed huge loss of lives and colossal damage of properties on account of earthquake in the last two decades. Many experts now maintain that Bangladesh in general and Dhaka in particular is vulnerable to earthquake disaster. The vulnerability of Dhaka is very high primarily because of poor adherence to national building code that led to the growth of many unplanned structures. Extremely high population density in the city of Dhaka has only worsened its vulnerability. Inadequate awareness and poor preparation of the city dwellers would certainly demand higher degree of response at the very critical initial stage after any major earthquake. Accordingly, the country needs to gear up its capacity building for earthquake response operations in all major cities especially in Dhaka. However, any capacity building process must be preceded by an exhaustive "Capacity Need Assessment" to depict thegaps, whichexist at different levels of stakeholders of earthquake response. Findings of such capacity need assessment would ultimately pave the way to formulate a capacity enhancement strategy. It is needless to say that the Government of Peoples' Republic of Bangladesh has put due importance to Earthquake Disaster Management.

The main aim of this research work was to assess the capacity gaps/needs of the units/organization, which are responsible for earthquake response operations in Dhaka City. So far, the whole Dhaka City has been divided into eight sectors and eight units of Bangladesh Armed Forces and Border Guards Bangladesh (BGB) are made responsible to operate in these sectors in earthquake eventuality. There are some other important stakeholders like Bangladesh Fire Service & Civil Defence, Dhaka South City Corporation, Dhaka North City Corporation, and Directorate General Health Services etc. to unfold respective response operations with a view to mitigating the sufferings of people and allowing them to get back to normal life. As such, efforts have been made to study the existing or baseline capacity of these important stakeholders. Attempts were also made to explore various other sources of un-tapped earthquake response capabilities. There is no denying the fact that the response capacity of these stakeholders would largely determine the success of any earthquake response operation in Dhaka City.

This research work has been a cross-sectional study, based primarily on the subjectivism position of ontology and the interpretivism position of epistemology where understanding of human behavior was an important focus. In many cases, conclusions were drawn from interpretations of human actions and their perception especially while studying the 'Awareness and Preparation for Earthquake Response' of Dhaka City Dwellers. Importantly, the research has a very strong exploratory component where attempts were made to explore new ideas and approaches to a particular problem or situation. On the other hand, the study used both qualitative and quantitative methods. Under qualitative research, a number of focus group discussions, interviews, and literature reviews were carried out to get in-depth information about respondents' behavior, attitude and perception on various aspects. Quantitative research used statistical methods to analyze the data collected to explain phenomenon and to test hypotheses.

As the study involved information gathering, among others, from four Brigades of Bangladesh Army, two Bases of Bangladesh Air Force, Bangladesh Naval Admin Authority Dhaka and Bangladesh Border Guards; due participation was ensured from the key personnel of these units while capacity need was assessed, as suggested by literature. So, a kind of participatory assessment was done for these units where views of commanders were of great importance. All these units kindly shared their own standard operating procedures, contingency plans and pamphlets prepared for earthquake response. Accordingly, analysis has been done with regards to their preparation for earthquake and resources available with them for earthquake response operation. Similarly, the key appointment holders of other important stakeholders were also interviewed while assessing the baseline capacity for them. The study also explored the potential for earthquake response lying with different civil engineering firms operating at Dhaka. There was no database available about such firms and hence a snowball approach was adopted while sampling in this respect. The author could finally select 20 reputed civil engineering firms, engaged primarily in construction and possessed a sizeable number of resources that can be used in search and rescue. Interestingly, some of them were found with experiences of rescuing people from collapsed structures.

Historically, the community people were the first responders in all disasters especially during first 72 hours. Findings of various studies maintain that the community people

have the added advantage of knowing the area and they, after absorbing the initial shock, look for helping their near and dear ones. As such, their capacity in terms of earthquake response would continue to matter in any future disaster too. The awareness and preparation of city dwellers of Dhaka for earthquakeswould also determine the response support required for them. For example, if they are well prepared with dry food and drinking water, the requirement relief food would certainly be less. So, 715 city dwellers from Dhaka were served with a questionnaire primarily to know the level of their awareness and preparedness. Since the population density and crowding of building structures are different in different areas of Dhaka City, the city dwellers were grouped into three categories namely 'Modern Dhaka', 'Semi-modern Dhaka' and 'Old Dhaka' to make a comparison of findings among the categories.

The study found that there is need for overall capacity building for all the main operational units (eight units of armed forces) but invarying degrees. It is also revealed that some of these units have the scope of resource sharing. The'14 Independent Engineering Brigade', for example, would be able to share some SAR resources with units, which are badly lagging in this respect. Similarly, the '86 Independent Signal Brigade' have the capacity to share some of its communication equipment with other units. Most of the units do not have sufficient manpower to effectively operate in a post-earthquake scenario and would require reinforcement from other formations/units. The draft contingency plan of Armed Forces Division has outlined wherefrom such reinforcement would come. Another important finding of the study is that the units need to update their own contingency plan because some plans are even 15 years old. Similarly, there is also a need for standalone policy guidelinesfor other stakeholders that would encompass their span of responsibilities.With regards to training, the Armed Forces Division is playing the most pivotal role by jointly organizing the annual training event Disaster Response Exercise & Exchange (DREE).Importantly, the main operational units are being given the responsibility of organizing the Field Training Exercise (FTX) of DREE. Such delegation of responsibility has immense training valueand would gradually help prepare all the main operational units within couple of years, as observed by the author. However, to facilitate immediate unfolding of SAR operation by these units, the Government may allocate sufficient fund to these units for procuring some heavy-duty SAR equipment and prepare men to work behind these

machines. Otherwise, the Government may also centrally procure such equipment and distribute among these units based on their operational requirement.

An important finding of this study is that there would be no effective 'Early Warning' given for earthquake incident from Bangladesh Meteorological Department. On the other hand, effective 'Damage Assessment' would not be possible from Space Research and Remote Sensing Organization (SPARRSO). Accordingly, the study recommends for a dedicated drone unit for damage assessment. The study also observed that the area of responsibility for all the sectors needs to be reviewed since some new areas (some unions)have recently been included in the City Corporations and owing to the fact that Dhaka City Corporation itself is bifurcated to give rise to DNCC and DSCC. Some main operational units might face difficulties in coordinating with two City Corporations since their area of responsibilities spread over both DNCC and DSCC. Besides, the search and rescue assets being procured through ongoing Urban Resilience Project for capacity building of City Corporations might be strengthened and there may be more warehouses across Dhaka City to house such assets. The Fire Service and Civil Defence may also strengthen its volunteer training programme but with an emphasis of recruiting local people from all Wards of Dhaka City. Besides, there may be a separate volunteer training programme for the main operational units of Armed Forces and BGB as they would require a good number of such volunteers.

The findings of this study amply highlight that there is need for making city dwellers, especially the people of Old Dhaka more aware of the likelihood of earthquake in Dhaka City, and they should be encouraged to enhance their level of preparedness. Authorities of power and gas supply may arrange for simple training sessions for the city dwellers so that they exactly know how to put off the power supply and gas supply from the residences in the immediate aftermath of major earthquake. It is an important outcome of this research work to highlight that there is huge potential among the construction workers and pharmacy workers for using them in earthquake response operation. Their expertise would be of immense value in conducting SAR operation and in providing first aid (medical care) in a post-earthquake milieu. It is also observed that Civil Engineering firms operating at and around Dhaka City possess a very good number of SAR resources that has the potential to be engaged in earthquake emergencies provided there is some peacetime understanding in this respect.

The implicationsof these results for the country are that the stakeholders, under study, would come to know the areas for furtherimprovement. They would be able to better device their own strategies for capacity enhancement. They would also be able to make better peacetime coordination with other organizations and establishments to get the much-needed reinforcement and other support during earthquake emergencies. The policy makers would be able to formulate judicious policies after rightly appreciating the need for capacity building of different stakeholders including the city dwellers. The concerned authorities would be able to better appreciate the need for preserving the open spaces of the city to use them as emergency assembly area. The earmarking or pre-assignment of limited open space of Dhaka City would reduce the chaos and confusion when people would be rushing for shelter under stress.

Management of earthquake emergency in a city like Dhaka would no doubt be a gigantic task and hence the coordination aspects of all the major stakeholders need to be reviewed time to time. Arrangement of mockup drill and other training programmes are to be continued as revealed by this study. Nonetheless, further research is also recommended to be undertaken at certain intervals to monitor the progress of any ongoing capacity building programme and to assess what else are required to be done.

CHAPTER I: INTRODUCTION

1.1 Background

Occurrence of earthquake across the globe and consequent loss of lives & property has been a great concern for humanity for a very long time. United States Geological Survey (USGS) reports in its website that the largest recorded earthquake in the world measured at magnitude 9.5 (Mw)in Chile on 22 May 1960. It is also estimated that there are about 500,000 detectable earthquakes in the world each year, 100,000 of which can be felt, and 100 of them cause damage (USGS). According to the same source, the world's deadliest recorded earthquake occurred in 1556 in central China. It struck a region where most people lived in caves carved from soft rock. These dwellings collapsed during the earthquake, killing an estimated 830,000 people. In 1976, another deadly earthquake struck in Tangshan, China, where more than 250,000 people were killed. So, occurrence of earthquake of varied magnitudes is a common phenomenon across the globe.Earthquake was also felt among others throughout northwestern Bangladesh (Rafferty, 2015). The Daily Star (2016) quotes Syed Humayun Akhter, a lead researcher on earthquake issues, saying that the Indian plate was thrusting the Burma plate towards northeast at a rate of 13 to 17 millimeters per year and accordingly, a huge quantity of energy has accumulated there over hundreds of years. As such, Bangladesh, owing to her close proximity to the boundary of Indian and Eurasian plate, stands as an earthquake prone country.

Bangladesh is placed at the juncture of several active tectonic plate boundaries and many fault lines. Moreover, it sits on top of the world's largest river delta at close to sea level, facing both the risk posed by a quake and secondary risks of tsunamis and flooding in the quake's aftermath (Islam et al, 2016). Consequently, the damage on account of any earthquake in Bangladesh is likely to be more primarily because of the poor compactness of deposited silt beneath the country. Besides, the Myanmar fault lies along the northern and eastern parts of Bangladesh alongside the 300-km Dauki fault along the Meghalaya-Bangladesh border. On the other hand, there is also a 150-km Madhupur fault and a 300-km fault running along the Surma basin. Importantly, near the Bay of Bengal, Bangladesh has the Chittagong-Myanmar plate (Rahman, 2016). The existence of an

active fault has also been proved in Haluaghat of Mymensingh recently, adding further risk to the vulnerability (Saha, 2005). With respect to earthquake risk, Alam (2009) reports that according to a seismic zoning map by the Bangladesh University of Engineering and Technology (BUET), 43 percent of the country is rated as high risk area, 41 percent as moderate risk and 16 percent as low risk region. Importantly, Bangladesh is not very far from active earthquake zones. For example, the epicenter of the 1897 Great Indian Earthquake, which caused extensive damage of brick masonry structures in Dhaka, was only 230 km from Dhaka (Oldham, 1899). In the recent past, Bangladesh has experienced a number of tremors of varied intensities. The earthquake of January 9, 2013 had a magnitude of 5.9 in the Richter scale and was felt throughout the country. Another study reveals that in the last 150 years, the country experienced damages from five earthquakes having magnitude over 7.0 in the Richter scale (Kamal, 2013). Hannam (2016) reports in the Sydney Morning Herald that scientists found convergence of tectonic plates at the rate of 13-17 mm per year very close to Bangladesh. This build-up has the potential to trigger major shifts in land and also an earthquake with a magnitude between 8.2 and 9. He adds that scientist Professor Steckler said that they could see the strain building up and could see the motion of the plates but could not estimate when something might happen. Akhter (2016) observes that Bangladesh is overpopulated everywhere and all the natural gas fields, heavy industries and electric power plants are located close to potential earthquake zones, and they are likely to be destroyed in case of a major earthquake. In Dhaka, the catastrophic picture would be beyond any imagination, and could even lead to abandonment of the city.

The crowded city of Dhaka is said to be very vulnerable to earthquake for many reasons. Akhter (2015) maintains that Dhaka, with an average population of 45,000 per square km, is one of the riskiest cities in the world for earthquakes. The consequence of large earthquake in Dhaka city can be dreadful with unbearable loss of human lives and innumerable economic costs. Rahman (2016) observes that in 1869, an earthquake scoring 7.5 on the Richter scale occurred 250 miles from Dhaka. On the other hand, the Assam earthquake, which scored 8.5 on the Richter scale, occurred in 1950, and was about 780 miles from Dhaka. A recent earthquake risk assessment study by Comprehensive Disaster Management Programme (CDMP) of Bangladesh for Dhaka

City Corporation reveals that in case of an earthquake of Magnitude 7.5 on the Richter scale and with its epicenter at Latitude 24.3 degree N and Longitude 90.1 degree E, the city would suffer complete damage of 72,316 buildings followed by another 33,153 buildings suffering extensive damage and another 53,166 buildings suffering moderate damage (CDMP, 2009). The Daily Sun (2017) quotes Professor Jamilur Reza Choudhury, who said, while delivering a key-note speech at the National Convention on Disaster Management - 2017 in Dhaka that if a strong earthquake occurs in Dhaka and Chittagong, a total of 214,000 buildings would be completely damaged while another 111,000 buildings would be extensively damaged in these two cities. About 183,000 and 88,500 people are likely to die in Dhaka and Chittagong if the earthquake hits at night and day time respectively. Akhter (2010), in his study, focuses on the vulnerability and risk mitigation of Dhaka city. Seismic experts consider recent repeated earthquakes of low to medium magnitudes as an advance warning for a massive, and potentially disastrous earthquake in the near future, as these tremors fail to release the majority of the stress that accumulates within fault rupture zones (Bolt, 2005). By all account, Dhaka needs to prepare itself and enhance its capacity to respond to any disastrous earthquake that may occur.

It is needless to mention that earthquake occurs without giving sufficient early warning. Thus, the sudden onset of earthquake brings huge damage to infrastructure, causes injury and loss of lives, and traps people in debris of grounded structures. The situation would certainly aggravate further for a city like Dhaka where construction of structures is often done without maintaining sufficient reinforcement. In the absence of an effective enforcement mechanism, it is widely believed that many new buildings do not have adequate provision for seismic resistance. As a consequence, the number of people living or working in unsafe structures in Dhaka is increasing everyday (Paul and Bhuiyan, 2010). As such, an immediate life-saving response would be required to rescue those who are trapped and injured on account of earthquake at Dhaka. In case of earthquake, the difference between life and death, at times, can be a matter of minutes. It is thus expected that the initial life-saving search and rescue (SAR) operations arrive very fast. The SAR efforts are to be made ideally by people having specialized skills, and often operating highly specialized technical equipment. Importantly, the operational milieu, especially if earthquake occurs at night, is likely

to be extremely difficult since public services like gas, water, electricity etc. would be disrupted. The devastation of 2015 earthquake in Nepal gives us enough reminders to adequately enhance the response capacity for earthquake, well in time, so that an effective response operation can be unfolded to save invaluable lives and properties. With this, another fundamental question arises – what does it mean to have the capacity for earthquake response? Taking the simple meaning of capacity, it would mean country's capability to carryout response operation in the aftermath of an earthquake. Taking lessons from the past, many resources are required for effective earthquake response operation. In Bangladesh, the administrative structure and the government earthquake response plan suggests that these resources are to be kept ready at different levels of functionaries like the National Level, City Corporation Level, Sector Level and Community (Ward) Level. So, there is an obvious need for capacity enhancement by all the stakeholders of earthquake response in Dhaka City.

As the question of capacity enhancement for earthquake response arises, there emerges the need for the assessment of existing capacity or baseline capacity meaning where we stand at the moment with regards to earthquake response. The very next question should then be "where do we want to be in the future?" Thus, the question of desired capacity comes. This desired capacity may not really be the optimum capacity for the response rather it may be the one, which a country or organization or any other entity wants to achieve at any particular timeframe in its journey to meet its operational requirement. This brings the issue of incremental approach of capacity enhancement, where an entity gradually increases its capacity. JICA (2008) suggests that capacity assessment should be the first step for any capacity development programme. However, with regards to a country's preparation for responding to any disaster, capacity enhancement must be disaster-specific and she must develop the same, following a well-articulated capacity development strategy. It is needless to say that such a strategy must be based on 'Capacity Need' (capacity gap) assessment, which essentially involves three phases. The first phase is an assessment to define the present capacity, as already mentioned. The second phase looks ahead to the future desired state and outlines the capacity perceived to meet the operational requirement. So, it answers another important question of "Where should one have been by now?" The third phase compares the present situation with the desired state to observe the gap, which can be termed as "Capacity Need".

Once such need is identified, it is perhaps wise to prepare a strategic plan or roadmap to reach that desired state. Now, the most important question is, "What determines the response capacity for earthquake?" It is evident from literature that disaster response capacity in general and earthquake in particular is a combination of six broad determinants, namely Manpower, Training, Search & Rescue resources, Financial Resources, Legal & Regulatory Framework and various other Material Resources (shelter materials, food, medical stores etc). Truly, in case of earthquake response, anything that enhances the capacity of a service providing organization or agency can be grouped under these six broad categories. On the other hand, it is needless to say that the individual capacities of the service recipient people (the city dwellers) always complement the overall capacity of earthquake response. For example, if the city dwellers have food and water stock for couple of days then the requirement of emergency relief would be less. As such, it is also important to see the 'awareness and preparation' of community people of Dhaka city with a view to recommending measures to enhance it further.

An increased coping capacity of the community would play an important role in securing effective disaster management. It has been stated by The United Nations Centre for Regional Development (2004) that Community Based Disaster Management (CBDM) approach received attention in mid-1990s mostly from NGOs involved in humanitarian assistance activities. Davis (UNCRD, 2004) discusses that the key issues in CBDM are partnership, governance, community, private sector, education and risk reduction measures. From her study on Nepal earthquake 2015, Periyanayagam (2015) observes that response is always local in the initial seventy two hours after any disaster. Besides, neighbours also share their scanty resources including temporary shelters with other victims. Importantly, untrained local people also come forward spontaneously to form SAR teams for saving people from demolished structures long before the intervention by outside agencies. Dheri (2001) highlights the importance of community preparedness for disaster response by saying that it is important among others to identify individual and community resources, earmark various escape roots, and locate shelter sites. FEMA Deputy Administrator Serino (2011) concludes that there are examples of neighbours taking care of one another, and in one example, of even rescuing each other. From this point of view, all disasters are said to be local. When a disaster strikes, neighbours will

be the first responders. Thus people at the root level (Ward Level) of the city corporations needs to be empowered through awareness, training and resources etc. It is again very important for Dhaka because it houses hundreds of slum households for thousands of slum dwellers. The number of slums according to 'Slum Census 2014' within Dhaka North City Corporation was 1639 whereas in Dhaka South City Corporation it was 1755 and according to 'Slum Census 1997' it was only 1579 in total within Dhaka City Corporation. On the other hand, the number of households in DNCC and DSCC was 135,340 and 40,591 respectively (BBS 2014) with the average household size of 3.67. So, it is evident that there is huge populationliving in slum areas. As such, to make any response architecture effective, this huge number of community people needs to be well articulated in the response mechanism and the capacity building should also follow the same outline.

For responding to an earthquake at Dhaka in a meaningful way, it is thus imperative to identify the important stakeholders of earthquake response. Accordingly, an attempt was made to identify the major stakeholders of different levels through a Focus Group Discussion (FGD). However, the stakeholders at the main operational level (sector level) were already determined by the Armed Forces Division (AFD). Besides, all the stakeholders for earthquake have already been well identified by the Department of Disaster Management (DDM) through its Standing Order on Disaster (SOD). Nonetheless, the important ones have been shortlisted for this study. The city corporations (DNCC and DSCC) were considered as two important stakeholders since they are implementing the donor funded 'Urban Resilience Project' to enhance the country's earthquake response capacity. The importance of airport in earthquake response was amply highlighted from the study of Nepal Earthquake 2015. As such, the capacity of HazratShahjalal International Airport (HSIA) was also studied in terms of cargo handling, aircraft parking, cargo storage, customs and immigration procedures etc. According to the Standing Order on Disaster (SOD) 2010 of the Ministry of Disaster Management and Relief, the operational responsibility in the aftermath of any earthquake causing destruction to Dhaka City is given to Bangladesh Armed Forces and Border Guards of Bangladesh though many other agencies and organization would work side by side. In line with this SOD, Armed Forces Division (AFD) has divided the city of Dhaka into eight sectors. Of them, Bangladesh Army is made responsible for 4 sectors (Sector

1, Sector 3, Sector 6 and Sector 7; Bangladesh Air Force is given the responsibility of 2 sectors (sector 2 and sector 4); Bangladesh Navy is tasked to operate in Sector 5 while Border Guards of Bangladesh (BGB) would operate in Sector 8. Accordingly, AFD has also prepared a Draft Contingency Plan, which outlines the duties and operational responsibilities of different units, assigned with different sectors. Thus it is imperative to know the baseline response capacities and desired capacities of different units of Bangladesh Armed Forces and BGB to identify the existing capacity gaps or capacity needs.

1.2 **Problem Statement**

Earthquakes are said to be the most hazardous and destructive types of natural events (Ashkenazi 2005) and Bangladesh is said to be one of the most disaster-prone countries in the world as it ranks 17th (out of 153 countries) in terms of its vulnerability to earthquake (ECHO, 2016). The urban poverty, unplanned construction of buildings with no regards to building code, population density, poverty and narrow road network increases country's vulnerability to earthquake. A major earthquake would cause huge devastation to this populated country especially to its capital city of Dhaka. The Government of Bangladesh has attached due importance to earthquake preparedness and efforts are already on to enhance her response capacity. The standing order on disasters (SOD) 2010 has spelt out the responsibilities of various organizations and agencies in a nut shell. The stakeholders of earthquake response are many and as such, the coordination need among them is also high. The number of drills to test various plans is still inadequate. The annual Disaster Response Exercise and Exchange (DREE) since 2010 is no doubt a noteworthy initiative, but Bangladesh needs to do more in this regard. For earthquake response in Dhaka city, the areas under city corporations (DNCC and DSCC) are divided into eight sectors by the Armed Forces Division (AFD) and the operational responsibility has been given to Bangladesh Army (BA), Bangladesh Navy (BN), Bangladesh Air Force (BAF) and Border Guards Bangladesh (BGB). However, it is also evident that Armed Forces Division is yet to finalize a contingency plan though individual units responsible to operate in different sectors have prepared their own operational plan.On the other hand, with regards to capacity building, how much is done for the units responsible to operate in the field, are yet to be studied. The DDM is procuring items for earthquake response and handing over the same to Armed Forces and

other agencies but there is need for a study to ascertain whether these are going to meet the requirement of the units responsible for earthquake operation. Ideally, there is need for studying the capacity gap of these units so that capacity building programme becomes a judicious one. Again, for capacity need (gap) assessment there is need for an exhaustive baseline study, which is yet to be done. In case of Bangladesh, such an assessment is essentially a very sensitive one since the units responsible are military ones. Besides, to complete the need assessment, there is also need for assessing the desired capacity, which is, again, a very tricky task. The desired capacity is primarily a relative term because; the desired capacity does not necessarily mean the optimum capacity. An incremental approach of capacity building says that a unit may build up its capacity over a long period. For a resource scarce country like ours, it is practicable that the capacity is built gradually. As such, this also needs to be studied as to how the units are planning to build their own capacities to meet the operational requirement.

The city corporations (DNCC and DSCC) are also enhancing their response capacities under World Bank financing. World Bank (2015) says that it is financing $173 to the Urban Resilience Project of City Corporations. On the other hand, Bangladesh Fire Service & Civil Defence (FSCD) has been augmenting its capability to operate in case of any earthquake occurrence. However, the baseline information especially with respect to available resources appears to be scanty and the coordination mechanism among different stakeholders needs to be reviewed. Similarly, baseline capacities for other important stakeholders at different levels are to be known with a view to knowing their ability in earthquake response. Without adequate capacity building of different stakeholders at different level and in absence of a well-articulated coordination mechanism among the stakeholders including the community people, the earthquake response effort would not be able to secure desired outcome.

Historically, many agencies (government, semi-government and non-government) have been found taking part in response activities after any major disaster. These agencies are not always local and many international agencies do extend huge support in case of disasters. However, as evident from available literatures, these response activities are very complicated and no single agency alone can perform even one of the response activities fully. Here lies the importance of coordination so that scarce resources are best utilized and efforts are not wasted. In a crisis like post-earthquake management,

operational stakeholders need to compliment and supplement each other to efficiently and effectively operate in the complex milieu to best serve the earthquake victims. The stakeholders might have sufficient resources but if there is inadequacy in coordination among them, response activities can't secure full benefit from their capacities. For securing better coordination, there must be some peacetime arrangement through policies, act, regulations, SOP etc among the stakeholders so that in crisis they can display their full potential without any misunderstanding and mismanagement. Importantly, the operational stakeholders should have their own contingency plan that outlines not only their own mode of operation but also their mechanism to coordinate with other agencies with whom they have to work together.

The operational area, the Dhaka City Corporation (DCC),was bifurcated in 2011 for ensuring better service to the city dwellers (The Daily Star 2011) and accordingly, DSCC and DNCC came into being. This led to the assigning of new numbers to the Wards under DNCC and DSCC, which are different from the common list of Wards used earlier. Again, in the recent past, through government promulgation, the areas under city corporations of Dhaka have been increased by 110% once sixteen neighbouring unions are equally given to DNCC and DSCC. Thus Unions of Beraid, Badda, Vatara, Satarkul, Harirampur, Uttarkhan, Dakshinkhan and Dumni are given to DNCC while DSCC is assigned with Shyampur, Dania, Matuail, Sarulia, Demra, Manda, Dakshingaon and Nasirabad. This has increased the Dhaka City's area from the current 129 square kilometres to 270 square kilometers. The inclusion of new areas means 10.623 million people now live in Dhaka's north and 7.5 million in the south (bdnews24.com, 2016). Accordingly, 36 new Wards are formed to make the total wards 129 from its existing 93. However, this change would demand consequent changes in the SOPs and Contingency Plans of the stakeholders for response operation. Importantly, some of the units of Armed Forces might have to coordinate with two city corporations since their AOR would now spreadover two city corporations. This might necessitate fresh marking of boundaries for sectors and it may also require increasing the number of sectors and number of units/services responsible for earthquake response operation. With this major change in the operational area, the task would be doubled since the area is getting more than double and the population would also nearly double. As such, it would be pertinent to study the actions being taken at different levels to accommodate this big change. In

addressing all these questions, the proposed study would make an attempt to assess the existing capacities of all major stakeholders and desired capacities of operational stakeholders of the Armed Forces with a view to assessing the capacity needs foreight main operational units for earthquake response in Dhaka City. The awareness and preparation of community people need also to be studied since it essentially complements the overall earthquake response capacity of a country or society owing to the fact that they themselves are generally the first responders when their community is in distress.

1.3 **Context Analysis**

1.3.1 **Why Earthquake**

In the regional context, we see earthquake caused unbearable loss of life and property in last couple of decades. Countries namely China, Nepal, India, Pakistan, Indonesia, Thailand, Sri Lanka, Iran and Iraq etc. were affected by earthquakes of varying intensity in the recent past. The Nepal Earthquake 2015 is still fresh in our memory because of its mammoth devastation. A number of small and medium earthquakes jolted the capital city of Dhaka in the recent past too. As revealed from different studies, out of all disasters, earthquake causes the most damage once a country is not well prepared for that. For a city like Dhaka, it is needless to say that the loss lives and properties, on account of a major earthquake, would be unbearable and beyond the capacity of government alone.

1.3.2 **Why Dhaka**

The density of people, poorly constructed buildings, narrow road infrastructure, large number of slum dwellers & floating people, and ever increasing economic activity in the capital city of Dhaka makes it highly vulnerable to disasters especially to earthquake. Fast pace of urbanization in this city is leading to growing risk of hazard exposure and vulnerabilities. As such, capacity building in the field of disaster response would be a judicious investment for saving lives and properties in case of any earthquake disaster in Dhaka. According to the results of the Earthquake Disaster Risk Index (EDRI) project, major earthquake risk is associated with the high vulnerability of the building stock due to both poor materials and poor construction processes (Choudhury, 2005).

1.3.3 **Why Capacity Need Assessment**

Capacity need assessment starts with the study of existing capacity. If one can decide a desired capacity then he/she can assess the capacity gaps and these leads to the capacity development program. However, the incremental approach suggests that the desired capacity may not always be the optimum capacity. Truly speaking, when the question is 'Capacity Building'or 'Capacity Development' for earthquake response, no country, like ours, can overnight develop its capacity to the optimum level since resource would always be scarce. For enhancement of response capacities to a desired level, assessment of capacity need would be of great value as it gives a roadmap for capacity development.

1.4 **Objectives of the Study**

The broad objective of the study is to assess the capacity need for earthquake response in Dhaka City. However, the specific objectives are as follows:

a. To carry out the capacity need (gap) assessment for eight stakeholders (main operational units) of Armed Forces and BGB.

b. To study the baseline capacity of all other important stakeholders for earthquake response in Dhaka City.

c. To explore the SAR resources available at Dhaka in the private sector.

d. To study the awareness and preparation for earthquake among the community people (city dwellers) of Dhaka.

1.5 **Scope of the Study**

The initial focus of this research would be to see the existing capacity of all important stakeholders for earthquake response in Dhaka City. Thereafter, the study would assess the desired capacities of all the eight main operational units of the Armed Forces and BGB with a view to finding out the capacity need of them primarily through a participatory assessment framework. The study would,first and foremost, take into account of various response resources and regulatory frameworks that are available with the stakeholders at different levels. However, special emphasis would be given to the capacities of Armed Forces (BA, BN and BAF) and BGB since they would be the

primary stakeholders of response drive in the aftermath of earthquake. The law and order situation, to facilitate the response operation, would primarily be maintained by Bangladesh Police, RAB and Bangladesh Ansar. To keep the study manageable within the given timeframe, the capacitiesof these law enforcing agencies would not be part of this study. The area of Dhaka City Corporation for this study would exclude 36 new Wards, which emerged out of some newly included unions. Since the subject as little technical and responding to the questionnaire involved sparing some reasonable time, small children (below 16 years of age) were not considered to become the respondents.

1.6 Limitations of the Study

The limitations of this study are as follows:

a. The capacity need was assessed for the operational units of eight sectors only. For other stakeholders, only the baseline capacity was studied.

b. The assessment of organizational (units of Armed Forces) capacity was a participatory one, which might have some inherent limitations.

c. While collecting baseline information with regards to rescue resources available in the private sector, only major 20 firms are taken into consideration.

d. The researcher followed convenient and judgment sampling mostly. The sample drawn might not be the true representative of the population concerned.

e. The slum dwellers, floating people and visitors were not considered.

f. The intervening variables were not considered while defining the relationship between the predictors and criterion.

1.7 Research Questions

This study would answer three major questions:

a. What is the existing capacity of Bangladesh to respond to a major earthquake in Dhaka City?

b. What is the capacity need (gap) of main operational units of eight sectors for earthquake response in Dhaka City?

c. What is the level of awareness and preparation of Dhaka City Dwellers?

1.8 **Significance of the Study**

Since the occurrence of earthquake can't be stopped, Bangladesh's best option would be to prepare for this potential threat so that she can unfold an effective response operation as quick as possible in the aftermath of a major earthquake to save invaluable lives and properties. Here lies the importance of capacity building with regards to response. Before taking any initiative with regards to capacity building, Bangladesh must be sure of the existing capacity where baseline information of all resources, regulatory frameworks that facilitate efficient operation are of great significance. The intended study would be beneficial to the policy makers of the country since it would enable them to understand the capacity need of main operational units of Armed Forces and BGB. It would also paint a clear picture of baselinecapacities of all other important stakeholders.

The study would also unearth the missing links in the existing coordination mechanism and the requirement of such coordination mechanism and response framework. Accordingly, it would allow the government to devise effective and all-encompassing coordination architecture for earthquake response in the country especially over Dhaka City. It is well known that the capacities of community people adds to the capacities of service providing stakeholders and accordingly, the awareness and preparation of city dwellers have also been studied in this paper. The findings highlighted a clear picture about our level of preparation and awareness as city dwellers. This would help devise befitting campaign for all concerned to enhance earthquake awareness and preparation.

Last but not the least; the study also highlighted the emergency response capacity of Hazrat Shahjalal International Airport (HSIA).The findings of this part of study highlighted the need for enhancing cargo and passenger handling capacity of HSIA and also placed importance in keeping one or more international airport operable in earthquake scenario. Finally, it is also expected that this study would generate more similar or related studies that would help carving out policies for further improvement in this field. From this point of view, the intended study has special justification too. The findings would undoubtedly benefit the stakeholders concerned to improve their own standing with regards to earthquake response in Dhaka City.

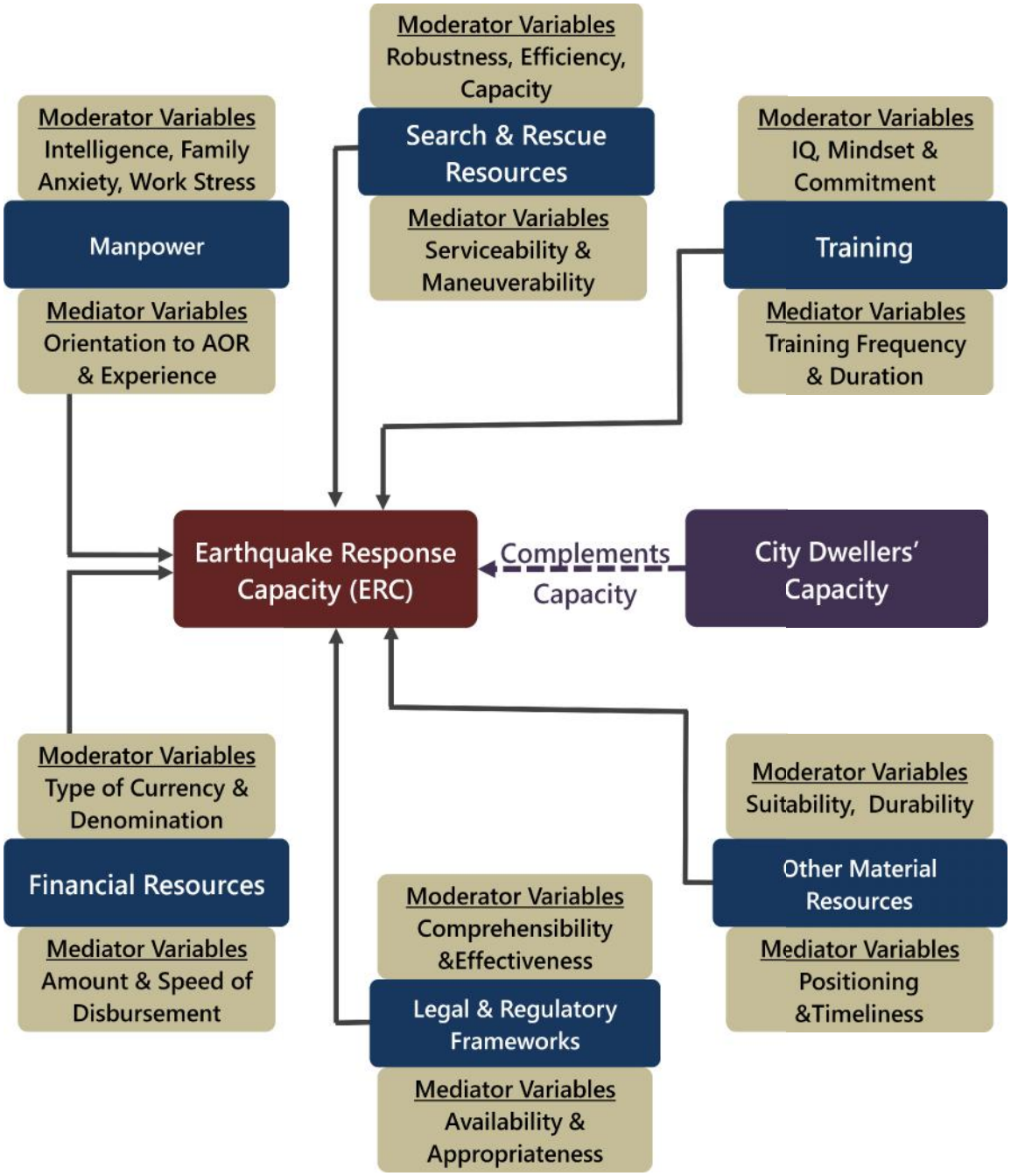
1.9 **TheConceptual Framework**

Miles and Huberman (1984) describe a conceptual framework as a 'researcher's map of the territory being investigated'. Secondly, doctoral candidates are expected to provide scholarship that contributes to knowledge (Winter et al, 2000). Evidence suggests that a thesis which has no conceptual framework is unlikely to gain a pass (Trafford, 2003).

The study primarily involves capacity need assessment for earthquake response. As such, it is very much prudent to define what makes capacity for an organization because service providers are mostly the organizations. Cigler (2007) defines capability as capacity, in terms of 'the financial, technical, effective policy, institutional, leadership, and human resource capacities that local government bodies must have in order to perform activities in routine emergencies'. Braun (2004) advocated that organizational capacity is about money, people, systems, policies, and technical resources'. AFD mentions thatit took an initiative in 2016 to identify existing capabilities of the Armed Forces along with civil resources. However, AFD appreciates that there is requirement of carrying out gap analysis of manpower, equipment and material. Issues of gap analysis as identified by AFD were sharing of resources with civil administration, lack of coordination with civil administration, lack of proper methodologies for damage/need assessment, lack of proper training, lack of database and need for accessing data bases of other organizations, lack of Incident Command System etc (AFD, 2019). These findings give enough clue about what makes earthquake response capacity and what are the gaps.

In light of the above and after talking to some experts, earthquake response capacity (dependent variable), for this study, was considered to be the outcome of six independent complex variables namely Manpower, Training, SAR Resources, Other Material Resources, Financial Resources and the Legal & Regulatory Framework as depicted in the figure below. It is also needless to say that anything that facilitates earthquake response operation would generally fall under these six complex variables (independent) of the study. Here, Legal and Regulatory framework would essentially include all coordination arrangements. On the other hand, the service recipients' capacity is a very important aspect proved historically. The overall earthquake response capacity is complemented by whatever little capacity the service recipients possess. As such, the capacity of Dhaka City Dwellers was given due importance while conceptualizing this

research work. Though various intervening variables had been identified, no field study was carried out against them. The identification of these variables would certainly educate all concerned that it is not merely the counting of the resources while building the capacity for earthquake response rather many other factors need to be considered.



Source: Developed by the Author

Figure 1: Conceptual Framework: The Cause Effect Relationship of Predictor and Criterion Variables

CHAPTER II:METHODOLOGY

2.1 Research Methods

Research Methodology is the process of collecting information and data while dealing with a research problem. It involves a meticulous process of, but not limited to, identification of population, sampling, data collection, data organization, data analysis etc. Accordingly, sources for such information and data may include various publications, interviews, surveys and other research techniques, and could include both present and historical information. Kothari (2004) observes that Research Methodology is a process that solves a research problem systemically. Simply saying, the descriptive method of research essentially involves gathering of data that describe events and then organizes, tabulates, depicts, and describes the data collection (Glass & Hopkins, 1984). As widely accepted, the descriptive method of research is a fact-finding study that involves adequate and accurate interpretation of findings to put forward some recommendations to address the problem under study. Descriptive research describes a certain present condition of the problem under study. Here, the technique used is the normative survey approach and evaluation to explore opinions according to respondents that can represent a whole population. The conduct of survey enabled the researcher in formulation of generalizations. Specifically, two types of direct-data survey were included in this study. These are questionnaire survey and interviews. Interviews with key personnel of different stakeholders were conducted to provide further insight about the results of the survey. The researcher opted to use this kind of research considering the desire to acquire first hand data from the respondents so as to formulate rational and sound conclusions and recommendations for the study. According to Creswell (1994), the descriptive method of research is to gather information about the present existing condition. A clear understanding about the conduct of this research would be revealed from the research onion.

2.2 Research Onion

Social research is different from scientific research primarily because a social researcher's outlook about people often depends upon his/her philosophy. Besides, the respondents' perception greatly influences the outcome of a research work. Accordingly, the research approach, methodical choices and strategies also vary. The research onion,

as presented below, details out various philosophical aspects and other dimensions of this research work.

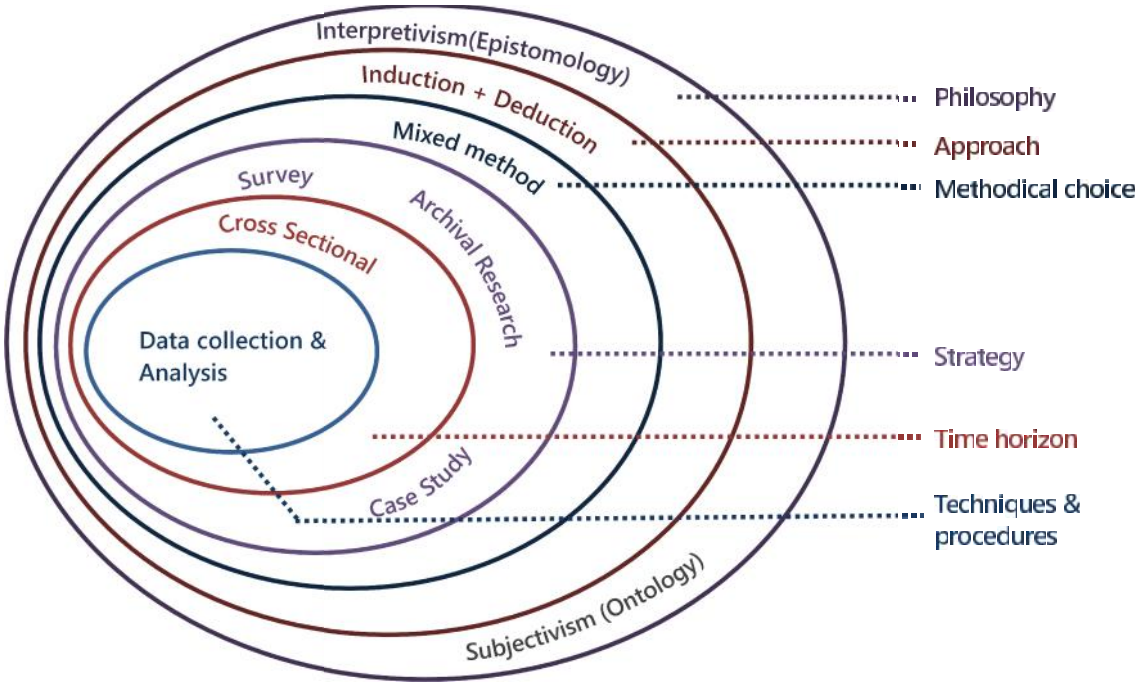


Figure 2: Research Onion of the Study

2.2.1 **Research Philosophy**

With respect to research philosophy, both ontology (the study of being or what is) and epistemology (the study of knowledge) have been considered in this study. Social ontology deals with the key issue of whether social entities can have a reality, external to social actors, who have no control over it. This gives rise to two major aspects of ontology, which are objectivism and constructionism (Bryman, 2012). The ontological position of objectivism states that social phenomena can exist independent of social actors. On the other hand, subjectivism (constructionism) affirms that social phenomena and their meanings are constantly being changed through social interaction. It asserts that truth only happens in the present. They rely more on qualitative research to determine the numerous realities. In social research, subjectivism refers mainly to individual experience, perception, and interpretations of the world as well as the material conditions and social relations that molds a person's vision (Ratner, 2002). Subjectivity is said to guide everything from the choice of topic that a researcher studies, to formulating hypotheses, to selecting methodologies, and interpreting data. This research

work is characterized by subjectivism philosophy both from the point of the researcher and the respondents.

While ontology is concerned with ‘what is there’ or ‘what is reality’, epistemology is characterized by ‘what do we know’ and ‘how do we know it’. It is defined as the “study of the grounds, nature, and origins of knowledge and the limits of human understanding. Some social researchers believe in the use of natural science methods in the study of social reality. This is known as the positivism epistemological position. It is based on the testing of observations against theories to find out how much they agree or disagree with each other. Realists, on the other hand, argue that conclusions cannot be drawn on the basis of observations alone, as reality can also exist ‘hidden’ from observations. On the other hand, an epistemological position that contradicts positivism is known as interpretivism. Advocates of interpretivism do not believe that natural science methods can be successfully applied to social research, where understanding of human behavior is the main issue of study. Here, conclusions are not drawn from theories but from interpretations of human actions. In interpretivism researchers should be prepared to alter any preconception they may have. This research is based predominantly on the subjectivism position of ontology and the interpretivism position of epistemology.

2.2.2 **Research Approach**

Once the research approach is the question, the study is predominantly deductive in nature since it did not attempt to establish any new theory from the acquired data. Rather, it commenced with understanding of some concepts about the ‘capacity’ and ‘capacity assessment’, and formulation of hypotheses against some variables. Finally, hypothesis testing was also done to some extent based on empirical analysis. However, to be very candid, in this research, both a deductive and an inductive approach were considered. In one hand, a quantitative survey was administered, the responses to which were analyzed in order to test hypotheses, and also conducted qualitative interviews with a number of the survey participants. The survey data were well suited to a deductive approach and they were used to test hypotheses. The interview data were well suited to an inductive approach where attempts were made to look for patterns across the interviews. These patterns offered some platform wherefrom theories could be developed (though not attempted in this study).

2.2.3 **Methodical Choice**

The nature and extent of research work essentially dictates the research methods to be chosen in order to collect data and information. The present study used a mixed method, which means that both qualitative and quantitative methods were used at different stages of the research based on suitability. Under qualitative research, number of focus group discussions, interviews, and literature reviews were carried out to get in-depth information about respondents' behavior, attitude and perception on various aspects. Quantitative research used statistical methods to analyze the data collected to explain phenomenon and to test hypotheses, formulated against some variables. The quantitative method used tools like surveys, structured interviews and reviews of numeric data.

2.2.4 **Research Strategy**

Different research strategies were adopted to complete this study. First, it has been the 'Archival Research' that gave an insight to develop the conceptual framework based on the identified research gap, emerged through an exhaustive literature review. Secondly and very importantly, this research also adopted the 'Survey' strategy of the research onion. Through various kinds of survey, information and data were gathered from different categories of respondents, which were found to be supportive to make inferences and recommendations at the end. This convenient research strategy allowed the researcher to gather huge data and analyze them to ultimately answer who, what, where, when and how of the research work. Nonetheless, a small 'Case Study' was also done where the experience of an Army Engineering Unit was revisited. The said Army Unit was involved in demolition and rubble clearance of DNCC market at Gulshan 1, Dhaka after it had collapsed following a fire incident in January 2017.

2.2.5 **Time Horizon**

As far as time horizon is concerned, the study falls under the category of cross-sectional one. As such, the information from the respondents was recorded without manipulating the study environment and without allowing the study environment to be changed. Accordingly, different population groups were compared in respect of different variables at a single point in time. However, as the study presented a snapshot of a single moment in time; it did not consider what would happen before or after the snapshot was taken. Given the timeframe, cross-sectional study was considered to be the best suited one.

2.2.6 **Techniques and Procedures**

Data Collection and analysis were done following statistical norms to arrive at some inferences to ultimately come to a conclusion for making recommendations. In general, the sampling for administering the questionnaire among the community people was a kind of convenient sampling. However, while selecting the areas for study, a sort of un-biasness was exercised. While administering the questionnaire the basic premise followed was "Who is ready to give time?"

2.3 **Stakeholder Identification**

The first and foremost job, before the data collection began, was to identify the important stakeholders of earthquake response for this study at different levels. Kamal (2019) while speaking about 'Earthquake Contingency Plan' in the recently held Disaster Response Exercise and Exchange (DREE)-2019 identified three different levels namely the National Level, City Level and Agency Level. The present study also considered all these three levels plus the community level since the capacity at the community people would matter while ascertaining the need for response. The community people may not have any written contingency plan, but they may have a kind of mental appreciation about their actions on account of earthquake. As gathered from literature review and an FGD conducted on 15 March 2016, the major stakeholders identified for this study were as shown in the table below:

Table 1**:** MajorStakeholders of Earthquake Response for Dhaka City

Level	Stakeholders
National Level	AFD, DDM, FSCD, SPARRSO, BMD, BIMAN, CAAB, DGHS, Customs and Immigration
City Corporation Level	DNCC, DSCC, Civil Construction Engineering Firms
Sector Level (8 Sectors of AFD Draft Contingency Plan)	46 Independent Infantry Brigade, 86 Signal Brigade, 6 Independent Air Defense Brigade and 14 Engineering Brigade of Bangladesh Army; Bangladesh Navy Admin Area, Dhaka; BAF Base Bashar and BAF Base Bangabandhu of Bangladesh Air Force; and the Border Guards Bangladesh (BGB)
Community Level	Dwellers of Dhaka City

Note: The agencies that would maintain law and order situation, and the NGOs/INGOs are deliberately excluded from this study.

2.4 **Variables**

As conceptualized in chapter 1, there are 6 independent variables (complex) to influence the only dependent variable - Earthquake Response Capacity. However, the city dwellers' capacity that complements the earthquake response capacity was studied separately. The independent complex variables were broken down into simple variables through an FGD conducted on 26 July 2016 with experts and the important ones are studied. It is needless to say here that the independent variables are not at all exhaustive.

Table 2**:** The Independent Variables of the Study

Complex Variables	Simple Variables
Manpower	Integral, reinforcement and volunteers of FSCD
Training	Participation in drill, seminar, symposium and exercise
Search and Rescue Resources	Specialized SAR equipment, Search dogs and Search helicopters
Other Material Resources	Relief Materials, Medical Facilities and Shelter Materials for the earthquake victims
Financial Resources	Money for own operation & money for disbursement to earthquake victims
Legal and Regulatory Frameworks	Policy, Act, Standing Orders, SOPs, Plans and all coordination mechanisms

2.5 **Population andSample**

All eight operational units of the Armed Forces and BGB were taken into consideration while from other stakeholders; important agencies/organizations were selected based on an FGD. However, while studying the civil engineering firms, 20 important firms were selected following mostly a snow ball system of sampling. Finally, while studying the community people, the population of Dhaka city was considered. According to the latest official BBS census (2011), the total population of Dhaka City was 8,840,855 without counting the slum dwellers and floating population (Appendix I). Determination of sample size is perhaps the most difficult part of a statistical investigation. Often it is claimed that a sample should bear some proportional relationship to the size of the population from which it is drawn. However, when the population is very large, such proportionate sample size might be unmanageable one. We know the equation for determining sample size, when the population is infinite, is as follows:

$$n = \frac{z^2\, p\,(1-p)}{d^2}$$

Where, n = sample size

z = reliability (depends on level of significance)

p = percentage of the population concerned

d = Precision (the accuracy or sampling error that the researcher accepts)

Here, z = 1.96 and p = 0.5 Assumed,

q = 1-p = 1- 0.5= 0.5 and d = 0.0375 (Assumed)

Accordingly, the required sample size should be

$$\text{Required Sample Size (n)} = \frac{1.96^2 \text{ X } 0.5 \text{ X } (1\text{-}0.5)}{.0375^2} = 682.95$$

For the convenience and to have more confidence, the number was increased to 715. As such, 715 respondents formed the sample while studying the awareness and preparation of the community people.

2.6 **Sampling Technique**

While sampling the city dwellers, attempts were made to have representation from all walks of lives though the slum dwellers, floating people, guards/caretakers and the dwellers of age below 16 were not considered.

2.6.1 **Selection of City Dwellers**:

a. Old Dhaka. The old Dhaka has a population of 2,720,659, according to the 2011 census. A total of 200 respondents were selected from 22 different areas of old Dhaka through a convenient sampling method where respondents were selected based on their willingness to give sufficient time in answering the questionnaire of the research.

b. Modern Dhaka. The total population of Modern Dhaka was 2,158,795. Accordingly, 179 respondents (proportionate to the total population) were selected following the convenient sampling but based on their willingness to give sufficient time in answering the questionnaire of the research.

c. Semi-Modern Dhaka. Since the population under semi-modern Dhaka has been the highest (3,961,401) among three areas, a total of 336 respondents (proportionate to the total population and sample size) were chosen for this study

but again based on their willingness to give sufficient time in answering the questionnaire of the research.

2.6.2 Selection of Civil Engineering Firms

There was no list available with the researcher to figure out the exact number of private civil engineering firms operating in Dhaka City. However, a total of 20 of them were selected for studying the resources available with them that could be used in earthquake response. While selecting the firms, a snow-ball approach was mainly adopted where a firm named Next Spaces Ltd was chosen as it had been found operating somewhere in 'Badda' area of the city. On the other hand, Navana Engineers was chosen as its name was already known to the researcher. Following the snowball, a total of 15 firms were chosen and another 7 firms were selected by visiting their WebPages through direct hunt using the internet. Out of 22 firms, 20 were finally selected as they expressed their willingness to share the information with the researcher. The selection procedure for the private civil engineering firms is shown in the figure below.

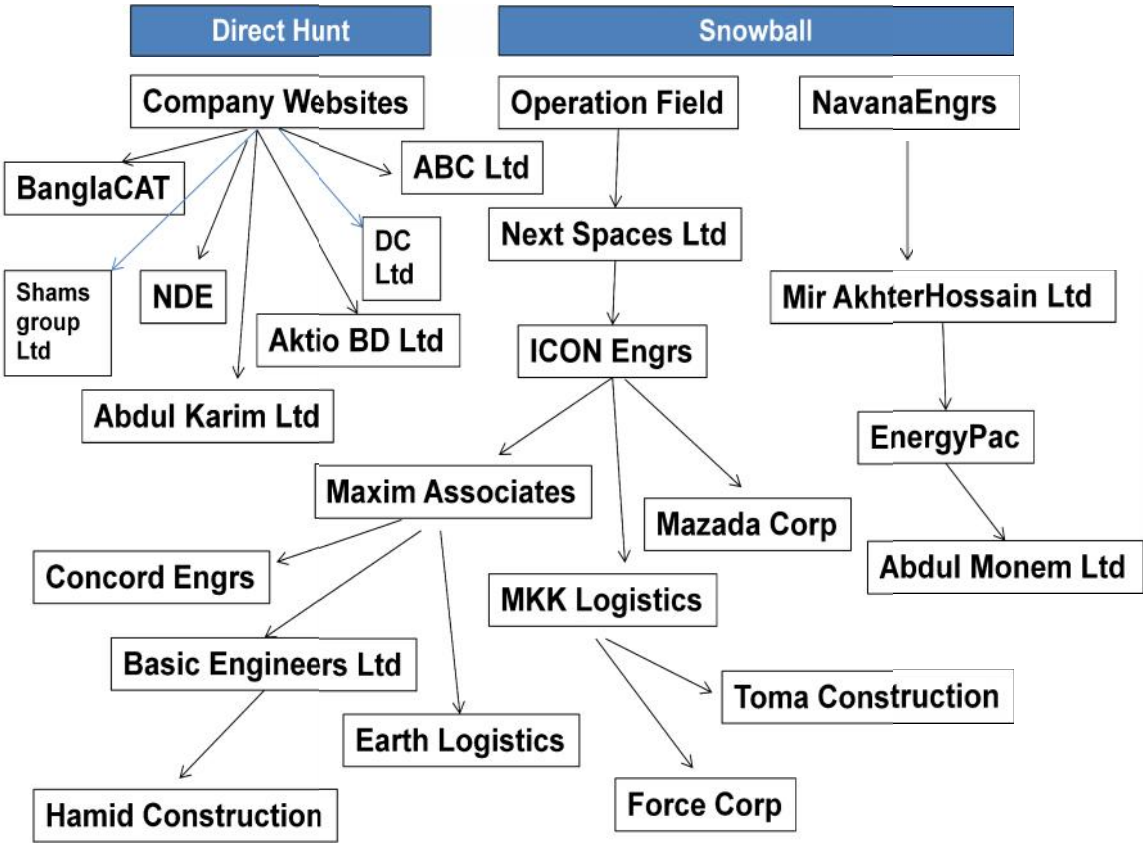


Figure 3: Selection Procedure of Civil Engineering Firms

2.7 **Coordination Schema**

Objective-wise coordination schemas were prepared to ultimately shape the 'Questionnaire' and 'Structured Interview Schedules'. However, as objective 1 & 2 dealt with similar variables, a common coordination schema was prepared for them (Table 3).

Table 3: Coordination Schema for Objective 1 & 2

Complex Variable	Variables	Data Type	Source	Method of collection
Manpower	Integral to unit	Quantitative	Primary	Check list & Interview
	Reinforcement (Mil)	Quantitative	Primary & Secondary	SOP review & Interview
	Reinforcement (FSCD)	Quantitative	Primary	Interview
Training	Seminar, symposium, workshop (Indoor)	Quantitative	Primary	Check list and KII
	Real life Experience	Quantitative	Primary	KII
	Mock drills	Quantitative	Primary	
SAR Resources	Helicopters	Quantitative	Mainly Primary and some secondary	Check list, Structured Interview (KII) and concerned SOP
	Specialized SAR Eqpt.	Quantitative		
	Vehicles	Quantitative		
	Sniff Dogs	Quantitative		
	Drones	Quantitative		
Other Material Resources	Shelter Materials	Qualitative and Quantitative	Primary & Secondary	Check list, Structured Interview (KII) and SOP
	Food Materials			
	Clothing Material			
	Medical resource			
Financial Resources	For own operation	Quantitative	Primary	KII
	For disbursement	Quantitative	Primary	
Legal and Regulatory Frame work	SOD – 2010	Qualitative and Quantitative	Primary & Secondary	Check list, Structured Interview (KII) and Review of Policy documents
	AFD Draft Plan			
	Disaster Act 2012			
	Own SOP, Pamphlet			
	National Plan for Earthquake Management (latest)			
	Dead body Management Plan			
	DM Rules			

Source: FGD conducted involving earthquake experts on 26 July 2016

Objective 3 was to explore the earthquake response resources of private sector and the coordination schema is given in Table 4 below.

Table 4: Coordination Schema for Objective 3

Complex Variable	Variables	Data Type	Source	Method of collection
SAR Resources	Excavators	Quantitative	Primary	KII
	Loaders	Quantitative	Primary	KII
	Cranes	Quantitative	Primary	KII
	Concrete Core Cut	Quantitative	Primary	KII
	Man/Boom Lift	Quantitative	Primary	KII
SAR Support Resources	Dozers	Quantitative	Primary	KII
	Generators	Quantitative	Primary	KII
	Forklift	Quantitative	Primary	KII
	Fuel Bowser	Quantitative	Primary	KII
	Water Tanker	Quantitative	Primary	KII
Transportation Resources	Trailer	Quantitative	Primary	KII
	Dump Truck	Quantitative	Primary	KII
	Pickup	Quantitative	Primary	KII

Again, objective 4 was aimed at studying awareness and preparation for earthquake among the city dwellers of Dhaka and the coordination is given in Table 5 below.

Table 5: Coordination Schema for Objective 4

Complex Variable	Variables	Data Type	Source	Method of collection
City Dwellers (CDs)' own Awareness	General Awareness (Likelihood of earthquake in Dhaka City)	Quali-tative	Primary	Questionnaire (Dichotomous questions – Yes/No Type)
	Awareness by other sources about actions in earthquake			
	Readiness to render Voluntary service			
City Dwellers' own Preparation	General Preparation			
	Stock of Food for 3 days			
	Stock of drinking water for 3 days			
	Exposure to Training/drill			
	Ability to cut off power supply			
	Ability to cut off gas supply			
CDs' perception about Awareness	Need to Strengthen Awareness Programme in general	Quali-tative	Primary	Questionnaire (Likert Scale)
	Media to play more role in awareness building			
City Dwellers' perception about Preparation	Preparation in General			
	Ward-wise training of volunteers			
	Need for regular drill in wards			
	Pre-designation of open space			
	Training Pharmacy Employees			
	Training Construction Workers			

2.8 Data Collection

2.8.1 National Level

At national level both primary and secondary data were collected through review of different documents, policy guidelines and interviewing key personnel (KII) of different stakeholders. Data from all the national level stakeholders were collected by the author himself after visiting respective offices physically. Such visits were repeated to confirm some information.

2.8.2 City Corporation Level

At the City Corporation level data was also collected through reviewing different documents, policy guidelines and interviewing some key appointment holders of both DNCC and DSCC. Besides, the Project Director of Urban Resilience Project was consulted. On the other hand, for collecting data from construction engineering firms, 20 leading firms operating in city corporations were contacted and interviewed to have the list of serviceable SAR equipment and other response support resources available with them. The KIIs at this level were also conducted by the author himself.

2.8.3 Sector Level

At the sector level, data was collected through review of various policy documents of the Government that were available with the stakeholders, their own operation plan and the draft contingency plan of AFD. Importantly key personnel in charge of operations were exhaustively interviewed for all 8 units responsible for operating in 8 sectors of Dhaka City Corporations. All the operational units for earthquake response in Dhaka City are primarily the units of Armed Forces and Border Guards of Bangladesh. As such, there remained a degree of reservation, from the units concerned, while dishing out classified/sensitive information. Universally, as revealed from the literature, various tools are used while measuring organizational capacity but all these tools suggest that it better be a guided self-assessment and participatory one, where stakeholders themselves determine the core capabilities to be investigated and assessed. It is needless to say that the units concerned would better know their strength & weak areas. Accordingly, structured interview formats and check lists were used to collect information from eight operational units.

2.8.4 **Community Level**

At the community level, data were gathered from city dwellers after administering a questionnaire. In this case, quantitative data was collected mainly by asking some dichotomous (yes/no) questions to know their own level of awareness and preparation. On the other hand, eight statements, structured in a 5-point Likert scale, were placed to them to get their perceptions with regards to city dwellers and awareness and preparation, in general.

2.8.5 **The Questionnaire**

A questionnaire (Appendix II) was developed to conduct the field survey among the city dwellers. It consisted of an introductory part and three sections. The introductory part was optional and was aimed at getting their names and contact information. The first section of the questionnaire started with a screening question in order to determine whether respondents were eligible to take part in the study or not. This was primarily to ascertain whether they could spare some time for answering the questions. The second section contained questions about their awareness on and preparation for earthquake emergency. The third part of the questionnaire was used to collect demographic information like gender, age etc. The questionnaire had structured questions and it was administered over a period of seven months from 20 September 2016 to 20 April 2017 to three categories of respondents who are, otherwise, city dwellers (community people) of Dhaka. Since the number of respondents was very big and they lived over a large geographical area, three data collectors were also employed for this period. In questionnaire survey, respondents were given ample time to express their views on the questions. The researcher opted to use this kind of research considering the desire to acquire first hand data from the respondents so as to formulate rational and sound conclusions and recommendations for the study. According to Creswell (1994), the descriptive method of research is to gather information about the present existing condition. Besides, a 5-point psychometric response scale, ‘The Likert Scale’, was used to obtain respondents degree of agreement or disagreement with a set of eight statements. The Likert Scale thus served the purpose of ascribing quantitative value to qualitative data, to make it amenable to statistical analysis. Accordingly, a numerical value was assigned to each potential choice and a mean figure for all the responses was computed

at the end of the survey. The Likert scale had five choices as ‘strongly agree’, ‘agree’, ‘indifferent’, ‘disagree’ and ‘strongly disagree’. The final average score was taken as representation of overall level of attitude toward the statement concerned. To prepare the questionnaire, following steps were followed:

a. Listing of required information on the basis of respective coordination schema.

b. Framing questions with suitable scale of measurement (dichotomous question and 5-point Likert scale.

c. First draft of questionnaire and pre-testing of the same to thirty respondents taking ten from each area.

d. Final drafting of the questionnaire and printing.

e. Distribution of questionnaires in the selected sample to get their responses.

2.8.6 **Interviews**

The Interviews with experts on earthquake, policy makers in the concerned Departments, top management of major stakeholders like Bangladesh Army, Bangladesh Navy, Bangladesh Air Force, Border Guards Bangladesh, City Corporations, FSCD, DGHS, SPARRSO, BMD, Biman Bangladesh Airlines, and Civil Aviation Authority of Bangladesh were conducted to provide further insight about the research under question. The list of various Key Informants interviewed is given as Appendix III.

2.8.7 **FGD**

Two FGDs were conducted on 15 March 2016 and 26 July 2016 with six meteorological experts (Appendix IV) in both the cases. The first FGD lasted for about 3 hours and ended with identification of various important stakeholders for earthquake response in Dhaka City. Again, the second FGD was to decide on the complex variables that determine earthquake response capacity and subsequently breaking them into simple variables. Finally, from a long list of simple variables for each complex variable, only the important ones were short-listed to complete the study within the given timeframe.

2.9 Types of Data Used

This research work involved the use of three types of data namely the primary, secondary and the tertiary data. The primary data was gathered from the answers received through the self-administered questionnaire. In addition, the information acquired from the interviews of experts and key personnel of various agencies also provided primary research data that supported the study. Various civil construction firms provided invaluable primary information with regards to SAR equipment. The secondary data was derived from the findings stated in published documents and literatures related to the research problem as were available with other organization/agencies and in open internet sources. The latest 'Disaster Response Exercise and Exchange (DREE) 2017' as held at Dhaka from 8 October 2017 to 12 October 2017 under the auspices of Armed Forces Division was a great source of huge secondary information. The lessons learned from this response exercise were widely referred to reinforce the findings of this study. Finally, the tertiary data are those data, which were collected from the publications of a third source, which were not connected with those particular research findings.

2.10 Statistical Treatment

Statistical tools and technique used for the accomplishment of survey were as follows:

a. Frequency Table. Frequency table is a summary for the number of times the different values of available occur. The frequencies provided statistics and graphical display that were useful for describing many types of variables.

b. Cross Tabulation. Cross tabulation is a method to quantitatively analyze the relationship between multiple variables. It is also known as contingency tables or cross tabs that groups variables to understand the correlation between different variables. It also shows how correlations change from one variable grouping to another.

c. Chi-square Table. Chi-square test was used to test the independence of two or more attributes. For testing the hypothesis of independence of two attributes, an observed set of frequencies were compared with a corresponding set of frequencies that were exposed under the null hypothesis.

d. Logistic Regression Model. Number of factors can also influence the dependent variable simultaneously. To investigate such relationship multiple regression models can be applied. But here is a big problem that our response variable itself is a dichotomous variable in nature which can take only two values;

1= "The people have preparation regarding earthquake";
2= "The people have no preparation regarding earthquake"

And the explanatory variable consists of qualitative or dummy variables. If we try to run multiple regressions here, it won't necessarily lie between 0 & 1, so our prediction will become inconsistent as we are interested with the probability. As 'Logit' model is easier to understand and takes standard form of analysis, we will use this model in analysis purpose.

2.11 **Pilot Study**

In a quantitative study, a survey instrument that is designed by the researcher needs a pilot study to validate the effectiveness of the instrument, and the value of the questions to elicit the right information to answer the primary research questions. In a scientific study, a pilot study may precede the main observation to correct any problems with the instrumentation or other elements in the data collection technique. Pilot study was done with 30 respondents in developing the data gathering instrument – the questionnaire.

CHAPTER III: EARTHQUAKE AND EARTHQUAKE RESPONSE

3.1 General

The literature review is a comprehensive summary of previous research works on the topic close to the one under investigation where emphasis is given to various findings by different researchers and investigators. As such, it essentially reviews scholarly research papers, articles, books, and other sources relevant to a particular area of the research. Since contribution to knowledge is the aim of a thesis, a careful check is generally made through literature review to make sure that the proposed study has not previously been carried out in the same context. Importantly, it offered the author a theoretical base for the research and helped the author outline this research work. It is well known that the literature review acknowledges the work of previous researchers, and in doing so, it assures the reader that the research work under study is well visualized by the researcher. A literature review creates a "landscape" for the reader that informs that the author has indeed assimilated as many previous works in the related field as possible. It essentially tells the reader what is already done in particular research area and what the gaps still exist. In the following three chapters various literatures are presented to provide the intended readers a conceptual platform along with various findings by experts and researchers that facilitate better comprehension of this piece of study.

3.1.1 Earthquake: Global Scenario

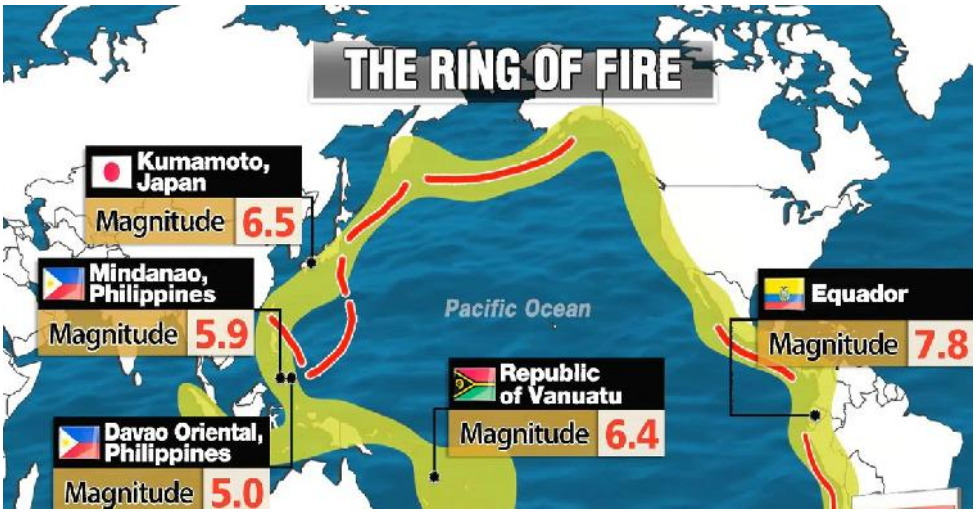
Perez (1994) maintains that on an average one million earthquakes occur globally per year. However, major earthquakes that cause colossal destruction to lives and properties take place once every three years. Conners (2016) maintains that the largest recorded earthquake in the world was a magnitude 9.5 in Chile on May 22, 1960 and other worth mentioning earthquakes that have occurred across the globe include a 9.2 magnitude earthquake that struck Alaska on March 28, 1964, a 9.1 magnitude earthquake that hit off the coast of Sumatra on December 26, 2004 and a 9.0 earthquake that occurred near the coast of Honshu, Japan on March 11, 2011. Earthquake of varying magnitude are occurring everyday across the globe. However, their frequency of occurrence per year greatly varies with the magnitude. Generally for an earthquake, the higher the magnitude; the lower is the chance of occurrence, as depicted in the table in the next page (Table 6).

Table 6: Earthquake Magnitude and Estimated Global Occurrence

Magnitude	Earthquake Effects	Estimated Number/Year
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake. Serious damage.	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.	One every 5 to 10 years

Source: http://www.geo.mtu.edu/UPSeis/magnitude.html

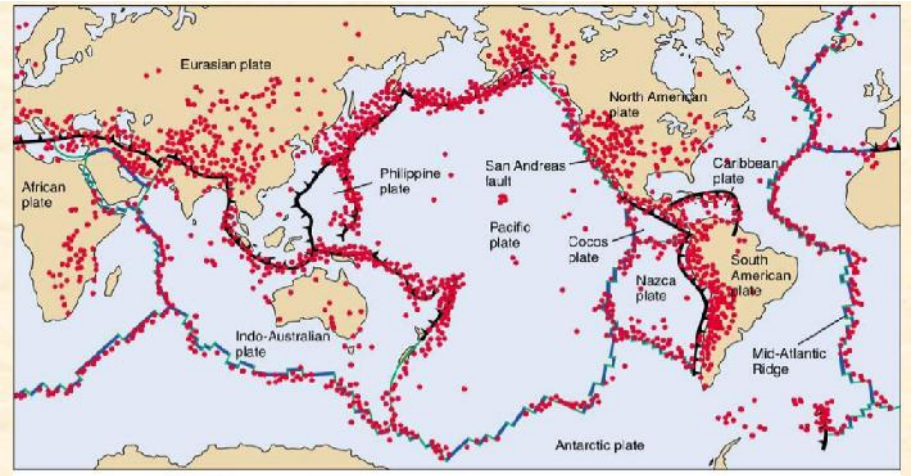
Since 1850, approximately 90% of the 16 most powerful volcanic eruptions on Earth have occurred within the Pacific Ring of Fire (Conners, Byrd and Gonzaga, 2016). Interestingly, 90% of world's earthquake and 81%of the world's largest earthquake occur along this so called 'Ring of Fire' (Figure 4). This region is so disaster-prone that all but 3 of the world's 25 largest volcanic eruptions of the last 11,700 years occurred at volcanoes in this 'Ring of Fire'. Mentionable, Bangladesh is not very far from this dangerous zone of earthquake.



Source: arirangnews.com

Figure 4: The Ring of Fire in the Pacific

Again, if someone looks at the global picture of earthquake occurrence, this is also evident that to the north of Bangladesh lies a very active zone of earthquake (Figure 5).



Source: USGS

Figure 5: Global Occurrence of Earthquake (Red Dots)

3.1.2 **Damage Caused by Earthquake**

The impact of disaster is always much higher in poorer countries because even small economic losses are critical due to awfully low capacities to recover from the distressed state. Countries like Bangladesh should be more concerned because a study observes that approximately 80% of all disasters occur in predominantly developing areas (Alexander, 1991) where **c**ountries lack right resources to prepare for the disaster and hence a disaster is addressed only after it hits. It is also revealed from studies that earthquakes are among the most dangerous and destructive types of natural events (Ashkenazi 2005) taking a huge toll of life and property. It is observed that the loss during 1990-2012 in Asia alone is 75% ($ 596857 million out of total$ 798,350 million) of the global financial loss.

Table 7: Financial Loss Due Earthquake (1990-2012) in US $ in Millions

Continents	**Total Loss**	**Insured**		**Uninsured**	
		Value	**%**	**Value**	**%**
Asia	$ 596,857	$ 46,521	7.8	$ 550336	92.02
Africa	$ 6,895	$ 93	1.3	$ 6802	98.7
North America	$ 48,746	$ 22,237	45.6	$ 26509	54.4
South America	$ 51,017	$ 9,747	19.1	$ 41270	80.9
Australia/Oceania	$ 29,456	$ 22,690	**77**	$ 6766	23
Europe	$ 65,379	$ 4,502	6.9	$ 60877	93.1
Total Global	$ 798,350	$ 105,788	13.3	$ 692562	86.7

Source: Swiss Reinsurance Corporation; figures rounded at 2012 estimates (WB, 2016)

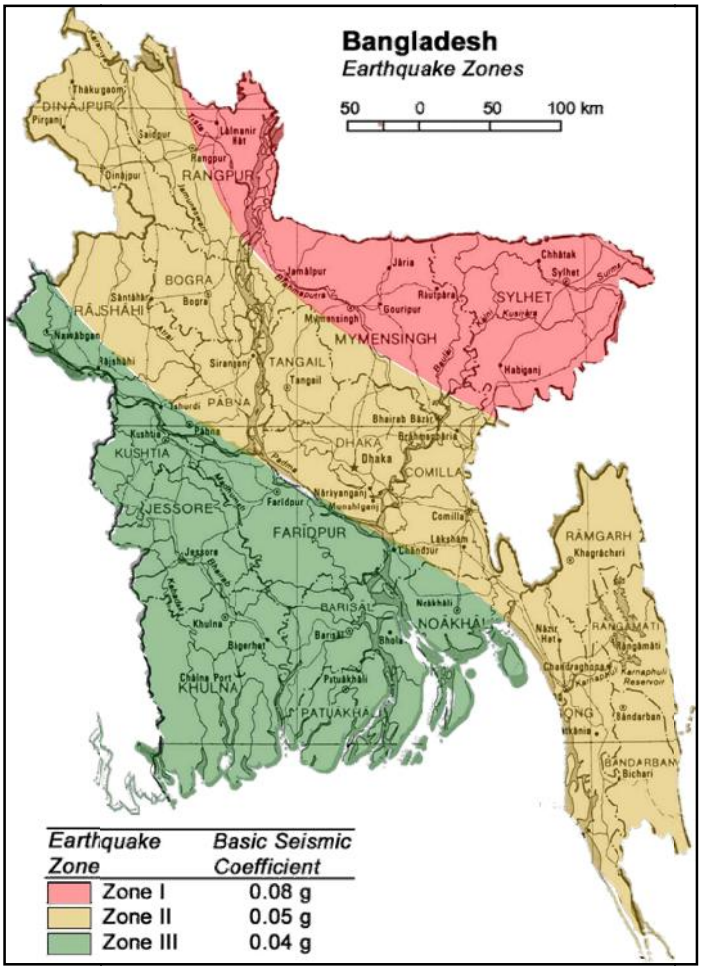
In the regional context, it is well known that an undersea earthquake in the Indian Ocean triggered tsunamis in 2004, killing over 225,000 people in 11 countries. Literature review suggests that earthquake causes unprecedented damage in crowded cities with unplanned growth and poor quality infrastructures. In case of Bhuj (India) earthquake of January 2001, the magnitude was 6.9 on the Richter scale with its epicenter about 20 km north-east of Bhuj, in Gujarat's Kutch district. Over 30,000 people were killed, and 167,000 injured. Nearly 8,000 villages were affected in 21 districts. Official figures state that 378,286 houses were completely destroyed, and 968,879 partially destroyed. Nearly 95 percent of all standing structures in the Anjar, Bachau and Rapar blocks of Kutch were razed to the ground. More than 20,000 cattle were reported killed. Estimates of the economic damage range from $1.3 billion to as high as $5 bn (Siddiqui, 2002).

In case of the Pakistan earthquake of 8 Oct 05, the magnitude was 7.6 with its epicenter 100 km NNE of Islamabad. Over 1000 aftershocks were recorded; ranging from 5.0 to 6.0 on the Richter scale. Most of the affected people lived in mountainous regions with access impeded by landslides, leaving an estimated 3.3 million people homeless in Pakistan alone. The total area affected was 30,000 km², included a range of unprecedented damage and destruction, such as: Houses: 500,000 (56%), Medical facilities: 365 (65%), Telecommunications Exchanges: 86 (34%); Power lines: 33,225 (13%), Schools/colleges: 6083 (50%) and over 1000 hospitals. Due to the earthquake, there was a significant loss to Pakistan's infrastructure. There were collapsed and blocked roads, a total loss of clean water supply, partial loss of telecommunications infrastructure, partial loss of UN VHF system, and in some cases hospitals were non-functional (ADB and WB, 2005). In Nepal, the devastating earthquake of April 25, 2015 and subsequent aftershocks have caused damage worth Rs 513.38 billion to physical infrastructure and assets, and inflicted income loss of another Rs 187.08 billion, indicating that billions of rupees will have to be spent in the coming years to regain lost opportunities, restore physical assets and improve livelihoods. Estimates show that the education has sustained damage worth Rs 28.06 billion and just to ensure resilient recovery of this sector, a sum of around Rs 39.70 billion is required. And to regain losses suffered by all 23 sectors and build back better, the country will need to spend at least Rs 666.31 billion in the short and medium term," Nepal Planning Commission member Swarnim Wagle told a newspaper (Sharma, 2015). Over 505,000 private houses were

fully damaged while around 279,000 houses were partially damaged (Sharma, 2015).

3.1.3 **Earthquake:Bangladesh Scenario**

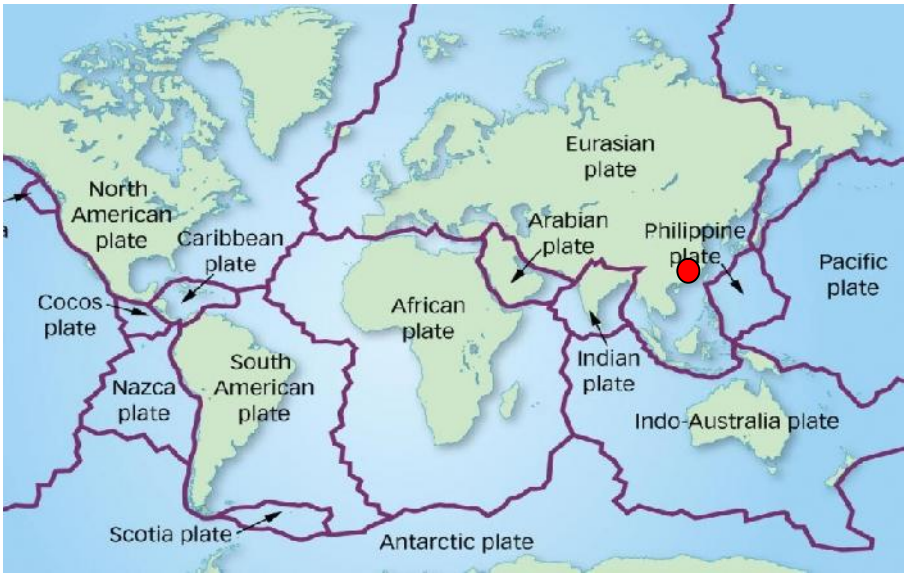
AFD (2019) maintains that the first recorded earthquake in 1548 was a terrible one for Bangladesh where. Sylhet and Chittagong were violently shaken leading to opening of earth in many places. In 1762, the great earthquake of April 2, caused a permanent submergence of 155.40 sq km near Chittagong. Ahmed (2016) observes that though Bangladesh did not face any large earthquakes since the 1918 Srimangal Earthquake, it has experienced about 116 seismic turbulences since January 2007, and each time the epicenter was in the country. This is noticeable and is a reminder of the seismic risks in Bangladesh. Geological Survey of Bangladesh (GSB) and Bangladesh Meteorological Department (BMD) have outlined a seismicity map of Bangladesh with three distinct seismic zones (Figure 6).



Source: http://www.thebangladesh.net/earthquake -maps-of-Bangladesh

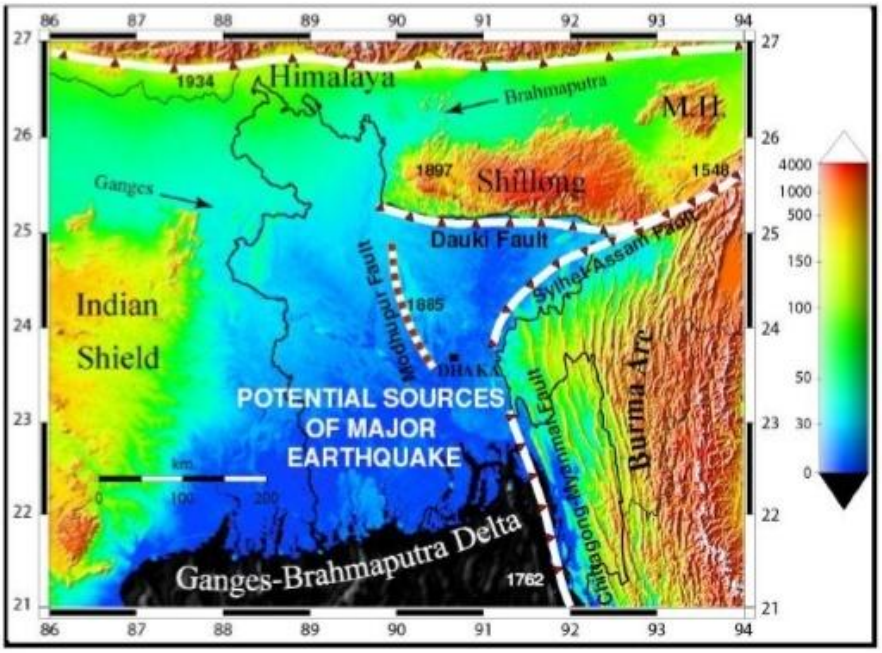
Figure 6: Seismic Zoning of Bangladesh

It is evident that Zone 3 is the most and Zone-1 is the least vulnerable areas to seismic hazards. Tectonic framework of Bangladesh and adjoining areas indicate that Bangladesh is placed adjacent to the plate margins of India and Eurasia where devastating earthquakes have occurred in the past (Figure 7). On the other hand, Figure 8 shows 'Fault Lines &Tectonic Plates' in Bangladesh's proximity.



Source: James Garlic, www.tes.com

Figure 7: Tectonic Plates in Bangladesh's Proximity



Source: www.arpnjournals.org/jes/research_papers/rp_2016/jes_1216_55.pdf

Figure 8: Fault Lines &Tectonic Plates in Bangladesh's Proximity

3.2 Earthquake Response

The Federal Emergency Management Agency (FEMA) of USA has incorporated another phase in the disaster management cycle and conceptualized the phases as shown in the figure below where it is evident that the response phase starts immediate after the occurrence of disaster.

Source: https://www.fema.gov

Figure 9: Disaster Management Cycle as adopted by FEMA, USA

Subba (2015) reported that the Nepalese Army had responded to Nepal Earthquake 2015 immediate after its occurrence with an operation, codenamed as "Sankat Mochan". In the peak period of response operation, Nepalese Army deployed a total of 67071 personnel. With regards to achievement, it rescued 1336 people alive, recovered 1731 dead bodies, delivered 5707 tons of relief materials, arranged shelters for more than 15000 victims and offered medical treatment to 35282 people. The "Sankat Mochan" operation of Nepalese Army was divided in to three phases. The Phase -1 of Nepalese Army's concept of operation for earthquake response was the Immediate Response phase that lasted for 72 hours. Thereafter, the coordinated rescue and relief stage started to continue for another two and half a month followed by a rehabilitation phase.

Subba (2015) also observes that one of the important lessons learnt by the Nepal in 2015 earthquake was that the Regional partners would be the first to assist and hence there is need to have a regional disaster response framework where SAARC Disaster Management Centre might be more effective. He also highlights that India, China,

Bangladesh, Sri Lanka and Bhutan were clearly ahead of 34 countries that reported to Multi-National Military Coordination Centre (MNMCC). Nepal Defined National Disaster Response as the "actions taken immediately before, during and after the disasters, or directly to save lives and property; maintain law and order; care for sick, injured and vulnerable people; provide essential services (lifeline utilities, food, shelter, public information and media); and protect public property" (Government of Nepal 2013).

The subsequent paragraphs present the related literatures for better comprehension of the study. Available findings of some previous studies are organized as per the capacity determinants (independent variables) of earthquake response that are conceptualized in Chapter I. Thus a kind of thematic segmentation is adopted in organizing the literatures. At the end, the literatures with regards to community empowerment and community participation are placed since their capacity always bolsters the overall earthquake response capacity.

3.2.1 **Manpower and Earthquake Response**

An earthquake response operation places demand on human resources and it was clearly evident in all recent earthquakes. In case of Pakistan earthquake 2005, Pakistan military was given the responsibility to coordinate the emergency response for the government. Practically; in many cases the Pakistan Army kept waiting for top-down orders that never came. The Pakistan Army relied on survivors, who could come down to its bases and inform them where aid was most needed. The main issue could be that Pakistan military was trained for war but not disaster relief (Phister Jr et al 2009).

Emmens and Houghton (2008) conclude that the type of human resources and the way in which they are deployed is critical for responding to any disaster. They uphold that certain behavioral and attitudinal competencies of human being such as flexibility of systems as well as people are essential when the question is to unfold rapid response in case of any disaster. Many agencies also observed that their best responses emanated when different tools, procedures and practices worked in parallel.

Following Hurricane Katrina, Goodman and Mann (2014) found that many locales along the Mississippi Gulf Coast did not have plans that addressed human resources (HR)

issues in the aftermath of a disaster, and the emergency planning process did not include many vital employees.Historically, it has been observed that despite great general preparedness, many officials find it difficult to cope with the disaster. As such, it is important to place the right manpower for the right tasks to accomplish. Schneider (2011) maintains that in some cases local officials were found unfamiliar with their responsibilities and also did not know what role other government agencies were playing. Some even expected the federal government to do everything. And often, local officials tried to do things that FEMA (or some other federal agency) were supposed to do that simply reflects poor situational awareness of people in action.

BBC (2015) reported from 'Nepal Earthquake 201' that on the 3rd day of earthquake, nine out of 10 Nepalese troops were told to be involved in search and rescue operations while the country was battling with a massive earthquake. Meanwhile, an army spokesman told the Associated Press news agency that 90% of the country's 100,000 troops were taking part in the quake effort. This finding amply highlights the role of militaries in disaster. Similarly, US Assistant Secretary of Defense for Homeland Security, McHale (2006) maintains that over 72,000 Federal military and National Guard personnel were deployed in response to Hurricane Katrina and they were directly employed in saving lives through extensive search and rescue, evacuation, and medical assistance.

Rahman (2003) argues that human resources development is the most important aspect of disaster risk reduction as skilled manpower contribute largely in pre-disaster awareness building; evacuation in the aftermath of disaster and relief operations. They can also reduce the loss of lives and properties by instructing and advising the vulnerable community about their actions during any disaster. Accordingly, local bodies, NGOs, members of the society and international community should have skilled human resource. Importantly, service organization like the Police, Fire Services, and Militaries might have specially trained and technically skilled special groups to combat disasters.

Awan (2006) observes that Sungi, an NGO in Pakistan, conducted community-based emergency response operation in the aftermath of 2004 Earthquake there with the involvement of grassroots people. On the other hand, Goodman and Mann (2008) conclude after studying the Hurricane Katrina that many areas along the Mississippi Gulf

Coast did not have operational plans that took into account human resources (HR) issues in the aftermath of a disaster, and many vital staffs were not made part of the emergency planning process. This finding amply highlights the importance of judicious use of available human resources.

India, on the other hand, has planned to do something commendable in provisioning human resources for disaster management. The Eleventh Finance Commission of India proposed to form a multi-disciplinary group of 200-300 skilled professionals in each State. The group would be prepared to handle disaster situations and trained in diverse fields like communication, medical and public health, sanitation, housing etc. This way the entire country would have 3000-4000 trained personnel – ready to handle calamities – at any point in time and their training would be sponsored by Calamity Relief Fund(Das and Jha, 2004).

3.2.2 **Training and Earthquake Response**

With regards to earthquake preparedness tips, US Embassy in Bangladesh has prescribed among others that one should know how and when to switch off his utilities. One should also store enough emergency food to provide for his family for at least 3 days and keep enough water for everyone in the family to last for at least 3 days**.** A joint research project conducted by the University of Kansas and Dhaka University found that 83% of Dhaka's residents do not consider themselves prepared for an earthquake (Paul and Bhuiyan, 2009).

Need for training made differences in many earthquakes of the past. Following the Loma Prieta earthquake, the U.S. General Accounting Office evaluated the performance of federal government agencies in disaster response and relief activities. Much of the report focuses on federal activities and responsibilities related to recovery, but emergency-response issues are also touched upon. The report assesses the response favorably, noting that "California's level of preparedness contributed to its ability to respond to the earthquake with relatively few problems" and that "A FEMA exercise that tested the catastrophic earthquake plan, two months before the earthquake, contributed greatly to a well-coordinated response" (GAO, 1991).In her book,Shared Risk: Complex Systems in Seismic Response,Comfort (1999) argues that key challenges facing disaster response networks include enhancing the ability to effectively manage information, to

adapt in the face of changing circumstances, and to accommodate emergent organizational processes; which, otherwise, highlights the need for training.

Federal Emergency Management Agency (FEMA) has stressed the need for training for any disaster response, which is equally true for Earthquake Response. FEMA says,disaster planning should provide a training and evaluation component. The first part of the training process involves explaining the provisions of the plan to the administrators and personnel of the departments that will be involved in the emergency response. Second, all those who have emergency response roles must be trained to perform their duties. Of course, this includes fire, police, and emergency medical services personnel, but there also should be training for personnel in hospitals, schools, nursing homes, and other facilities that might need to take protective action. Finally, the population at risk must be involved in the planning process so they can become aware that planning for community threats is underway, as well as what is expected of them under the plans. As noted previously, they need to know what is likely to happen in a disaster and what emergency organizations can and cannot do for them.

The key to efficiency in disaster response will lie in – more than equipment or anything else – the effectiveness of training and constant re-training of NDRF personnel. Also, training in disaster response – as opposed to training in other aspects of disaster management (prevention, mitigation, relief, rehabilitation, etc.) – has to be much more elaborate and multi-faceted. It has to be more skill-intensive and more operations-oriented, with larger proportions of ‘demonstration’ and ‘hands-on’ content than merely conceptual inputs covered through ‘talk and chalk’ method in classrooms. Further, efficient response to disasters will necessitate training of not only NDRF personnel but also several other target groups since notwithstanding the existence of NDRF, the response to any disaster would inevitably involve several other agencies and groups, such as state government personnel, members of civil defence organization as well as civil society volunteers (Singh, 2008).

3.2.3 **SAR Resources and Earthquake Response**

Khan (2017) maintains that there are 40,000 volunteers trained by Bangladesh FSCD. These volunteers would follow a unique operational procedure where 40 volunteers would be led and guided by three firemen of FSCD. One fireman would operate 2 search

teams each comprising of 6 volunteers (Total 12) and another fireman would operate 2 rescue teams each comprising off 11 volunteers (Total 22). On the other hand, the third and last fireman would lead the 'First Aid' team consisting of 6 volunteers.

Research findings (Poteyeva et al., 2006) reveal that Search and Rescue is very crucial in disasters that involve building collapse. In case of earthquakes with building collapse, crush syndrome kills most of the injured people within 24 hours. Accordingly, fast response by neighboring volunteers, either singly or in groups, is more important than the response of well-equipped urban SAR team primarily because the latter generally takes days to arrive even from within the country.

Shodhganga (2001) reports that22 Search and Rescue (SAR) teams comprising of a total of 399 rescuers and 26 rescue dogs, and equipped with technical and rescue equipment assisted the search and rescue operation at Gujarat. Medical and SAR teams from many other countries like Denmark, Hungary, Israel, France, Germany, Italy, Japan, Mexico, Poland, the Russian Federation, South Africa, Switzerland, Turkey, USA, and the United Kingdom have been involved in the Search and Rescue operation.

Dugger (2001)found that the rescue equipment did not arrive even within two days after the earthquake in the city of Bhuj and Anjar, close to the epicenter where damage was more. The army officers said the machines could have been flown more quickly into the air force base here in Bhuj if the government had been better organized. A high-ranking army officer told that they were literally working with their hands and shovels and pickaxes. Another army officer added that they could have saved more lives if equipment had reached them much earlier.

Mishra (2004)concludes that during the first 15 hours of Gujarat Earthquake 2001, in Ahmedabad city alone, the fire brigade attended to 37 emergency calls, rescued 68 people and recovered 67 bodies. A total of 1,221 army personnel were also engaged in the initial rescue operations. Finally, 135 people were rescued in total where 82 were by the fire brigade and 53 by other municipal corporation staff and NGO workers. The army played an important role in many of these rescue operations. Of the persons rescued by the fire brigade, two were rescued after 99 hours and one woman even after 120 hours. On the other hand, BBC (2015) reports that the British SAR organization named Search

and Rescue Assistance in Disasters (SARAID), has sent a team of 14 experts with 1.5 tons of specialist equipment to quake-hit Nepal. This includes an electrical power generator and power tools for cutting through concrete and steel.

Gilmour (2015) discovers that the skill and dedication of International Urban Search and Rescue (USAR) is exceptional but they cost more than ~US $2.5 million annually to maintain. It has also been observed that most USAR teams arrive on the disaster scenes more than 24 hours after the incident when time is too short to make an impact on mortality. Evidences from Japanese tsunami in 2011 and the earthquakes in Gujarat (2001) and Pakistan (2005) shows this response pattern of international SAR teams produces minimal results. In case of Iran earthquake in 2003, 40 international rescue teams participated and only a handful of people were saved. In Indonesian earthquake in 2009, 21 USAR teams consisting of 688 personnel and 67 rescue dogs participated but could not find any survivors. The biggest problem in every case has been response time. After the Haiti earthquake, it was calculated that the costs of international urban search and rescue teams equated to about US$1 million per life saved.

Ferris-Rotman (2015) observes the use of drones has become a feature of the search and rescue in the aftermath of the Nepal Earthquake 2015. Quidich, an Indian aerial visual company, used its drone to aid relief in Nepal and also sent them to remote areas where they can map and assess destruction in order to speed up search-and-rescue operations. Similarly, Reich (2016) highlights the importance of aerial views in large-scale disaster zones and adds that drones, designed to be agile, fast and robust, allow disaster response teams with a big picture of devastation by furnishing aerial views. Drones can access hard-to-reach areas and perform data-gathering tasks that are otherwise unsafe or impossible for humans following difficult surface routes. Drones can also be fitted with various sensors that can be flown to conduct ground surveys. For example, the thermal sensor is one, which is perfectly suited for detecting the heat a human body emits, which helps locate survivors.

Nepal Interior Ministry Spokesman, Dhakal (2015) observed that as on 04 May 2015, a total of 4,050 people from 34 different countries were involved in rescue operations in Nepal while 129 dogs were also being used. He said on the same day that government was using 13 helicopters, including seven private ones, while the Indian Air Force was

helping with 14 helicopters, to cover the country's mountainous terrain. Mr. Dhakal added that these helicopters were not enough to deliver relief materials and conduct rescue operations simultaneously though the U.S. military brought four Osprey aircraft and China brought another three helicopters that morning.

CBS News (2015) reports that a Spanish search and rescue dog led his human counterparts down into the shaky remains of a collapsed building, sniffing for the "live scent" of earthquake survivors among the debris while the Dutch Urban Search and Rescue team also worked in Nepal with their tracker dogs. Besides, Rescue dogs from France, Poland and China also took part in rescue operation.

3.2.4 **Other Material Resources and Earthquake Response**

On many occasions, the assessed needs or the specific requests of the disaster-hit country are overlooked and in-kind donations turns to be inappropriate assistance. For example, Haiti was flooded with a large number of relief items following the Haiti earthquake in 2010. But there had been useless in-kind donations, such as expired medication and other goods that could not be collected because there was no way of transporting them. Similarly, in the Philippines after typhoon Haiyan, containers and aircrafts filled with clothing and medications reached the country and sometimes ended up staying for weeks at the airport. Handling of donations of medicines was very difficult especially those that required the respect of cold chain protocols during their transportation. This was considered to be one of the extremely difficult logistical challenges in the aftermath of the disaster.

FEMA is the provider of mobile homes in situations where there are insufficient houses for displaced disaster victims in the U.S. However even this method of expanding the housing stock takes ample time (Peacock et al., 1997). In case of 1989 Loma Prieta earthquake, most people who evacuated from disaster sites made their own shelters or stayed with friends and family after earthquakes. About using 'official' shelters, Bolin and Stanford (1990) stated that at the peak period, among the displaced people, only 2,500 were provided with shelter at night while 20 % of the estimated 12,000-13,000 were left homeless. From another study, Revkin (2015) concluded that there had been huge gap between the number of tents that were getting to devastated communities in

Nepal and the enormous need estimated by the government. The estimated need was for 500,000 tents by the end of second week after the earthquake while the government thought that with existing flow of supplies they could obtain 300,000 rectangles of canvas, and were uncertain where the rest would come from.

Selection of right relief material is very important in earthquake response. In case of Gujarat (India) earthquake, right materials did not always reach the right people. For example, Savlon, a disinfectant, was distributed for maintaining hygiene. Unfortunately, many earthquake victim women had no idea about it and assumed it was hair oil. On the other hand, block-level hospitals, primary health centers and sub-centers of Rapar, Bachau and Anjar were flooded with medical stores like oral rehydration solution, cotton wool, bandages and antibiotics where the immediate need was for disinfectant ointment and eye drops, which no organization seemed to have (Siddiqui, 2002).

Plan International (2015) concludes that shortage of fuel has badly affected the relief operations in the aftermath of the 2015 earthquake in Nepal. Serious fuel emergency caused long lines of cars and bikes all through Nepal. Relief operations by Plan International were being gravely affected due to this same reason. Mattias Bryneson, Country Director for Plan International in Nepal remarked that they were delivering winter relief kits that include tarpaulins and blankets to families living in high-altitude areas where winter could be the most severe, but they were facing an impossible situation with very little fuel available in the country, and they might not reach many communities before they are cut off for the winter.

Facts and Details (2011) stated that in the aftermath of Kobe Earthquake, food was scarce for the first two days and consequently some Kobe residents had to fight over packets of noodles. One survivor in an emergency shelter told a Japanese television station that they had not eaten anything except one or two slices of bread and a banana on that very day. Survivors even spooned up dirty water from underneath ruptured pipes to meet their thirst. The same source also added that in one area 1,000 refugees were given 1000 rice balls to divide among themselves though nothing was supplied to drink.

Sharma (2015) reported that In Nepal Earthquake 2015, the treatment of patients was difficult due to shortage of hospital beds and medicines. He quoted Shanta Bahadur Shrestha, Ministry of Health secretary saying on 15 May 2015 that their capabilities of

giving assistance have significantly decreased because many doctors have died, many hospitals have collapsed and scores of equipment and medical supplies were damaged in the earthquake. He also quoted Anil Kumar Mishra, professor and head of the Bir Hospital Liver Unit who said the disaster had exceeded their estimate. At least 450 beds, medicines and tools were damaged/destroyed in their hospital. Thousands of people go there to get treatment, but their means to treatment were really limited. So, they were treating people at the tents. The Asia Development Bank (2015) reports that hospitals operated beyond capacity with many wounded left waiting, while many patients were treated in the open due to unstable hospital structures.

In case of Bhuj earthquake, organizations face limitations in the procurement and dispatch of material. It appeared to be very difficult to procure the required material at short notice, because relief items were limited against huge demand. They failed to ensure that procurement was done giving due priority to local sources. For example, bamboo poles required for the erection of tents could have easily been obtained in Gujarat or neighbouring states, but instead organizations chose to fly materials in from New Delhi, or even from abroad (Siddiqui, 2003).

3.2.5 **Financial Resources and Earthquake Response**

Immediately after the Bhuj Earthquake, the then Indian Prime Minister, Vajpayee (2001) made an appeal to International community by saying that they could help to meet the shortage of fund to address the crisis by contributing money to the Prime Minister's National Relief Fund, no matter how small the amount. He also added that the Union Government would be releasing funds from the existing schemes but this would be inadequate given the magnitude of the calamity and the large number of people affected.

As per the Disaster Rescue and Relief Standard 2064, the Natural Disaster Relief Fund shall remain active at the central, regional, district and local level. The Prime Minister Natural Disaster Relief Fund will be mobilized for disaster response as per the Prime Minister Natural Disaster Relief Fund Regulation 2064. In addition, there are several funds available at international and national humanitarian communities for disaster response. These funds are being used as per the response needs; therefore, it has been realized to establish a dedicated disaster response fund at the central, regional and district levels (Government of Nepal 2013).

In earthquake response there emerges huge requirement of emergency finance. Literature suggests that pre-hand provisioning of money would facilitate response activities. In case Pakistan earthquake of 2005, one issue that came up that was unforeseen was that the local people were reluctant to move from their village to a relocation center. The reasons being: (a) awaiting compensation payments; (b) uncertainty regarding available services / assistance at new locations; (c) majority were poor and feared that they would lose their land if they left; and (d) reluctance to leave their main source of income of livestock rearing. Adequate funding from the UN is necessary to enable a swift international response (Khan, 2006).

The 'Finance Commission in India' decides the sharing of revenues between the Union Government and the State Governments including the mode of financing for major disaster activities. Earlier, with regards to disaster, it was concerned for the financing of response, relief and rehabilitation but now mitigation, prevention and preparedness are also included. Presently, it set up two funds – Calamity Relief Fund (CRF) at the state level where Central Government's share is 75% and rest is shared by the state concerned. The second one is the National Calamity Contingency Fund (NCCF) at the central level, which is fully contributed by the Government of India (2005).

FEMA Training Manual states that in the event of an international disaster in a member country, the International Monetary Fund (IMF) has the provision to utilize its 'Emergency Assistance Specific Facility' to provide rapid financial assistance to the country in distress. The IMF goal through such provisioning is to rebuild government capacity and to return stability to the local economy. In the event of a natural disaster, funding is directed towards local recovery efforts and for any economic adjustment that may be needed.

In India, financing for disaster management is primarily done through Calamity Relief Fund (CRF), which has a unique feature. Das and Jha (2004) observe that a CRF is constituted for each State India that receives contributions from the Central Government and the respective State Government in the ratio of 75:25 respectively. The former releases its share in two installments (May and November) in each financial year.

Similarly, the State Governments also transfer their respective shares in two installments to concerned CRF.

Researchers such as Clarke, Mahul, Poulter, and Teh (2016) have found through observation that disaster risk finance ultimately save money. According to them, without disaster risk finance, disaster responses ultimately become too expensive. These findings tell the governments to place emergency funds at different levels, including the community level with the aim to unfold the response operation effectively.

During and immediately after an event, the government of any country is required to provide emergency relief to the affected population. These costs are usually small in terms of the overall costs of the event, but these funds are required to be immediately mobilized. Emergency relief expenditure for the 2011 Great East Japan Earthquake was less than 1 percent of the government's total expenditures related to the event, but was firstly mobilized within just three days (Sato and Boudreau, 2012). This kind of speed is necessary for a successful government response.

UNDP (2009) has concluded from a study in Liberia that in order to enable effective and timely response to disasters every county should have an Emergency Fund. As an initial process, counties would be permitted to allocate a certain percentage (2-5%) of their development budget of US $200,000. Any additional resources required to support the Emergency Fund should be mobilized by the County Authorities in their respective counties by getting the private sector organizations involved in their DRR activities.
Finance becomes even more critical once there is question of generating surge capacity while responding to disasters. Emmens and Houghton (2008) observes that having the financial means to initiate a response is a critical component of surge capacity, whether that be money in the bank, special relationships with key donors or some other substantial source.

3.2.6 **Legal and Regulatory Framework in Earthquake Response**

In case of international disaster response operations, the regulatory frameworks of the host country can often either boost or limit the humanitarian actors' capability to provide relief timely and effectively. Disaster laws serve a number of critical functions like setting out clear roles and responsibilities of stakeholders involved in emergency

preparations and response at the national and local level, and establish funding and accountability mechanisms. They also help facilitate international cooperation in situations where disasters exceed domestic coping capacities. As such, a lack of legal preparedness can negatively impact the response in many ways like delaying the delivery of needed aid to affected populations, creating confusions and duplications of effort leaving gaps in the response and resulting in inappropriate assistance and a general lack of accountability.

It was revealed from the Pakistan Earthquake Case Study that there was no truly functioning civil administration in the region; and, the Army generals were placed in charge of the operation. It's interesting to note that the Pakistan government stated that one of the reasons for lack of an "initial response" was that they had no detailed plan for a disaster response. Kees Boersma et al. (2016) indicate that humanitarian actors faced challenges in coordination and cooperation between the various responding organizations and governmental bodies in the aftermath of the Nepal earthquake.

Singh (2003) describes that the legal framework does not mean the formal law alone rather it also includes the set of codes, manuals, regulations and policies. Clearly enunciated policies guide the functionaries of all government stakeholders in unfolding their actions. Legal framework should also include the mechanism for financing disaster management including mitigation of disasters to ensure a holistic approach to disaster management as a whole. There is need for some regulatory arrangement in regards to medical services too. Merin et al. (2015) highlight the importance of coordination in facilitating the much-needed medical services by the medical teams coming from outside and conclude that such teams should be competent in delivering effective services to diverse patient groups of the country in distress. The researchers also recommend that the supporting countries' embassies (if present) in the affected country can provide information about the medical teams by using translators/interpreters, such as medical students, who understand pertinent medical terminologies.

Sharon Wiharta et al., (2008) observe that the success or failure of disaster relief operation is determined by the critical factor of coordination. Thus the degree of coordination between the actors of different levels not only affects the efficient running of the operation but also determines the operation's overall effectiveness.

Customs policy at times largely delays the process of relief material reaching to the disaster victims. Bannon & Fisher (2006) conclude that in Indonesia, even after one year of the tsunami hit, approximately 217 containers of relief aid were reportedly lying with customs authorities in Tanjung Priok Port and another 232 containers were in a similar dilemma in Belawan Port, Medan. Similarly, during the relief operations in Sri Lanka, over 100 relief containers were stranded at the port in Colombo awaiting inspection and approval from different government ministries. Many food items therefore perished before they could be distributed and other items, such as tents and body bags, were no longer needed.

A post-earthquake study by CARE and Save the Children observe that in the 2010 Haitian Earthquake, a large number of international civil society organizations that were operating immediately after the disaster, placed huge pressure not only on the coordination mechanisms, but on the coherence of the overall aid effort with many NGOs pulling in different directions, unaware of the efforts of others as well. Various aid packages had been provided and there were reportedly overlaps and gaps in the delivery of assistance (CARE & Save the Children, 2010).

Bourque et al., (1993b) advocates that there is need for development of procedures that allow people to perceive and act on "generic" information about safe places. Particularly, people need to realize the way to scan and quickly assess a location for safety, and a way to behave in presence of massive numbers of other people so that they do not endanger themselves and other disaster victims. Sanderson and Ramalingam (2015) highlighted that many international responders did not engage and collaborate with national and local actors in the aftermath of the Nepal Earthquake.

Response to disasters by the international community is delayed due to mobilization time, long flights and visa problems (Prater and Wu, 2002). In such cases extensive coordination is required among a number of different organizations that do not normally work together. Procedures need to be developed that allow people to identify and act on "generic" information about locations which can then be generalized from one location to another. In particular, people need to know how to scan and quickly assess a location for safety, and how to behave in the presence of large numbers of other people so that they do not endanger themselves and others (Bourque et al., 1993b). In July 2005,

ASEAN adopted the Agreement on Disaster Management and Emergency Response, a treaty addressing cooperation between states and with other disaster-relief actors. (Victoria Bannon & David Fisher, 2006)

Government of Nepal shall establish provisions for granting immediate visa, visa fees and custom duty exemptions at entry points (land or air) to International Humanitarian Communities (IHC) along with relief goods, search and rescue equipment, including medical equipment and accessories as per the Model Agreement for Emergency Customs Procedure 2007(Government of Nepal 2013). Government of Nepal shall do a bilateral and multilateral agreement with friendly and neighboring countries as necessary based on agreed procedures to support disaster response including entry process of the Search and Rescue Team (Government of Nepal 2013).

Sri Lanka is a signatory to the Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations of 1998, which entered into force in January 2005, in the thick of the tsunami response operation (Victoria Bannon & David Fisher, 2006). At one point during the Tsunami relief operations in Sri Lanka, over 100 relief containers were stranded at the port in Colombo awaiting inspection and approval from different government ministries. Many food items therefore perished before they could be distributed and other items, such as tents and body bags, were no longer needed.

Castro (2011) describes how particular actions can be taken from a preventative standpoint. She stated that it is important to train employees on how to act and how to create crisis procedures. Employees need to be prepared regarding how to act both in the workplace and at home. Asking employees for feedback on performance before and after emergencies can help enhance disaster planning efficiency in the future.

According to David Sanderson and Ben Ramalingam (2015), in the aftermath of the Nepal earthquake, many international responders did not engage and collaborate with national and local actors. On the other hand, Kees Boersma et al. (2016) pointed out that there had been challenges faced by humanitarian actors in responding to the Nepal earthquake in coordination and cooperation between the various responding organizations and governmental bodies.

The Asia Foundation (2015) observes that confusion and tensions over aid distribution was increased during the early relief phase in Nepal Earthquake 2015 as the multiple aid agencies initially acted without required coordination. For example, many aid providers bypassed government channels for relief coordination and distributed relief materials directly to the earthquake victims along the highways and accessible roads. Such lack in coordination only spoils the much-required economy of effort.

3.2.7 **Community People and Earthquake Response**

In case of disaster management, the need for community empowerment has been appreciated by many disaster-prone countries and accordingly, they have taken various policy steps to empower their community people especially the local volunteers, as the community people including the local volunteers have thorough knowledge of the context and are familiar with those residents who may need special assistance to evacuate, such as the elderly people, disabled or bedridden. Community involvement is essential in the development process because none can understand local opportunities and constraints better than the local communities themselves who therefore need to be involved in the identification and resolution of disaster vulnerability issues. Besides, none is also more interested in understanding local affairs than the community whose survival and well-being is at stake. Fritz and Mathewson (1957) observed that survivors of any disaster tend to be more cooperative, passive, and 'subject to social control' by emergency services than those who converge on the scene from the outside.The Deputy Branch Chief of US Homeland Security, Stover (2012) maintains that all disasters are local because from the moment an event or disaster happens, citizens are the first, most directly affected. For this reason, Stover adds, programs like the Arkansas Citizen Corps (USA) and many others like it, around the country, spend countless hours and dollars ensuring that members of the community are prepared to respond to these catastrophic events.

Lindell & Perry (2000) put forward that in addition to administrative bodies, community people are also expected to come forward with community-based disaster-preparedness measures, which should then be reflected in administrative plans. Highlighting the need for community preparedness for disaster they add that it is necessary for wide-scale participation of residents in community-based disaster preparedness activities. However,

drills and exercises are long-accepted practices to test the abilities and response capabilities of emergency service personnel and in turn paint a picture of organizational readiness. One problem associated with such drills is that community people rarely participate in such process (Simpson, 2002).

There are three dimensions of community empowerment namely, structural empowerment, psychological empowerment and resource empowerment. The fundamental principle of structural empowerment is that power can be delegated to the powerless (Kreisburg, 1992; Lincoln, Travers, Ackers, & Wilkinson, 2002). The removal of structural barriers that impede community access (Friedmann, 1992) to information, opportunities, resources, and so on is a direct mechanism is. The restriction of Structural empowerment is only to the "behavior" aspect of superiors, it overlooks the "perceptual" aspect of powerlessness (Conger & Kanungo, 1988); it doesn't necessarily lead to the feeling of being empowered (Spreitzer & Doneson, 2005).Psychological empowerment on the other hand emphasizes the feeling of empowerment that a community experiences. Some examples of psychological empowerment include providing emotional support (Kieffer, 1984), cultivation of a supportive climate (Spreitzer, 1996), bridging of social divisions, and facilitate others' empowerment (Christens, 2012). Resource empowerment assumes that possessing or controlling resources is different from access to resources, in the sense that possessing or controlling gives true power to the owner. When there is increase in power over resources or ability to control resources, more innovative resources and capabilities may be developed, which in turn will expand the community's social capital (Ersing, 2003).

BU KRDAE (2006) concludes that the lessons learnt from response operations to disasters amply suggest the need for the communities to remain prepared because during the initial 72 hours after any disaster, it is the neighbouring people who extend majority of the assistance (Sungay, Cakti and Erdik – 2010). Accordingly, he stressed the need for empowerment of community people through local authorities and community leaders so that their own capabilities can effectively be unleashed during initial hours of disaster. On the other hand, Scolobig et al. (2015) argue that there had been a paradigm shift in the approach of DM where the top-down, command and control style of management was re-focused to a people-centered approach with local participation in the center.

A somewhat promising way of engaging community people in responding to disasters is said to be growing around residential areas in United States. A programme named the 'Community Emergency-Response Team (CERT)' has been launched to impart training for empowering community people to display their responsibilities as the first responders in case of emergencies. A CERT provides the required manpower, initiative, and also a platform regarding accumulation and dissemination of information that are crucial to decision-making with regards to environmental issues. Community people hardly sit idle after any disaster. O'Brien and Mileti (1993) from their study with dwellers in Santa Cruz and San Francisco counties conclude that 70% inhabitants of Santa Cruz and 60% of San Francisco County were involved in some kind of emergency response activity after the earthquake.

Banerjee and Gillespie (1994) observe that getting well prepared for any disaster has proved to be the effective way to reduce damage caused to the affected population. It is also well-recognized by the officials of emergency management and disaster planners that for initial 72 hours after the strike by an earthquake, supplies can be disrupted and the most expected emergency support may not be right away accessible to the earthquake victims. As such, individuals and families must be well equipped for self-sufficiency during that period (Russell et al. 1995, Basolo et al. 2009).In case of Cypress structure collapse due to earthquake at Oakland, California Garcia et al. (1993) note that community people were extremely involved from the very beginning after the impact. They rescued trapped motorists, helped victims to safety, and gave them the first aid. However, as the response from the volunteers was huge, coordination of volunteers emerged as one of the major challenges.

Twigg and Mosel (2017) observes that spontaneous responses by self-organizing, 'emergent' voluntary groups and individuals are a common feature of urban disasters and they are primarily engaged in SAR, transporting and distributing relief supplies, and providing food and drink to victims and emergency workers. Importantly the unofficial helping attitude of community people also takes an organized structure.

Thapa (2016) while speaking on the catastrophic Earthquake of Nepal on 25 April 2015 highlighted the communities as main actors for disaster reduction and basic units for improving the comprehensive capacity of disaster prevention and reduction. He hoped

that during the workshop, the exchange of views and experiences will support the participants to explore new ideas in our field with new modalities which will enable for better Community Disaster Reduction and Relief actions.

The communities, because of their close proximity to the disaster areas, possess vital and decisive situational information (Liu, Palen, Sutton, Hughes, & Vieweg, 2008). Thus community people need to be engaged in disaster response operations. Community people are generally the "real first responders" (Palen, Vieweg, Sutton, Liu, & Hughes, 2007) to reach out to help disaster victims (Turoff et al., 2010). The community people are also the best assessors of their own vulnerability and essential requirement (Yodmani, 2001). According to Fiseket al (2003) on the other hand, informed ownership of responsibility by the public, training in risk mitigation and local organization for community preparedness are the main ingredients of an effective public contribution to disaster management.Aid workers (both local and international) may overlook local capacity and neglect community participation in the emergency response due to the urgency associated with responding to disasters. Responses to past disasters demonstrate that community participation in decision-making, implementation and evaluation of humanitarian efforts generates positive results, particularly in strengthening local capacities (Cosgrave 2008). Needless to say that only when the community is empowered well before the disaster occurs will community participation be effective.

Keeping the community aware of the disaster situation and community empowerment is said to be a determinant of capacity because it makes the response faster and effective. Lessons from previous responses to disasters emphasize the importance of engaging with national and local authorities as well as civil society groups. O'Donnell, Smart and Ramalingam (2009) observed that before, during and following a disaster, such partnerships are essential for promoting national ownership and coordination, which paves the way for a sustainable recovery from disasters.The World Disaster Report (2015) concludes that local actors are the key to effectiveness of humanitarian operations. Their effectiveness goes beyond their proximities because of their understanding of local contexts more than anyone else. On the other hand, the ACAPS (2015) study underlines the importance of engaging with the local community and harnessing their capacity in response and needs assessment. It also adds that they are able to establish the best channels and methods.

In any social work with no exception to disaster management, local volunteers always played the pivotal role. Cosgrove (2000) observes that social workers are making up a large percentage of disaster volunteers. Harrell and Zakour (2000) found in another study that the smaller and less formal organizations could be important sources of volunteers in a disaster. Kamal (2019) maintains that about 40% of people in collapsed structures experience self-evacuation while rest 60% of them generally need search and rescue assistance and importantly 50% SAR is done by community people leaving only 10% for outsiders' assistance. This observation amply highlights the importance of facilitating community people to work in SAR operation.

Shaw and Goda (2004) maintain that immediately after the earthquake, most affected people were helped or rescued by friends, families and neighbours. A case study in the Nishi Suma area by the authors pointed out that 60 per cent of residents were evacuated by their own efforts, and approximately 20 per cent were rescued by neighbours. These data indicate the importance of communities and neighbours in the immediate rescue operation. The main reasons local people are so effective in rescue activities, as reported from the interviews are: information and knowledge of the community; leadership within informal and formal community-based organizations; availability of small tools for rescue operation such as saws and crowbars. Wegner (1978) discussed the importance of the community response to disaster. Similar observations were also made after the Marmara earthquake of 1999 in Turkey and the Gujarat earthquake of 2001 in India (Jalali, 2002; Shaw, 2003).

Periyanayagam (2015) concludes from her observation of Nepal Earthquake Response that in the first 72 hours after a disaster, the response is always local. The neighbours provide housing to others in temporary shelters and share their scanty resources with them. Search and Rescue teams are also formed from untrained local people much before the outside aid agencies enter to save people in demolished buildings.Increasing the coping capacity of the community would play an important role in securing an effective disaster management. The United Nations Centre for Regional Development (2004) states that Community Based Disaster Management (CBDM) approach received attention in mid-1990s predominantly from NGOs involved in humanitarian assistance activities. In the final report titled "The Future of CBDM",

Davis (UNCRD, 2004) discusses the key issues in CBDM as partnership, governance, community, private sector, education and risk reduction measures. The aftermath of Loma Prieta earthquake (magnitude 6.9) in 1989 led directly to the creation of an umbrella group called SF CARD (San Francisco Community Agencies Responding to Disaster), which connects nonprofit, faith-based and private organizations with the network and knowledge they need to continue providing critical services after a disaster. Vulnerable populations naturally turn to these organizations immediately following a disaster for housing, food and essential services. During Loma Prieta, there were people volunteering to help the Fire Department fight fires. Nonprofit organizations are working on ways to give those people tools to help.

NDRF of Nepal recommended in 2013 that the CAAN should develop TIA disaster response plan and upgrade regional airports as alternative response hubs as well as preposition adequate ground handling and other equipment at airports within one year (by 2014). The earthquake occurred in 2015 but airports were not ready to receive international flights with reliefs. NDRF of Nepal recommended in 2013 that the MoHA to make Provision of Visa fees and custom duty exemptions at entry points to IHC, relief goods, SAR equipment by 2014. But it was revealed that slow custom procedure delayed the reaching rescue teams to the disaster sites (Government of Nepal 2013).

The term community is used to describe overlapping social units that act as a focus of social activity (Dynes, 1998). As such, a social drive like earthquake response operation would be better accomplished through community participation. On the other hand, Cavaye (2000) observes that capacity of community consists of networks, organizations, attitudes, leadership and skill that allow community to manage change and sustain community-led development.

CHAPTER IV: CAPACITY AND CAPACITY ASSESSMENT

4.1 Capacity and Capacity Development

Simply saying, the term capacity may be defined as the ability to perform appropriate tasks effectively, efficiently and sustainably (Hilderbrand and Grindle, 1996). The way it is true for an individual, it is applicable for an organization too. More briefly, it is the capability to handle an issue effectively. On the other hand, JICA (2008), putting emphasis on developing countries, defines capacity development (CD) as the "process of improving the developing countries' capabilities for handling issues as an integrated whole at multiple levels including the individual, organizational, and societal level. UNDP has published extensively on capacity development and, in particular, on assessing capacity needs (UNDP 1997 and 1998b). Their approach is simple in concept where the first step is to assess the existing capacity, then assessing the future capacity envisaged by answering the question where do we want to go? Finally, from these two, identifying the capacity gaps, which can also be termed as capacity need. Once the capacity need is ascertained, the strategies can then be developed to fill the gaps over a particular time span. Capacity is never said to be a static state rather, it is continually developing and changing dynamic process. It is a lengthy process requiring continuous attention and investment and the recognition that the capacity of an individual or organization is never complete or in a steady state. As strategies need to be flexible, the same is true for capacity assessment so that it supports continuous decision-making and becomes an internal cycle of review and updating, rather than being a one-off, externally driven event.

UNDG (2008) concludes that in recent times, the notion of capacity development has undergone significant changes not only from the conceptual point of view but also operationally and institutionally. Conceptually, the notion of capacity development is no longer limited to human resource development only, but rather it now covers a wider scope that includes among others organizational and societal changes, policy-level impacts, creation of space for and management of dialogues, relationships, and partnership; knowledge networks and accountability. Operationally, it no longer emphasizes outputs alone, but also processes and mechanisms that lead to outputs. On the other hand, institutionally, it is at the core of the work of countries and national governments as it is embedded in national development strategies as well as sub-national development plans. EuropeAid (2005) observes that Capacity development (CD) is the

process by which people and organizations create and strengthen their capacity over time. As such, a time dimension is always attached herewith. According to JICA (2008), three elements namely Core Capacity; Technical Capacity and Enabling Environment constitute capacity:

a. Core Capacity. As per JICA, the core capacity is one, which is needed for producing results through the use of technical capacity, regardless of whether it is in a technical field or not. These are underlying capabilities which shape all behavior in individuals and organizations, and the central force in capabilities for handling issues under consideration. Specifically, these are the management capabilities for implementing the projects and running the operations, as well as the will and attitude and leadership that influence the behavior of individuals and organizations to largely determine capacity.

b. Technical Capacity. Technical capacity encompasses that knowledge and skills (techniques), which are required for an individual and organization to elaborate on their assigned tasks. It also refers to the tacit knowledge (knowledge and know-how that are difficult to explicitly express in words) accumulated within the organization and always puts an impetus in achieving the organizational goal.

c. Enabling Environment. Enabling environment specifically includes existing policy frameworks, legal systems, standard operating procedures (SOP), political institutions, and market economy institutions that have direct or indirect bearing with the organizational outcome. Besides, the resources such as physical assets, capital, and social infrastructure are also perceived as the enabling environment for capacity. Furthermore, elements like the unique informal systems within the culture and society of the country and involvements by stakeholders outside the organization also have a significant effect in capacity development.

The ‘Figure 10’ in the next page gives a clear picture of different types of capabilities of a typical organization.

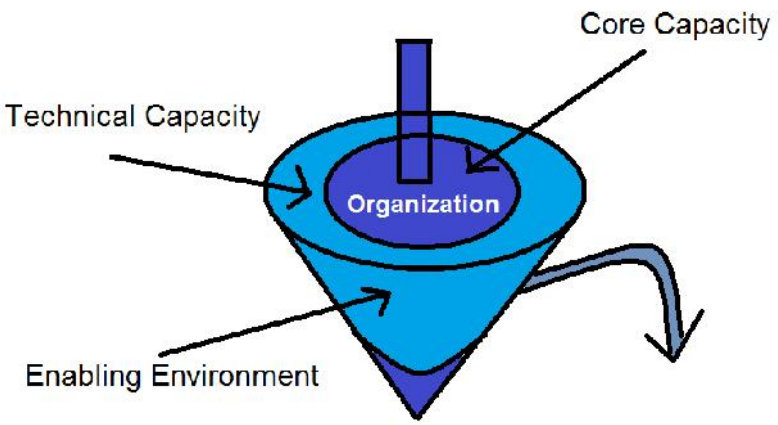
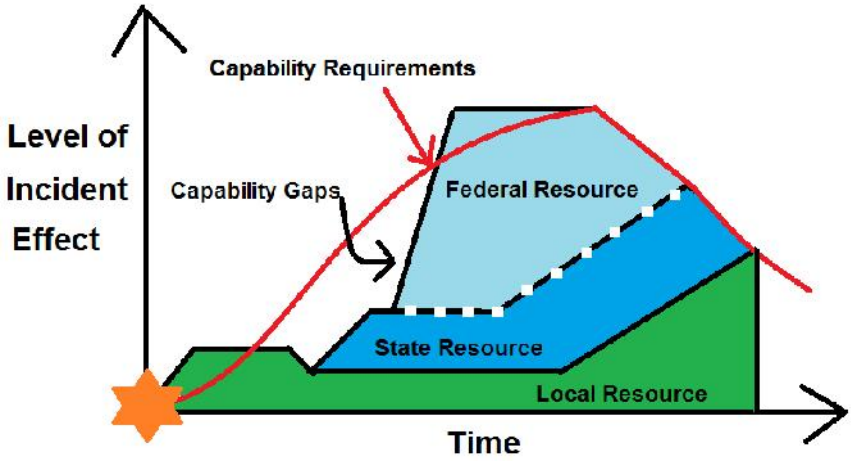


Figure 10: Different types of Capacity of an Organization (after JICA)

The document published by United States Government Accountability Office (GAO, 2011) on "Measuring Disaster Preparedness" gives a conceptual illustration for assessing capability requirements and identifying capability gap -for national preparedness. The 'Figure 11' below shows how the resources at different level enhance her capability over time.



Source: GAO, "Measuring Disaster Preparedness" (2011)

Figure 11: Conceptual Illustration for Assessing Capability Requirements and Identifying Capability Gaps for National Preparedness

Kay, Franks and Tato (2003) identified five strategic phases in respect of capacity development where the first phase is an assessment to define present capacity within the system. It establishes the baseline and addresses the basic question regarding our present

position in respect of particular capacity. The second phase enquires about the future desired state, which entails the vision of what capacity is required in the future and asks the second important question - where do we want to go in terms of capacity under question? The third phase weighs out the present situation and future desired state to identify the capacity gaps and plans strategies and actions designed to fill these gaps and achieve the desired goals. This step raises the question - how do we get there? The fourth phase revolves around undertaking the planned capacity development activities in order to meet the defined objectives. The final or fifth phase is monitoring and evaluation to furnish feedback experiences into the planning phase. However, to them, this is not a linear process, the phases are interlinked and overlapping, and they form a continuing cycle of development and change according to the prevailing circumstances. Of the five phases, assessment of capacity needs, that is, establishing the existing and required capacities as well as identifying the gaps between both, is perhaps the least well developed, at the same time it is the most vital. In simple words, their postulation says that capacity assessment is measuring the capacity. Capacity development may appear to be synonymous with workshops and training to some people, to senior managers it can mean organizational development, to non-governmental organizations (NGOs) it is associated with empowering individuals and grassroots organizations and on the other hand, to international agencies and donors it is about national institutions, governance and economic management (Horton 2002).

Different agencies have their own definition of capacity development. The definitions reflect, in some cases quite strongly, the specific business processes and logics of the agencies that define them, and that is entirely appropriate because a definition should always be context-specific. WBI (2009) observes that capacity development is a locally driven process of learning by leaders, coalitions and other agents of change that brings about changes in sociopolitical, policy-related, and organizational factors to enhance local ownership for and the effectiveness and efficiency of efforts to achieve a development goal. Again, Sandstrom (2014) quotes President Paul Kagame of Rwanda saying that capacity or “the ability to get things done” goes beyond formal qualifications and technical skills development to include the cultivation of intangible or “soft” attributes such as the ability to drive change and to build processes, organizations, and institutions which can deliver public services over the long term.

Capacities in the world exist in different forms such as knowledge, skills, technology and resources. However, the capacities necessary for effective disaster risk reduction mitigation in general could be represented through comprising a society with organizations particularly deal with disaster issues, well-developed disaster plans and preparedness, coping mechanisms, adaptive strategies, memory of past disasters, good governance, ethical standards, local leadership, physical capital, resilient buildings and infrastructure that cope with and resist extreme hazard forces, etc. (Benson et al., 2007). Accordingly, the institutions, strategies, frameworks, policies, laws & regulations, projects and programmes etc. can be considered as the relevant capacities.

4.1.1 **Approaches for Capacity Development**

While undertaking capacity development programme, two popular approaches used by the stakeholders are the 'Incremental Approach' and the 'Gap Analysis'. However, the approach to be adopted should be chosen considering the ground reality. A capacity development programme with regards to earthquake response to meet national requirement would involve huge investment of financial resources, efforts, time and many other resources. As such, a country like Bangladesh should judiciously adopt an approach that is manageable for her part. A brief description of two approaches,as advocated by Learning Network on Capacity Development (LenCD), is appended below:

a. The incrementalapproach, as the name says,is a method of capacity development where the development (growth) model is designed and implemented incrementally (a little more is added each time/period) until the desired development is completed. This approach is said to have a much more positive feel to it and, because of its simple and affirmative starting point; it better involvesa targeted stakeholder organization in participatory self-assessment. Besides, instead ofaiming for ambitious high-level capacity targets, this approach defines needs as realistic steps that will move the organization forward in the right direction. The flexibility component of this approach allows stakeholders to define what they consider to be important from their own context. However, the main weakness of this approach is that the stakeholders may not necessarily have the appropriate technical knowledge and understanding of other ground realities required to frame their next capacity steps in a meaningful way.

b. The gap analysis, on the other hand, tends to be based on externally defined criteria for full and effective functioning of the stakeholder organization to meet the requirement for which the organization is meant for. Thus gap analysis targets the optimum or desired or the ideal situation. LenCD identifies three weaknesses of this approach. Firstly, gap analyses tend not to rightly appreciate the existing capacity to make it the starting point of new initiatives. Secondly, the statement of the ideal situation is often far too ambitious to be helpful in setting realistic goals and objectives for moving forward. Finally, gap analyses tend to focus on hard capacities, without paying due attention to essential soft capacities. Besides, it generally depends on outside experts (assessors) and their assessment process do not pay due importance to the opinion of people (being assessed). Such non-participatory assessment might not appreciate the real problem lying with the organization being assessed. As a result, there might be a strong disagreement between the person assessing and the stakeholder organization, under assessment. This is particularly true when the organizations under assessment are from Armed Forces or the like where required information are classified at times.

4.1.2 **Organizational Capacity**

Combaz (2013) maintains that organizational capacity is about money, people, systems, policies, and technical resources. In case of crisis, an organization needs to unleash its surge capacities though it is for a certain period only. UNICEF (2017) maintains that the surge capacity is not only an organization's ability to mobilize a humanitarian response or rapidly deploy staff rather it is the result of a continual process, encompassing preparedness planning, response and transition/recovery programming. As such establishing surge capacity requires a holistic, organization-wide approach, in which agency mandate, structure, culture and leadership are just as critical as protocols, processes and systems. In the humanitarian context, surge capacity can, therefore, be defined as the "ability of an organization to rapidly and effectively increase its available resources in a specific geographic location" in order to meet increased demand to stabilize or alleviate suffering in any given population.

4.2 **Capacity Assessment (CA)**

For UNDP (2005), a capacity assessment is an analysis of current capacities against desired future capacities, which generates an understanding of capacity assets and needs, which in turn leads to the formulation of capacity development strategies. On the other hand, UNDP (2008) says, Capacity Assessment is an essential basis for the formulation of coherent strategies for capacity development. This is a structured and analytical process whereby various dimensions of capacity are assessed within a broader systems context, also being evaluated for specific entities and individuals within the system.

JICA (2008) defines capacity assessment as "the process of broadly assessing both the current state of the developing countries' capabilities for handling issues (capacity) at multiple levels-including the individual, organizational, and societal level – and the extent to which development process has brought about positive changes (Capacity Development), and then sharing the results from this with concerned parties in order to formulate Capacity Development strategies."

The UNDG (2008) Capacity Assessment Methodology User's Guide provides some useful definitions as follows:

a. Capacity is the ability of people, organizations, and society as a whole to manage their affairs successfully;

b. Capacity development is the process whereby people, organizations and society as a whole unleashes, strengthens, creates and maintains capacity over time;

c. Capacity assessment (CA) is the identification of capacity assets and needs at national and local levels.

From a country's perspective, the existing capacity levels describe a country's baseline capacity. On the other hand, the future capacity is one that a national government desires to reach for each of the respective response capacity areas. From these two, a country gets a picture of capacity gap to decide on her subsequent actions for capacity development.

4.2.1 **Organizational Capacity Assessment**

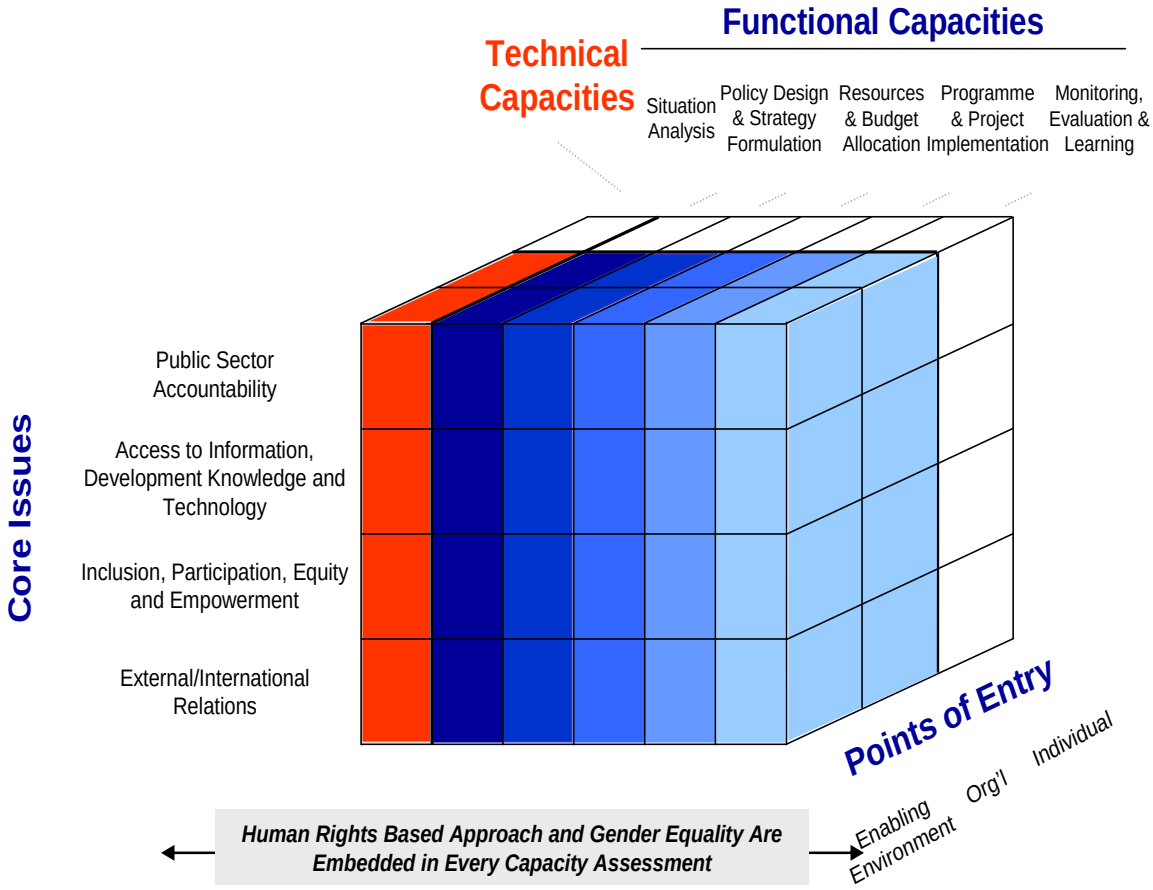
It needs to be appreciated that key stakeholders will only accept the findings of an assessment study if they perceive they have been appropriately involved with the process. The management and staff of an organization might reject a critical report done by an external expert, whereas if they have been asked to assess their own strengths and weaknesses, any negative findings in the analysis will be accepted as true and reasonable. So, the core assessment activities need to directly involve the relevant stakeholders. This means it is important to allow enough time to consult the stakeholders appropriately in the design and implementation of the assessment, including explaining assessment and analysis tools before the process begins. (LenCD)

The methodology of organizational capacity assessment (OCA) for organizations funded by USAID is a guided self-assessment that essentially facilitates active participation of the stakeholder concerned. In this method, the facilitator and participants meet and discuss each area to determine where the organization stands along the continuum of implementation. Importantly, facilitators ask open-ended, probing questions to generate group discussion, and take notes of participant responses. This is how the areas to be addressed are identified (USAID, 2012).

On the other hand, Root Change's organizational capacity assessment (OCA) methodology is a comprehensive and highly participatory approach to achieving organizational change, learning and development. At the core of OCA is a participant-designed assessment tool that is broken into key organizational capacity areas. Root change maintains that the participation is key to the success of all stages of OCA. During OCA tool design, stakeholders themselves determine the core capabilities to be investigated and assessed. During tool administration, a representative team of staff discusses issues related to, and score their performance in, each of the areas of capability identified (Root Change, 2009).Similarly, Catholic Relief Services' (2015) follows a Holistic Organizational Capacity Assessment Instrument (HOCAI), which is also designed to support organizations to carry out a self-analysis of their strengths and challenges, develop an action plan, and improve organizational functions through capacity strengthening. It reiterates that Capacity Assessment of sensitive organizations

better be done through a kind of participatory approach where the opinions or key staffs of the organization being assessed is very important.

EuropeAid (2005) maintains that outsiders often have a limited understanding of and feeling for what is going on inside other organizations. In particular it is much easier to identify poor performance than the causes for this poor performance and the remedies to enhance it. Capacity assessments made by outsiders risk being based on superficial observations of what an organization does not do or does not have e.g. that it does not perform efficiently, that it does not have a proper budget and planning system etc. On the other hand, the UNDG capacity assessment framework is composed of three dimensions as presented in the figure below in terms of a three-dimensional cube.



Source: United Nations Development Group (UNDG, 2008)

Figure 12: UNDG Capacity Assessment Framework - a Three-Dimensional Cube

4.3 The Standing of this Research

The phenomenon of capacity development has so long been somewhat slow in the field of disaster management in Bangladesh. However, the government has given due importance to disaster management and geared up her effort in this connection in the recent past. An FGD involving five retired meteorologists of Bangladesh Air Force and conducted by the author concludes that the capacity development for the stakeholders of earthquake response better follow an incremental approach and the capacity gap has to be filled up gradually for a country like ours. However, this approach might suffer from an undermining of capacity requirement and the process of capacity development might be a reluctant one leading to inadequate attention and commitment. It has also been revealed after the pilot study that the units concerned prefers to follow a gradual capacity building strategy, which is, otherwise, an incremental approach only. Their perceived capacity gap means the difference between what they have now and what ideally they should have. Again, it is also revealed from the above discussion in this chapter that most of the international organization and others suggested for a participatory approach to assess the organizational capacity. Importantly, as all the operational units are from the Bangladesh Armed Forces and Ministry of Home Affairs, such participatory assessment would be the most effective one. Some information is classified one for which active involvement of the units concerned is very much essential. The Capacity need was also taken as what they perceived in respect of various ‘Capacity Determinants’.

CHAPTER V: EARTHQUAKE RESPONSE ARCHITECTURE IN BANGLADESH

5.1 General

Earthquake is considered to be one of the major disasters in Bangladesh after flood and cyclone. Accordingly, due importance has been attached by the Government to earthquake while dealing with disasters in general. The Disaster Management Vision of the Government of Bangladesh is to reduce the risk of people, especially the poor and disadvantaged, from the effects of natural, environmental and human induced hazards, to a manageable and acceptable humanitarian level, and to have in place an efficient emergency response system capable of handling large scale disasters (National Plan for Disaster Management: 2010-2015). The vision of the government encompasses the response to earthquake. For earthquake risk management, like any other disaster, The Ministry of Disaster Management and Relief (MoDMR) functions as the government's focal point.

The government has promulgated various policy documents to outline the response architecture for disasters that also includes earthquake. The formation of the 'Earthquake Preparedness and Awareness Committee (EPAC)' is one of the epoch making steps to mention. This committee was first formed in 2009 following a verdict of the High Court division of Bangladesh Supreme Court with a view to preparing the nation for earthquake risk management. The EPAC is headed by the Minister for Ministry of 'Disaster Management and Relief' (MoDMR) while the Director General, DDM serves as its member secretary. The committee consists of 39 members from various government departments, Armed Forces Division (AFD), Fire Service and Civil Defense, research institutes, academia and NGOs. Representatives from international organizations also participate in the meetings of EPAC on invitation. The committee meets twice a year and is empowered to form various sub-committees to prepare Contingency Plan and to work for other earthquake risk reduction activities. The main responsibilities of EPAC include the following;

a. Review of national earthquake preparedness and awareness program and recommend suggestions for concerned organizations;
b. Review the list of Search and Rescue equipment for earthquakes;

c. Prepare and recommend a list of equipment for earthquake risk reduction and search and rescue programs after an earthquake.

The government has brought out the Standing Orders on Disasters (SODs) in 2010, which was followed by enactment of the Disaster Management Act 2012. Besides, the five year (2010-15) National Plan for Disaster Management (NPDM) provides the new legislative framework and revised institutional arrangements. The next National Plan for Disaster Management Plan (2016-2020) has already been drafted in 2017. The apex National Disaster Management Council (NDMC), led by the Honourable Prime Minister, formulates and reviews disaster management policies. Under this, the Inter-Ministerial Disaster Management Coordination Committee (IMDMCC) implements policies and decisions. The IMDMCC is assisted by the National Disaster Management Advisory Committee (NDMAC), headed by an expert as nominated by the government. A number of other national committees were formed under the NDMC to efficiently deal with disaster management activities. In a nutshell, the DM regulatory framework in Bangladesh is as shown in the Figure below.

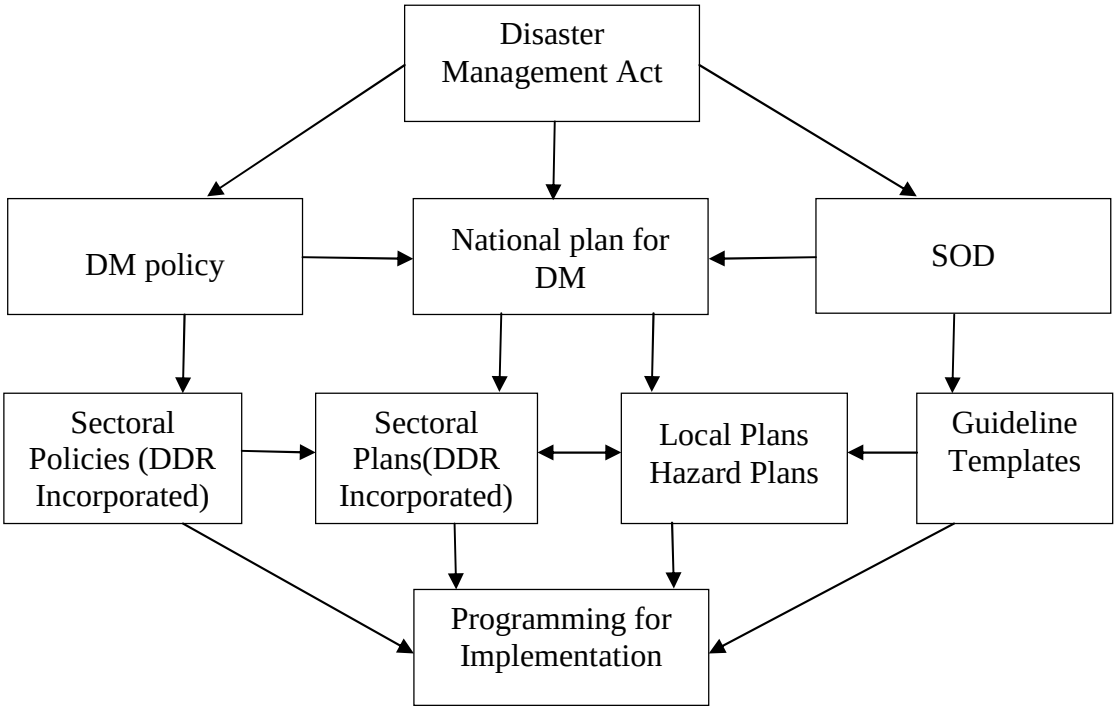


Figure 13: Disaster Management Regulatory Framework

Source: Comprehensive Guideline for Armed Forces in Disaster Management

5.2 Standing Order on Disasters (SOD)

The Standing Orders on Disaster (SOD) - 2010 exhaustively outlined the duties and responsibilities of various concerned agencies and organizations including the Armed Forces to unfold their respective operations at different stages of disaster including the earthquake but in a coordinated fashion. The SOD describes the disaster management roles for a total of 28 agencies/organizations including the three services of the armed forces. It demands that all Ministries, Divisions/ Departments and Agencies/Organizations shall prepare their own SOP (Action Plans) within the purview of SOD for efficient management of any disaster. It is the very essence of the SOD that the National Disaster Management Council (NDMC) and Inter-Ministerial Disaster Management Coordination Committee (IMDMCC) will ensure coordination of disaster related activities by all concerned at the National level. As such, in case of an earthquake at Dhaka, both of these high-powered committees would facilitate actions by all others. However, any coordination at sub-national levels will be done by the respective Disaster Management Committees. The Department of Disaster Management would render necessary assistance to all concerned in facilitating their actions.

5.3 Disaster Management Act 2012

The Disaster Management Act was enacted on 24 September 2012 with a view to creating the legislative tool under which disaster risk and emergency management will be undertaken in Bangladesh. This act also gives a legal basis in which activities and actions will be undertaken and managed for disaster management. Besides, it will also create compulsory obligations and responsibilities on Ministries, committees and other appointments for the same purpose. The justifications of the Act are as follows:

a. To help communities to mitigate the potential adverse effects of hazardous events by undertaking various disaster risk reduction programmes.

b. To efficiently conduct various post-disaster rescue and rehabilitation programmes.

c. To deliver emergency humanitarian assistance to the distressed community.

d. To strengthen and coordinate disaster management activities of concerned governmental and non-governmental agencies.

e. To develop an effective disaster management structure.

This act also paves the way for deployment of members of armed forces once recommended by the National Emergency Response Coordination Group. As per organizational structure, it includes services' Chiefs and PSO, AFD in the NDMC, responsible for providing all strategic directives in any major disaster. Importantly, the inclusion of PSO, AFD in the National Disaster Response Group facilitates participation of the Armed Forces in any disaster.

5.4 **NationalDisaster Management Policy 2015**

The Disaster Management Policy 2015 was formulated in January 2015 under Clause 19 of Disaster Management Act 2012. The main aim of this policy is to reduce risk emanating from natural, environmental and man-made hazards to an acceptable limit for the greater interest of common mass especially for the poor and under-privileged people. It is strategic in nature and is expected to secure good governance in DM, and ensure accountability of all level stakeholders in disaster management. It has also amply covered the aspects of 'Earthquake Risk Management' and 'Emergency Response Management' for earthquake by forming separate disaster management unit comprising all security and law enforcement agencies. Major objectives of this policy are as follows:

a. Establishing a culture of tolerance, risk reduction and disaster preparedness through knowledge, technological innovation and education.

b. Devising strategy for active participation of common mass in disaster risk management.

c. Merging of DRR activities with national development plan.

d. Empowerment and enhancement of response capacity of local government organizations by involving them with DRR activities.

e. Devising efficient and rapid response strategy, and its implementation.

5.5 National Plan for Disaster Management 2010-2015

The Bangladesh National Plan for Disaster Management 2010-2015 is a strategic document, published in April 2010. This umbrella plan provides the overall guideline for disaster management committees at all levels to act in response to any disaster. This plan gives the structure of Disaster Management Institutions in Bangladesh.

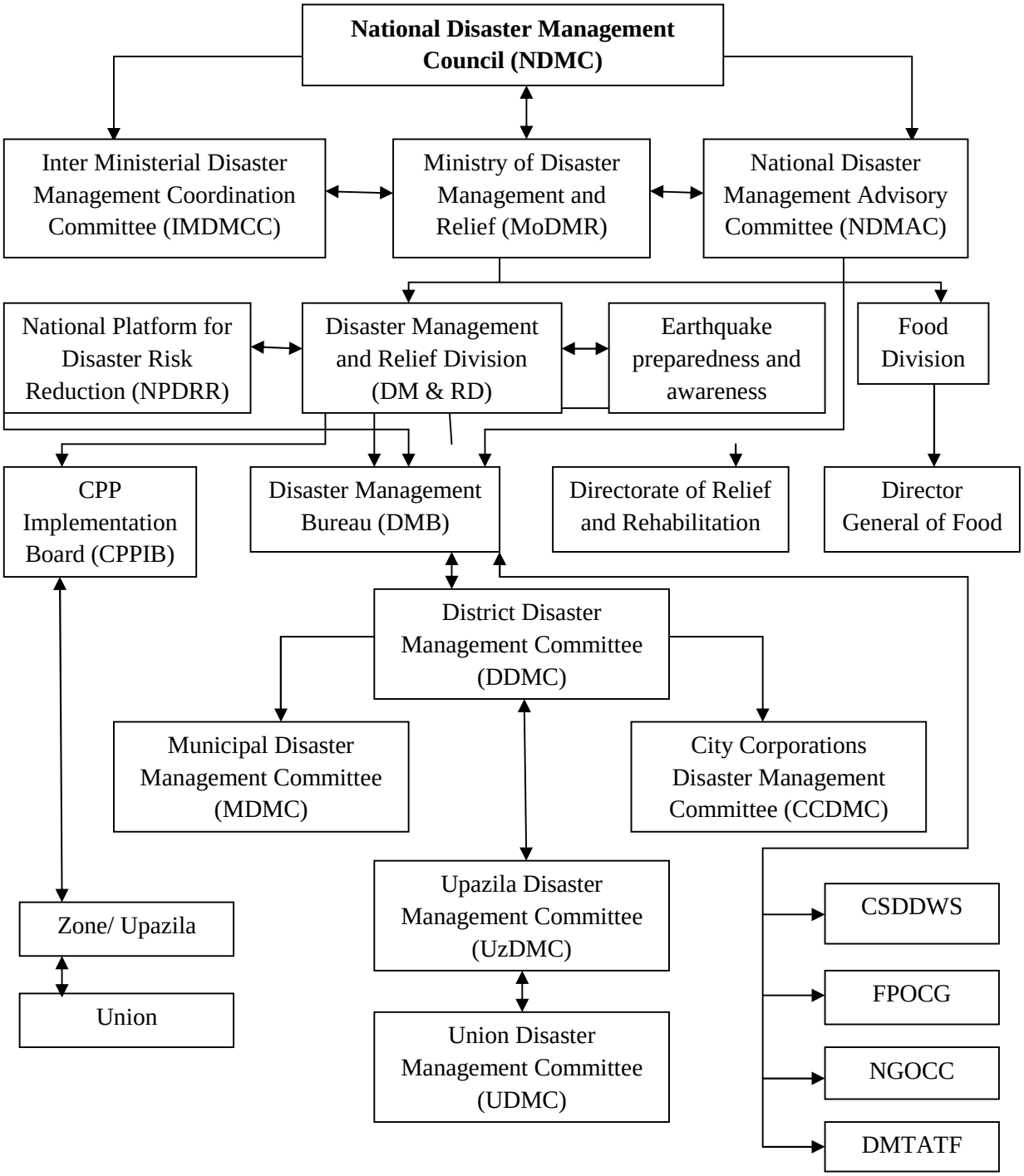


Figure 14: Disaster Management Institutions in Bangladesh

Source: National Plan for Disaster Management 2010-2015

This plan highlights the importance of pre-disaster mitigation and preparedness of the people as against the previous notion of responding after a disaster has taken place. Importantly, this plan goes down to the union level. The main objectives of this plan are as follows:

a. To align the strategic direction of DM programs with national priorities and international commitments.

b. To articulate the vision and goals for DM.

c. To outline the strategic direction and priorities to guide the design and implementation of DM policies and programs.

d. To create a cohesive and well- coordinated programming framework incorporating government, non-government and private sector.

e. To ensure that DM has a comprehensive and all-hazards focus comprising DRR and emergency response.

5.6 Draft National Plan for Disaster Management (NPDM) 2016 – 2020

The Government of Peoples' Republic of Bangladesh has prepared the draft 'National Plan on Disaster Management (NPDM) 2016-2020' on 27 March 2017 with a view to building resilience for sustainable human development. This NPDM 2016-2020 is a follow up of the earlier plan (NPDM 2010-2015). However, this NPDM largely differs from the earlier one because of its alignment with recent global agreements including Sendai Framework for Disaster Risk Reduction(SFDRR), Climate Change Agreement and the Sustainable Development Goals (SDGs). This plan would be periodically reviewed, updated to make it a live and adaptive document. Disaster Management under this plan would support three core goals namely saving lives, protecting investments and effective recovery and rebuilding. However, this plan adopts a phase-wise approach and proposes 34 key targets to be achieved or initiated by 2020 and continued until 2030. As such, this plan would serve as a transformational instrument to build the resilience of the vulnerable group of people by addressing their sufferings. However, successful implementation of this plan would remain as a vital question to be answered by the agencies at different levels.

5.7 **Post Disaster Dead body Management Guideline 2016**

The Government of the People's Republic of Bangladesh has published the first guideline of managing the post disaster dead bodies in June 2016. It is needless to say that the dead bodies, after any disaster, are first recovered by community people and thus such recovery efforts are often haphazard and poorly coordinated. On the other hand, very shortly various other agencies like FSCD, local administration, BDRCS, Scouts and other organizations also join in the rescue effort. If the scale of disaster is very large then members of Armed Forces also step in on national call. This guideline highlights the importance of preserving the dead bodies, how to bury them and other aspects of management of dead bodies in details. The guide book paves the way to conduct following activities:

a. Information management with regards to dead bodies and coordination of further necessary action.

b. Locating the forensic team, morgue and bag to carry the bodies.

a. Disposal of the dead bodies through proper management.

b. Searching for the missing victims and

c. Furnishing the correct information regarding the disposal of dead bodies to the families of the deceased persons and to their communities.

5.8 **Earthquake ResponseOperation in Dhaka City**

In case of any major earthquake in Dhaka City, Bangladesh Armed Forces would be called in to operate in aid to civil power. The Standing Orders on Disaster (SOD) sets forth the major roles and responsibilities for the Armed Forces Division (AFD) and the three services namely Army, Navy, and Air Force in different phases of disaster management. Upon request from the MoDMR and directives from AFD, the personnel of Army, Navy, and Air Force would be deployed with a coordination cell at AFD. Various important committees at the national level have representatives from different ranks of the Armed Forces to help decision making and coordinate disaster management as shown in the table below.

Table 8: Various Committees and Representation from Armed Forces

National Committee	Committee Representative
National Disaster Management Committee	Chief of Staff for Bangladesh Army, Navy, Air Force and PSO, AFD
Inter-Ministerial Disaster Management Coordination Committee	Secretary, Ministry of Defense
National Disaster Management Advisory Committee	Director General, Operations and Plans, Armed Forces Division
Earthquake Preparedness Awareness Committee	Director, Operations and Plans, Armed Forces Division
National Disaster Response Coordination Group	Principal Staff Officer, Armed Forces Division
Committee for Focal Points Operational Coordination Group	Representative, Armed Forces Division

Source: Standing Order on Disaster 2010

5.9 **Military Role in Disaster Relief**

The SOD-2010 sets forth the major roles and responsibilities for the Armed Forces Division (AFD), in conjunction with the Army, Navy, and Air Force in disaster management. Upon directives from the Ministry of Disaster Management and Relief, the AFD aids civil authorities in disaster management and overall relief operations. Army, Navy, and Air Force personnel could be deployed down to the sub-district level to engage in the relief operations. During a disaster, a monitoring cell will be activated to coordinate with the ministries to include the Ministry of Foreign Affairs (MOFA), Ministry of Home Affairs (MoHA), Ministry of Civil Aviation and Tourism (MoCAT), Ministry of Food, Ministry of Health, and the Armed Forces. The military representatives, as detailed by the AFD, support the key national level committees to assist with national level guidance and decision-making.

5.10 **The Armed Forces Division**

The Armed Forces Division (AFD) of Bangladesh is comprised of three uniformed military services namely Bangladesh Army, Bangladesh Navy, and Bangladesh Air Force. The AFD functions as an extension of the Prime Minister’s office and develops policies, issues Government approval for Armed Forces deployment, and coordinates between the three Services Headquarters. AFD laterally coordinates with MoDMR, other ministries, organizations & agencies involved in DM. The organization is the principal

Government structure for coordinating the operational and administrative affairs of the Armed Forces and enjoys the authority to direct and control the three Services as advised by the Honourable Prime Minister. The overall responsibilities of the AFD include providing military support by request/requisition of the MoDMR, aiding civil authorities, developing earthquake contingency plans, conduct of drills, and reporting to the various disaster management agencies. The AFD will assist the affected population with:

a. Transportation of relief goods by Air Force assets from Dhaka;

b. Transportation of relief goods in impacted districts through road and river routes using Army, Navy, and civil resources;

c. Augment civil healthcare services with the Armed Forces Medical Teams;

d. Clear roads and restore road connections; and

e. Assist in telecommunication restoration efforts.

The sector map is shown in the figure below.

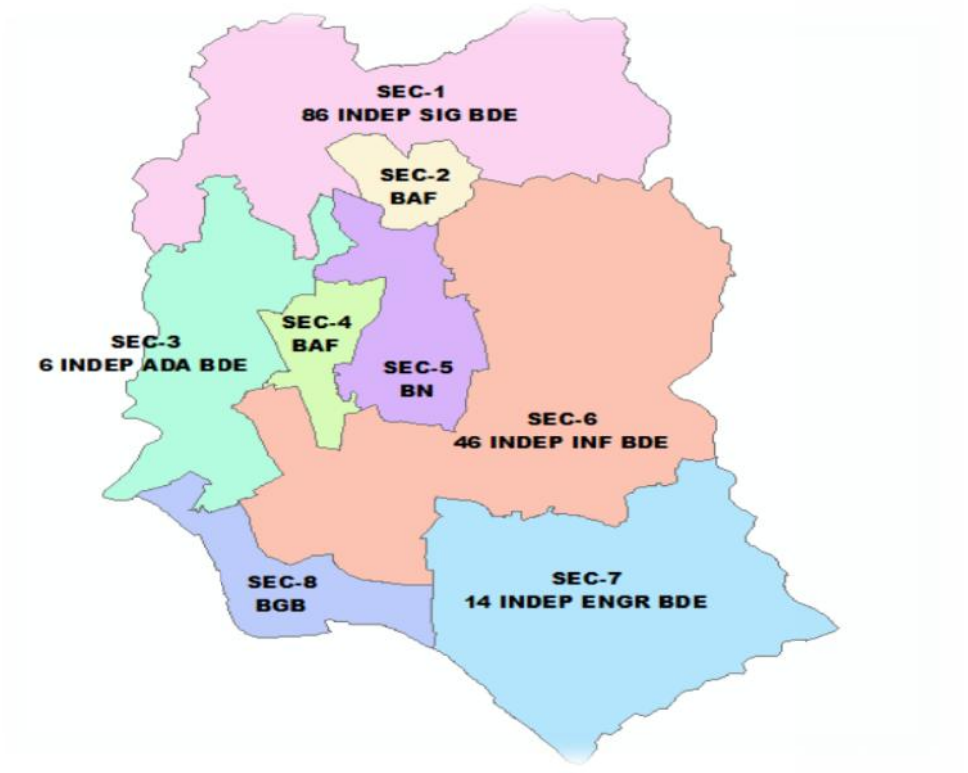


Figure 15: Eight Sectors covering both DSCC and DNCC (without new wards)

Source: DREE 2019

The AFD has delegated the responsibility of earthquake response operation of these eight sectors to eight units of armed forces and BGB as follows:

Table 9: Different Operational Units and their AOR

Sector Number	Name of the Unit Concerned	Thana Involved
01	86 Independent Signal Brigade of Bangladesh Army	Uttarkhan, Uttara & Dhaka Cantonment Khilkhet area of Gulshan Thana.
02	BAF Base Bangabandhu	Airport Thana
03	6 Independent Air Defence Brigade of Bangladesh Army	Pallabi, Mirpurand Mohamadpur
04	BAF Base Bashar	Kafrul Thana
05	Bangladesh Navy Administrative Area Dhaka	Gulshan Thana
06	46 Independent Infantry Brigade of Bangladesh Army	Badda, Khilgaon, Tejgaon, Dhanmondi & Ramna
07	14 Engineers Brigade of Bangladesh Army	Mothijheel, Sutrapur, Sabujbag, Shaympur and Demra
08	Border Guards Bangladesh	Kotwali, Hazaribag, Lalbag& Kamrangirchor Thana

Source: Draft Contingency Plan of AFD

All the units of Armed Forces and BGB have their own contingency plans to operate in the aftermath of a major earthquake. Mentionable that new 'Thanas' (Police Stations) have been created and the AOR of each unit has also changed accordingly.

5.11 **Coordination Mechanisms between Government and Development Partners**

The government of Bangladesh has a 'Draft National Policy on Development Cooperation' (NPDC) in order to provide a consolidated framework for mobilizing and managing development cooperation in the country. The goal of the NPDC is to ensure that foreign assistance follows national development priorities as determined by national development plans and strategies and supports the country's development efforts to bring benefits to the lives of the people. Foreign assistance in NPDC include ODA (grants and concessional loans), vertical funds and funds from international foundations, climate-funds, aid for trade, non-concessional loans, commercial borrowings for public undertakings, and other sources of cooperation such as south-south and triangular cooperation and any form of cooperation that commensurate with qualifications of

foreign assistance. Remittances and FDI though elements of development cooperation in broader sense, shall remain out of the purview of the NPDC.

5.12 **City Corporations Earthquake Response Plan**

The city corporations of Dhaka have an earthquake response plan that would be put into action during any post-earthquake response operation. However, the plan needs major updating as it was prepared about ten years ago. Besides, the plan must include the unions recently put under Dhaka City Corporations (DSCC and DNCC). Importantly, DNCC and DSCC should develop their separate plans that would also address their own peculiarities, limitation and other ground realities.

CHAPTER VI:CAPACITY NEED OF MAIN OPERATIONAL UNITS

6.1 General

In this chapter, an attempt has been made to assess the "Earthquake Response Capacity Need" of eight main operational units of Bangladesh Armed Forces and BGB. The units are the 86 Independent Army Signal Brigade, the 6 Independent Air Defence Artillery Brigade, the 14 Engineers Brigade, the 46 Independent Infantry Brigade, Bangladesh Naval Administrative Authority (Dhaka), BAF Base Bashar, BAF Base Bangabandhu and Border GuardsBangladesh. Mentionable, BGB is also commanded by the officers of Bangladesh Armed Forces. With regards to earthquake response, these units draw their operational guidance from the "Draft Earthquake Contingency Plan" of the Armed Forces Division (AFD). Nonetheless, the units also have their own Standard Operating Procedures (SOP), Pamphlets and other policy guidelines from the Government. The SOPs of the units were composed separately and they largely varied in their contents. As mentioned earlier in methodology, some information provided to the author by different units is classified and some questions to the stakeholders of such units bear a degree of sensitivity. However, all available documents were consulted and the concerned officers (Unit Commanders/Brigade majors/Operations Officers) were interviewed to make out their standing on earthquake response capacity and the perceived need on the same. Some facts and figures, taken from various official documents, are also presented. The subsequent paragraphs would depict the existing arrangement for earthquake response leading to their perceived capacity need.

6.2 86 Independent Army Signal Brigade: Sector-1

6.2.1 Area of Responsibility (AOR)

The '86 Independent Army Signal Brigade' is responsible to carry out earthquake response operation in Sector 1 (Figure 15) in the aftermath of Major earthquake in Dhaka City as per AFD Earthquake Contingency Plan (Draft). This sector, as per its SOP, is comprised of areas under five police stations namely "Cantonment", "Uttara (except Baunia area)", "Turag", "Uttarkhan" and Dakkhinkhan". Of them, only Uttara is well-planned township with good road network. Rest of the area has grown up little unplanned and approach roads are not well developed. The Sector Headquarter is

located within the 86 Independent Signal Brigade positioned at Dhaka Cantonment (Little north of Dhaka CMH).

6.2.2 **Important Features of the AOR**

The AOR has got two contrasting features in terms of road networks, maneuvering space and quality of buildings. In Cantonment and Uttara thana the township is more or less planned while it is haphazard in case of Turag, Uttarkhan and Dakkhinkhan thana. This sector houses the "Ashkona Haji Camp", Airport Railway Station and a large number of busy shopping malls and academic institutions including a couple of universities and hospitals. The Army Signal Brigade carried out reconnaissance of the area in 2011 and made lists of various important establishments and contact personnel though many more need to be included and updated considering the present-day context. As time elapsed, the AOR became more crowded with emergence of new high-rise buildings and other structures. The number of academic institutions and hospitals has also been increased manifold. In general, the vulnerability of the sector has increased. The following table shows the number of various establishments in "Sector 1" as listed by the Brigade in 2011.

Table 10: Major Schools, Colleges, Madrasas and Hospitals-Sector 1

Police Station	School	College	Madrasa	Hospital	Author's Remarks
Uttara	2	2	1	3	The list would be longer since some are missed and some came new
Turag	8	6	18	1	
Uttarkhan	13	2	4	2	
Dakkhinkhan	8	4	8	6	
Cantonment	12	4	5	6	
Total	43	18	36	16	

Source: SOP of the Brigade & Brigade Major on 16 February 2017

To ensure faster response, the Brigade made a list of different service providers (WASA, DESCO and T&T) under different police stations in its AOR (Table 11). However, it is also evident from the table that the list is half done and needs to be updated especially with regards to "Titas Gas", which has not been included. Besides, no information is also available for Turag and Uttarkhan Thana.

Table 11: Thana-wise service providers in Sector 1

Police Station	WASA	DESCO/PDB	T&T	Remarks by the Author
Uttara	43	1	1	The initiative is appreciable but the list is incomplete
Turag	-	-	-	
Uttarkhan	-	-	-	
Dakkhinkhan	5	-	-	
Cantonment	6	-	-	
Total	54	1	1	

Source: SOP of the Brigade & Brigade Major on 16 February 2017

To secure easy communication with local distressed community and ensure best possible discharge of duties, the '86 Independent Signal Brigade' has also prepared a list of local leaders (Table 12) of its AOR. But again, the list is incomplete one and importantly, most of the local leaders are not in the office since new people have been elected in the subsequent elections after the list was prepared. .

Table 12: Number of Local Leaders listed in SOP of Sector 1

Police Station	Ward Commissioner/ Chairman	Member	Others	Remarks by Author
Uttara	1	-	-	The initiative is appreciable but the list is incomplete
Turag	1	12	1	
Uttarkhan	1	12	-	
Dakkhinkhan	-	3	-	
Cantonment	-	1	1	
Total	43	18	36	

Source: SOP of the Brigade & Brigade Major on 16 February 2017

The same database also presents some other important information but for the Cantonment Police Station area only, as depicted below. Open areas would be very vital in sheltering the distressed people in the post earthquake scenario.

Table 13: Open field/playground, Ponds/lakes and Mosques under Cantonment PS

Police Station	Open field/Playground	Ponds/lakes	Mosques
Cantonment	23	35	32

Source: SOP of the Brigade & Brigade Major on 16 February 2017

6.2.3 **Command and Control Arrangement**

As a disciplined independent Brigade of Bangladesh Army, the '86 Independent Signal Brigade' maintains a proven chain of command, which would take charge of the earthquake response operations too. Brigade Commander will retain the overall command while the Brigade Major or any other officer nominated by the Brigade Commander will act as his coordinating staff for any earthquake eventuality.

6.2.4 **Major Responsibilities in the Post Earthquake Scenario**

As per the draft earthquake contingency plan of AFD, the major responsibilities of 86 Independent Signal Brigade' are as follows:

a. Troops' deployment as per directives of the concerned authority.

b. Setting up of 'Earthquake Management Control Cell' at Thana level.

c. Identification of victims and relocation to safe shelters.

d. Ensuring relief collection, carrying and distribution in affected areas.

e. Arrangement of medical teams for treating the victims after having a well-knitted coordination.

f. Arrangement of drinking water to arrest surge of epidemic diseases.

g. Establishment of relief centre in coordination with civil administration and preparation of relief cards for the victims at relief shelter.

6.2.5 **Response Capacity**: **Manpower**

With regards to manpower for earthquake response operation, the 86 Independent Signal Brigade has three battalions available, from which about 1,000 personnel would join the earthquake operation and remaining personnel would be required for conducting normal administrative duties and some would be out of strength due to sickness plus staying on leave for meeting personal emergencies. In brief, this strength would roughly be 50% of its desired capacity for such operation as opined by its Brigade Major during the personal interview. However, as reinforcement provision, it would get one Brigade strength personnel from Savar Cantonment that would facilitate another 1,200 army personnel to

join the emergency response operation in Sector-1. In total, 2,200 personnel would be available for sector 1 area. Again, these 2,200 army personnel are expected to be reinforced by some volunteers as already trained and enlisted by Bangladesh Fire Services and Civil Defence. It may be mentioned here that each Ward of Dhaka City has 200 such enlisted volunteers. These volunteers are supposed to report to their nearest fire stations in case of any disaster. Now, whether FSCD would control them for their own operation or spare some of them to work with respective main operational units is a question to be answered. As such, there is need for strong peacetime coordination between AFD and FSCD in this respect to make best use of these invaluable trained volunteers.

6.2.6 **Response Capacity**: **Training**

The 86 Independent Signal Brigade is yet to participate, in large scale, in any worth-mentioning training on earthquake response operation. However, under the head of Military Operations Other Than War (MOOTW), some small scale demonstration training programmes are conducted on regular basis. Truly, such training does not depict the real time scenario of earthquake. Besides, some of its personnel took part in small training on Disaster Risk Reduction as organized by AFD time to time. Otherwise, it has also been regularly participating in the annual DREE as jointly organized by Bangladesh and United States through AFD. Importantly, the findings of the reconnaissance, carried out in 2011, would serve as an important tool for training of its personnel especially in terms of orientation of the AOR. Accordingly, the Army Signal Brigade has also prepared a “Disaster Management Database” that primarily addresses earthquake.

6.2.7 **Response Capacity**: **Search and Rescue (SAR) Resources**

With regards to SAR resources, the Brigade do not have any heavy SAR equipment in their possession. However, it maintains some traditional SAR resources like shovel, hammer etc. They would receive some more traditional SAR equipment from Savar cantonment on demand once the ear-marked brigade joins them. It expects that the 14 Engineering Brigade would share some of its SAR resources with them as the former has good stock of such heavy equipment, integral to the unit and received from the DDM. However, what would be the extent of such assistance from other formations has not

been worked out. In case of emergency, how effectively this important issue of SAR would be conducted still remains uncertain. On the other hand, the Signal Brigade has identified 16 (sixteen) different types of essential equipment for its SAR operation but did not specify the number of such equipment (Appendix VI). Being a specialized communication formation, the 86 Independent Signal Brigade has roughly 200% of the required capacity in respect of communication equipment. It means that the Brigade would be able to lend communication equipment for another such sector. Signal Brigade did not carry out any compatibility test of their communication equipment with other units/services responsible for operating in other sectors. However, it would have about 50% compatibility with communication equipment of other users of Bangladesh Army especially in Sectors where other Army Brigades would operate in case of major earthquake. The number of vehicles of Army Signal Brigade is appended in Table 14.

Table 14: Number of Vehicles of 86 Independent Signals Brigade

Type of Vehicle	Jeep	Pickup	Truck 3-ton	Total
Number	42	24	40	106

Source: Brigade Major, 16 February 2017

However, it would receive another 100 plus vehicles, which is integral to the Brigade,which would come from Savar Cantonment for reinforcement. In a nutshell, after meeting own administrative and operational requirement, it would be able to spare 30 trucks (3 ton) for debris removal and other response purposes. The Signal Brigade does not have any other specialized resources that can facilitate the SAR operation.

6.2.8 **Response Capacity**: **Other Material Resources**

With regards to medical resources, the Brigade does not have any integral medical facilities. In case of emergency, it would ask Army Headquarters to detach field ambulance (medical team) with them. So, the Brigade is not in a position to provide any direct medical support to the victims. However, it would be able to provide some administrative support to the medical teams operating in its AOR during earthquake response operation. On the other hand, the Signal Brigade does not possess any worth-mentioning relief and shelter materials to give support to the earthquake victims. It considers that the Brigade would be given the responsibility of distribution of relief

material provisioned by the Government or by other competent authority. However, it has listed the location and possession of 76 generators within its AOR that could be used for emergency power generation. Nonetheless, question remains whether these would be handed over to the Brigade and who would operate those generators in a crisis situation. As such, it is well understood that it would take some considerable time for the brigade to collect various material resources from different sources to reach the same to the victims. The brigade also appreciates that there may be some emergency stock of various materials in the brigade itself so that response operation is much faster.

6.2.9 **Response Capacity**: **Regulatory Frameworks**

The 86 Independent Signal Brigade would operate in its AOR anytime as AFD deems it necessary in the aftermath of earthquake. It has the Standing Order on Disaster (SOD) – 2010 to follow in this respect. However, it has also the copy of Draft Earthquake Contingency plan as prepared by AFD. Importantly, it has prepared a Data base of the AOR for Disaster Response, which orients its personnel with the AOR and acquaints them with various facilities and infrastructures available in the AOR. However, this database was prepared in 2011 and required massive revision since many establishments came up new; many local leaders are no more in charge because of subsequent elections; much information was incomplete even during the preparation of this database.

6.2.10 **Response Capacity**: **Financial Resources**

With regards to financial resources, the '86 Independent Signal Brigade' does not maintain any separate fund for earthquake response operations but it has its own provisioning of finance wherefrom it would be able to meet petty operational expenditures and other deployment expenditures at least for 15 days of earthquake response operation. However, any financial support to the earthquake victims is to be provisioned through fresh allocation from the government, which might be a time-consuming affair in case of a national disaster like earthquake.

6.2.11 **Capacity Need**

The perceived capacity need of the "86 Independent Signal Brigade" with regards to earthquake response is depicted in the table below.

Table 15: Capacity Need (Gap) for 86 Independent Signals Brigade

Category	Desired	Existing	Gap (%)	Measure	Gap Remains	Type of Gap
Manpower	2,200	1,000	55%	55% Support from Savar	Nil	'No'
Training	100%	40%	60%	-	60%	'High'
SAR Resources	100%	10%	90%	10% from Savar	80%	'Very High'
Other Material Resources for own operation	100%	80%	20%	-	20%	'Low'
Regulatory Frameworks	100%	70%	30%	-	30%	'Mode-rate'
Financial Resource for own operation	100%	100%	0%	-	Nil	'No'

Source: Brigade Major, 16 February 2017 and 05 Jul 2019

Note: Gap 1%-25% (Low Gap), 26% to 50% (Moderate Gap), 51% to 75% (High Gap) and 76% to 100% (Very High Gap).

6.3 **Bangladesh Air Force Base Bangabandhu: Sector- 2**

6.3.1 **Area of Responsibility (AOR)**

BAF Base Bangabandhu (the then BAF Base Kurmitola) is responsible for Sector-2 (Airport Thana) for earthquake response in Dhaka City as per AFD Draft Earthquake Contingency Plan. This sector is comprised of Civil Aviation Authority of Bangladesh (CAAB) area under Airport Thana and part of Uttara Thana. The Sector Headquarter is located at the Operations Wing within BAF Base Bangabandhu (BBD) at Kurmitola, Dhaka. The area under Airport Thana is about 8.02 sq km (Banglapedia).

6.3.2 **The Important Features of the AOR**

The Post Earthquake Disaster Management Plan of Airport Thana as prepared by BAF (2003) describes that the area lies in Seismic Zone II where basic seismic co-efficient is 0.05 with possibility of earthquake of the intensity of 6 or more in the Richter Scale.However,the CDMP study in 2009 postulates about earthquake of higher magnitude in Dhaka City in general. The important features of Sector - 2 are shown in Table 16 below.

Table 16: Various Important Features of Sector -2

Population (Total)	Buildings (Number)	Open Ground	Educational Institute
20,000	211	02	02

Source: Detail Plan for Earthquake Management: BAF Bangabandhu (2003)

It is needless to say that the population of Airport Thana has gone further up by these 14 years after the estimation was made by BAF in 2003. Again, it is obvious that the number of buildings and educational Institutes has also increased by now and would require greater response operations in case of any major earthquake. Notably, the Hazrat Shahjalal International Airport (HSIA), CAAB Headquarters, Customs Office, Biman Bangladesh Airlines Headquarter, Biman Cargo Complex etc are few important structures in this sector.

6.3.3 **Command and Control**

BAF Bangabandhu maintains a proven chain of command that would take charge of the earthquake response operation with Officer Commanding, Operations Wing as the focal point. However, he would be closely supervised by the Air Officer Commanding of the Base. Again, Air Headquarters would also keep an eye on overall operations through Director of Air Operations at the Air HQ.

6.3.4 **Major Responsibilities in the Post Earthquake Scenario**

As per the draft earthquake contingency plan of AFD, the major responsibilities of the Unit are as follows:

a. Activation of Earthquake Operations Room at the Base Headquarters for Biman Bandar Thana.

b. Damage assessment of Biman Bandar Thana and intimating the same to Air Headquarters (Directorate of Air Operations).

c. Assessment of required rescue equipment for debris removal and arrangement of relief and rehabilitation work.

d. Commencement of rescue work with available manpower and equipment, and bringing necessary equipment from BD Army or civil organisation.

e. To extend technical and medical assistance to the affected people.

f. To coordinate with Government/Civil Organizations, NGO and Ward Commissioner for smooth conduct of relief and rescue operation.

g. To coordinate with voluntary organisation and key personnel/local leaders.

h. To re-establish the supply of water, electricity and gas in affected area.

i. To prepare a list of real victims and coordinate with media.

6.3.5 **Earthquake Management at a Glance**

BAF Bangabandhu would derive all operational guidelines from the SOD of the government and Draft Contingency Plan of AFD. In addition, BAF Bangabandhu has its own SOP (2003) for earthquake response operation and Pamphlet – 32 (2004), which describe the organizational structure and main functions of BAF Central Earthquake Operations Room that is to be established at Air Headquarters. This Operations Room would have seven cells to facilitate overall earthquake response operations by BAF. As such, it would have a supervisory and coordinating role with the operations room of BAF Bangabandhu. Various cells and Directorates responsible for activating those cells are shown in the table below.

Table 17: Various Cells of BAF Central Earthquake Operations Room

Serial Number	Name of the Cell	Directorate Responsible
01	Logistics Cell	Directorate of Supply
02	Rescue Cell	Provost Marshal Directorate
03	Medical Treatment Cell	Directorate of Medical Services (Air)
04	Publication Cell	Directorate of Air Intelligence
05	Control Cell	Directorate of Air Operation
06	Coordination Cell	Directorate of Personnel
07	Communication Cell	Directorate of Communication & Electronics

Source: BAF Pamphlet Number – 32

6.3.6 **Priority of Operation**

The airfield, the runway and the tarmac area would remain in the top priority for response operation in the post-earthquake milieu. Due to the impact of Earthquake, if the only runway of HSIA becomes inoperative, it is to be made operational as soon as possible to keep the domestic and international flights operating especially to facilitate the relief operation by air. BAF, CAAB & other related expert agencies are required to undertake prompt action to re-establish the facilities of runway, taxiway, cargo area, terminal facilities and parking areas to enable flights' landing and taking off. Priority will also be to keep the approach roads to HSIA serviceable.

6.3.7 **Response Capacity**: **Manpower**

With regards to manpower, BAF Base Bangabandhu has about 1,398 uniform personnel (124 officers and 1,274 airmen) in its strength as on 14June 2017. In addition, there are 268 civilian employees (support staffs) working at the Base. However, this calculation does not include the manpower strength of its lodger units located far away. Out of 1,398, however, about 675 personnel would be available for Earthquake response operation if there is no other special national commitment. Rest of the people would not be available for reasons like – normal administrative work, people on emergency leave and people on sickness. This 675 people would meet 84.9% of its desired capacity as opined by its Officer Commanding, Operations Wing. However, it is likely to get reinforcement from Shamsernagar, Sylhet which would meet their manpower requirement for earthquake response. Until then, it would operate with a total force of 675 personnel in its AOR. Nonetheless, its manpower is also likely to get a boost with about 300-400 enlisted volunteers, trained by Bangladesh FSCD as every ward of Dhaka City has 200 trained volunteers. The manpower requirement, as estimated 13 years ago is projected in the table below (Table 18), it is seen from the table that a total of 216 personnel would be required for different types of duties like security duties, traffic duties and task force duties. However, with changed scenario of greater responsibility due to the fact there are more city dwellers and more structures now, at least 795 people would be required as opined by Officer Commanding, Operations Wing of BAF Bangabandhu. Table 19 depicts the Revised Manpower Requirement for Sector – 2 due to changed ground reality.

Table 18: Manpower Requirement of Sector - 2

Tasks	Duty Place	Posts	Manpower per shift	No of shift	Total Man-power	Task wise Total	Grand Total
Security	Security Points	5	3	3	45	51	216
	Airport PS	1	2	3	06		
Traffic	Traffic Points	10	1	3	30	30	
Task Force	Task Force Posts	3	15	3	135	135	

Source: Detail Plan for Earthquake Management: BAF Bangabandhu (2003)

Table 19: Revised Requirement of Manpower for Sector-2

	Each Shift	Total (3 Shift)	Total-HQ	Total for 5 Sub-Sectors	Grand Total
HQ	15	3x15=45	45	150x5=750	795
Sub-Sector(5)	50	3x50=150			

Note: The actual deployment may be different based on the devastation caused.

*Source: Officer Commanding, Operations Wing, BAF Bangabandhu (14 June 2017)

6.3.8 **Response Capacity**: **Training**

With regards to training, the Base has been regularly participating in the annual Disaster Response Exercise and Exchange (DREE) as jointly organized by Bangladesh and United States through Bangladesh Armed Forces Division (AFD) since 2010. The area of operation for BAF is well known to most of the base personnel since it is in the close proximity and it is relatively small in size and with less population density. However, regular training is not carried out within the base though the Base maintains Task Force to handle any emergency and it always has an updated Ground Defence Plan to activate within shortest possible time. Inter-base postings and attachments, which is, otherwise, a must for professional development and operational requirement, affects the maintenance of trained pool of base personnel at Dhaka area. As such, there is need more training of personnel and a kind of policy so that at any given time there is a bare minimum trained personnel staying within the base.

6.3.9 **Response Capacity**: **Search and Rescue Resources**

The BAF Base Bangabandhu does not have mentionable SAR equipment in its possession at the moment. They would coordinate, through AFD, with other sources

available in the AOR to facilitate SAR operation as maintained by Officer Commanding, Operations Wing. However, what type of SAR equipment they would get and by what number is not yet decided. Importantly, which sources would be approached for such support is not clear. The Detail Plan of BAF Bangabandhu says that it does not have all the specialist vehicles and equipment and these are to be borrowed from other sources. Importantly, it does not have sufficient skilled manpower to operate such equipment. Accordingly, it has to bring skilled operators of such equipment and vehicles from other agencies. On the other hand, BAF Bangabandhu would dump the debris as directed by City Corporation or instruction by controlling authority. Peacetime designation of dumping area for different sectors by City Corporations is necessary to facilitate smooth response operation. With regards to vehicle, it has a total of 81 general purpose vehicles, most of which can be employed during response operation. The base has 04 fire extinguishing vehicles (FIRE TENDERs) of its own that would be very useful in the initial response phase. Besides, the crane, excavator and fork lift would be handy for clearing the debris in the rescue phase. For aerial search, BAF Base Bangabandhu would have to rely on BAF Base Bashar. The SAR equipment that the Base is supposed to maintain as per own detail plan prepared in 2003 is shown as Appendix VI. It may be observed from this Appendix that the number of SAR equipment is never judicious against the mammoth task of post-earthquake response operation. For example, for debris clearance, the Base appreciated the requirement of only 8 Dozers, 2 Wheel Loaders, 2 Truck Dumpers and one excavator along with some other equipment. It is very likely that there would be requirement of many more such items for earthquake response operation. Importantly, the evaluation was done about 16 years back in 2003 and a review of the same is very much required now. On the other hand, the base would also be able to spare couple of its ambulances for extending medical facilities. The number of different types of vehicles of the BAF Bangabandhu is given in Table 20, Table 21 and Table 22 below.

Table 20: Vehicle State (General Purpose)

Car	Jeep	Pickup	Coaster	Microbus	Coach	Total
17	24	13	11	08	08	81

Source: Officer Commanding Maintenance Wing, 14 January 2017

Table 21: Vehicle State (SAR)

Ambulance	Truck	Excavator	Crane	Fork Lift	Towing Truck	Fire Tender	Total
05	13	01	02	06	06	04	37

Source: Officer Commanding Maintenance Wing, 14 January 2017

Table 22: Vehicle State (Special)

Oxygen Truck	Nitrogen Truck	GPU	A/C Truck	Crash Tender	Water Bowser	Air Truck	Total
01	01	04	02	05	03	03	19

Source: Officer Commanding Maintenance Wing, 14 January 2017

6.3.10 **Response Capacity**: **Other Material Resources**

Various other materials that can be used in the initial response phase after earthquake are appended below:

a. Communication Resources. With regards to communication equipment BAF Base Bangabandhu is self-sufficient to operate during any earthquake response operation in its own sector as observed by its Officer Commanding, Operations Wing. He also adds, for inter-personal communication, the Base has 30 walkie talkie sets available for earthquake response operation. Another 10-15 sets would be immediately brought from other stations or purchased 'off the shelf'. Thus, a total of 40-45 walkie talkie sets would be made available for the earthquake response operation. This would meet 80% of the total requirement of the communication equipment. However, none of the communication equipment is said to be compatible with similar equipment used by other sectors. In fact, there is no compatibility study carried out so far, in this respect.

b. Medical Resources. BAF Bangabandhu has a Medical Inspection (MI) Room, which looks after the medical treatment of its own personnel in peacetime. It has a 25-bed hospital in its possession, which is primarily meant for BAF personnel.It is needless to say that in the aftermath of earthquake, the medical care services would become overtaxed due to acute disparity between needs and demands. As such, for responding to earthquake victims it would require support from DGHS and DGMS, Armed Forces. Nonetheless, BAF medical team would

reach the affected people within the shortest possible time to render medical services. For that, it would establish two medical centers in the AOR. Besides, it would be able to provide some administrative support to any medical team operating in its AOR from other sources. Importantly, it would involve all the hospitals and clinics within the AOR to facilitate medical services to the victims.

c. Relief Materials. BAF Bangabandhu does not maintain any relief material to give support to the earthquake victims. The Base considers that it would be given the responsibility of distribution of relief materials by the government for which it has full preparation. So, provisioning of relief material for the earthquake victims is not a consideration at the moment. The limited shelter materials, field toilets etc. whatever is available with BAF Bangabandhu would be required for own deployment in the field. Nonetheless, the Base would be able to extend limited support for the earthquake victims from its resources.

d. Specialized Resources. BAF Bangabandhu has some specialized resources like 01 Air Truck, 01 Nitrogen Truck and 01 Oxygen Truck, which would be very useful at the time of sustained air operation in the aftermath of earthquake. Besides, BAF Base Bangabandhu has 04 GPUs, which, if spared, would boost the air operation to and from Hazrat Shahjalal International Airport (HSIA) in case of intense relief operation.

6.3.11 **Response Capacity**: **Regulatory Frameworks**

BAF Base Bangabandhu would operate in its AOR anytime AFD deems it necessary, in the aftermath of major earthquake. The Base has the Standing Order on Disaster (SOD) – 2010 to follow in this respect. However, it has also the copy of draft contingency plan as prepared by Armed Forces Division (AFD) and the BAF Pamphlet – 32 as compiled by the Air HQ and deals with earthquake response. Again, It has also prepared, in 2003, a document named “Detail Plan for Earthquake Management: BAF Bangabandhu (own SOP) through a Board of Officers, which orients the Base personnel with the AOR and acquaints them with various facilities and infrastructures available in the AOR. It has primarily described various operational aspects too. However, the information in this document is scanty in some cases and hence needs thorough revision to make the same befitting against the current ground reality.

6.3.12 **Response Capacity**: **Financial Resources**

Presently, BAF Bangabandhu does not maintain any fund dedicatedly for earthquake response operation and so far, it did not receive any allocation from any source in this regard. However, it would be able to spend Tk 2,000,000 (Twenty Lacs) for 10 days of own emergency operation once it is tasked to be deployed. This amount would be sufficient for own operation @ Tk 200 per day per person. A total of Tk 1,590,000 (15.9 lac) would be required for food alone (provided normal supply of dry ration items would be available) and another 410,000 (4.1 Lac) would be needed as contingency money as opined by its Officer Commanding, Operations Wing and shown in the table below.

Table 23: Money required (BDT) for own Operation for 10 days

Total Person	Per Day Cash	Total Cash Per Day	Total Cash for 10 Days	Contingency Money	Grand Total
795	200	159,000/=	1,590,000/=	410,000/=	2,000,000/=

Source: Officer Commanding Operations Wing, 14 January 2017

6.3.13 **Capacity Need**

The perceived capacity need of BAF Base Bangabandhu with regards to earthquake response is depicted in the table below.

Table 24: Capacity Need (Gap) for Bangladesh Air Force (BAF) - Bangabandhu

Category	Desired	Existing	Gap (%)	Measure	Gap Remains	Type of Gap
Manpower	795	675	15.1%	200 personnel from other unit	Nil	'No'
Training	100%	20%	80%	Training to be strengthened	80%	'Very High'
SAR Equipment	100%	10%	90%	-	90%	'Very High'
Other Material Resources for own operation	100%	60%	40%	Procurement needed	40%	'Mode-rate'
Regulatory Frameworks	100%	70%	30%	Review of Own plan & Policy	30%	'Mode-rate'
Financial Resource for own operation	100%	100%	-	-	Nil	'No'

Source: Officer Commanding Operations Wing, BAF BBD 14 January 2017

Note: Gap 1%-25% (Low Gap), 26% to 50% (Moderate Gap), 51% to 75% (High Gap) and 76% to 100% (Very High Gap).

6.4 6 Independent Air Defence Artillery Brigade: Sector-3

6.4.1 Area of Responsibility (AOR)

The 6 Independent Air Defence Artillery Brigade is responsible to carry out response operation in Sector 3, in the aftermath of Major earthquake in Dhaka City, as per AFD Earthquake Contingency Plan (Draft). This Sector comprises 6 Thanas (Police Stations) namely Pallabi, Mirpur, Shah-Ali, Darussalam, Adabor and Mohammadpur thana. However, the latest contingency plan (2017) of 6 Independent AD Brigade, in its first page, says that the Rupnagar Thana is also part of this Sector. Again, in page 10, of the same contingency plan, it maintains that Sher-e-Banglanagar thana also falls under Sector-3. Thus it is seen that a total of 8 thanas make this sector. These areas are generally plain with some undulating ground in Mirpur and Pallabi especially north western part of Pallabi and western part of Mohammadpur thana are more vulnerable because these townships are built by earth filling over low land. The Sector Headquarter is located within 6 Independent AD Artillery Brigade situated at Mirpur Cantonment (Little north of Mirpur 12 Bus Stand)

6.4.2 Important Features of AOR

The AOR is approximately 45.15 Sq Km in size as per the contingency plan. Various important installations like National Zoo, Botanical Garden, Mirpur Cantonment, BAF Radar Station, National Defence College, MIST, National Heart foundation, Agargaon Radio Station, Bangladesh Meteorological Department (BMD), Sohrawardi Medical College, Mirpur Stadium, Fire Service & Civil Defence Training Complex, Japan Garden City, Gabtoli Bus Stand and NAM Building etc are located in this sector. The major road network includes, Mirpur Road, Begum Rokeya Avenue, Sangsad Bhaban Avenue, Lake Road, Asad Avenue which are much spacious. Except those, the roads and streets of this area are very narrow and would severely restrict vehicle movement during earthquake disaster. Besides, age-old and close spaced buildings and structures connected by narrow roads and lanes, would only add to the difficulties in any rescue operation.

6.4.3 Command and Control Arrangement

The Mirpur-based 6 Air Defence (AD) Brigade follows a well-structured chain of command that would take charge of the earthquake response. Commander, AD Brigade

would retain the overall command while the BM or any other officer designated by the Brigade Commander will act as his coordinating staff. The Regiment would take charge of different sub-sectors to facilitate a coordinated response operation including SAR, relief and rehabilitation. Each sub-sector will have a 1,000-man shelter station, one medical team, 6 rescue teams, 6 debris clearance teams, one cook house, one field communication team, one volunteer service coordination team, one security team, one burial team and the Sub Sector HQ. To effectively conduct the response operation in earthquake, the Brigade has delegated the responsibility of the AOR (Table 25).

Table 25: AOR of Regiments under different Sub-Sectors: Sector 3

Sub Sector	Unit	AOR
3A	25 AD Regiment Artillery 60 Independent SAM Battery Artillery	Mirpur, Darussalam, Sher-e-Bangla Nagar
3B	37 AD Regiment Artillery 57 Independent Medium AD Battery Artillery	Rupnagar, Pallabi, Shah Ali
3C	38 AD Regiment Artillery 58 Independent Medium AD Battery Artillery	Mohammadpur, Adabor

Source: Earthquake Contingency Plan - 2017 of the Brigade (Updated for DREE 2017)

6.4.4 **Visualization of Post Earthquake Response Operation**

The 6 Independent Air Defence Artillery Brigade visualizes the unfolding of operation, in the Contingency Plan 2017, as follows:

a. In post earthquakde situation, the community people of the quake hit area would be the first responders.

b. The ward level volunteers (200 volunteers per ward) would be organized immediately and start working with the community people.

c. The nearest Fire Service and Civil Defence (FSCD) authority will, thereafter, be called by the community people and volunteers.

d. The FSCD, based on their initial survey, is to establish an incident command system (ICS) to carry out necessary SAR, firefighting, evacuation, first aid medication and dead body management operation.

e. In case the incident is uncontrollable by the FSCD, appropriate ministerial authority will call upon AFD to assist in post disaster management operation.

f. AFD would then order all the Services to deploy troops in their respective AOR. The Services/Formations would be deployed in respective sector in the framework of Disaster Incident Management Team (DIMT).

6.4.5 **Major Responsibilities in the Post Earthquake Scenario**

As per the draft earthquake contingency plan of AFD, the major responsibilities of the Unit are as follows:

a. Troops' deployment as per directives of concerned authority.

b. Setting up of 'Earthquake Management Control Cell' at Thana level/ AOR.

c. Identification of victims and relocation to safe shelters.

d. Ensuring relief collection, carrying and distribution in affected areas.

e. Arrangement of medical teams for treating the victims after having a well-knitted coordination.

f. Arrangement of potable water to arrest surge of epidemic diseases.

g. Establishment of relief centre in coordination with civil administration and preparation of relief cards for the victims at relief shelter.

h. Information collection on relief goods, relief shelter, treatment facilities, affected people, crops, animals, and household etc and consequent distribution of relief according to the information collected.

6.4.6 **Response Capacity**: **Manpower**

With regards to manpower, the Independent AD Brigade has three Regiments (battalions) available, from which roughly 40% (800 personnel) of the desired capacity can be met as opined by its Brigade Major. Remaining personnel would not be available

because of many routine works and personal problems (leave, sickness etc.). However, it would get one Brigade strength force from other army establishments that would facilitate another 600 army personnel (meeting their own administrative requirements) to join the emergency response operation of the Brigade. In total, 1400 personnel would be dedicated for this sector that would meet 70% of the capacity. As such, there would remain a 30% capacity gap, which has to be met by calling people from other Army Units. Again, it is also expected by the Brigade that some volunteers, already trained and enlisted by Bangladesh FSCD, would join this strength of manpower of the Brigade. Nonetheless, the Brigade has to carve out a mechanism to integrate them in the response operation once they are directed by the FSCD.

6.4.7 **Response Capacity**: **Training**

With regards to training, the AD Brigade arranged the FTX of DREE 2017, which gave them a great exposure with regards to earthquake response operation. Besides, some of its personnel took part in small training on Disaster Risk Reduction as organized by AFD time to time. The Brigade is also regularly participating in the annual Disaster Response Exercise and Exchange (DREE) as jointly organized by Bangladesh and United States through AFD. Importantly, the reconnaissance of the AOR was thoroughly done in 2017, which appears to be a good beginning and covers many aspects that would help facilitate the response operation. However, the document prepared out of this study has also some gap areas, which needs to be addressed.

6.4.8 **Response Capacity**: **Search and Rescue (SAR) Resources**

With respect to SAR resources, the AD Artillery Brigade does not have worth-mentioning equipment in its possession. However, it has listed some essential equipment in its contingency plan as shown in Appendix VII. Most importantly, Army Engineering Brigade would share some of its resources in this case. However, what would be the extent of such assistance from other formations are yet to be worked out. In terms of communication equipment, the Brigade has the required capacity, which is integral to the Brigade. However, compatibility of their communication equipment with that of other operational units is yet to be tested. The number of vehicles of the Army AD Artillery Brigade would be sufficient for their own deployment and operation during earthquake emergencies. However, they would have only limited vehicles available for SAR

operation in its sector. To meet any requirement of debris clearance, AD Brigade would deploy Civil Trucks. In October 2017, while AFD was holding DREE with United States, the 6 AD Brigade organized the Field Exercise (FTX), which involved participation of all of its officers and most of the other ranks both in planning and execution phase. Such exposure has added value in its SAR capability.

6.4.9 **Response Capacity**: **Other Material Resources**

With regards to medical resources, the Brigade does not have any integral medical facilities. In case of emergency operational requirement for post-earthquake scenario, it would ask army headquarters to detach field ambulance (Medical Team) with them. The Brigade Contingency Plan - 2017 says that Sector – 3 should get 6 Doctors, 12 Medical Assistants, 2 AFNS, 3 Ambulances with Driver and 12 Stretchers from Directorate General of Medical Services (DGMS). So, the Brigade is not in a position to provide the required medical facilities to the victims. However, it would be able to provide some administrative support to the medical teams operating in its AOR. To facilitate medical services, it has listed 13 hospitals in its area where 418 doctors, 253 Nurses and 584 beds were available during the reconnaissance carried out about 10 years back in the Draft Contingency Plan of AFD. Again, in 2017, it has made another list where names and addresses of 53 hospitals and clinics are available. On the other hand, the AD Brigade does not also possess any worth-mentioning relief and shelter material to disburse among the earthquake victims. Nonetheless, it has identified 8 places for using as shelter places and relief centers for the Sector people. The places are Eastern Housing (Mirpur 12), Harun Mollah Eidgah, City Club Ground, Sher E Bangla National Stadium, Laboratory School, Abahani Ground, Residential Model College and National Parliament House area. However, the Brigade is fully prepared to effectively distribute relief and other material resources through its own chain of command.

6.4.10 **Response Capacity**: **Regulatory Frameworks**

The 6 Independent AD Artillery Brigade would start operating in its AOR anytime once AFD deems it necessary in the aftermath of earthquake. It has the Standing Order on Disaster (SOD) – 2010 to follow in this respect. It has also the copy of draft contingency plan as prepared by AFD. Importantly, it has updated its contingency plan in 2017 while organizing the FTX for DREE 2017. Otherwise, it would act along with the laid down

frameworks of DDM and the Government. Its latest contingency plan stressed the need for coordination, in peace time, with concerned stakeholders like DNCC or DSCC (as the case may be), DDM, FSCD, Utility Service providers, NGOs, ward level disaster management committee etc.

6.4.11 **Response Capacity**: **Financial Resources**

With regards to financial resources, the AD Artillery Brigade does not maintain any separate fund for earthquake response operation but it has its own provisioning of finance wherefrom it would be able to meet petty operational expenditures and other deployment expenditures for initial few days (10-12) of earthquake response operation. However, any financial support (cash disbursement) to the earthquake victims is to be provisioned through fresh allocation from the government. Following the existing Chain of Command, it would be able to distribute money to the victims.

6.4.12 **Capacity Need**

The perceived capacity need of 6 Independent AD Brigade with regards to earthquake response is depicted in the table below.

Table 26: Capacity Need for 6 Independent AD Brigade - Sector 3

Category	Desired	Existing	Gap (%)	Measure	Gap Remains	Type of Gap
Manpower	2000	800	60%	30% Support from other formation	30%	'Mode-rate'
Training	100%	40%	60%	-	60%	'High'
SAR Equipment	100%	10%	90%	10% from other station	80%	'Very High'
Other Material Resources for own operation	100%	10%	90%	10% from other station	80%	'Very High'
Regulatory Frameworks	100%	70%	30%	-	30%	'Mode-rate'
Financial Resource for own operation	100%	05%	95%	-	90%	'Very High'

Source: Brigade Major on 16 November 2017

Note: Gap 1%-25% (Low Gap), 26% to 50% (Moderate Gap), 51% to 75% (High Gap) and 76% to 100% (Very High Gap).

6.5 Bangladesh Air Force Base Bashar: Sector- 4

6.5.1 Area of Responsibility (AOR)

Bangladesh Air Force (BAF) Base Bashar is responsible for Sector-4 for earthquake response in Dhaka City as per AFD Draft Contingency Plan. This sector is comprised of areas under "Kafrul" Thana and mainly covers Dhaka Cantonment area, Ibrahimpur, Kachukhet and Western side of Rokeya Shoroni. The Sector Headquarter is located at the Old Airport building within BAF Base Bashar at Dhaka. As per the detail plan of BAF Bashar, four wards of Dhaka City Corporation namely Ward- 4, Ward-14, Ward-15 and Ward-16 constitutes this Kafrul Thana (Figure 1). According to Banglapedia, the area of Kafrul Thana is 7.89 sq km.

6.5.2 Important Features of the AOR

The post-earthquake disaster management plan of Kafrul Thana as prepared by BAF (2003) mentions that the area lies in Seismic Zone II where basic seismic co-efficient is 0.05 with possibility of earthquake of the intensity of 6 or more in the Richter Scale.However,thisinference conflicts with the findings of CDMP study in 2009 that says earthquake of higher magnitude is possible in Dhaka City in general. The important features of Kafrul Thana are shown in Table 27.

Table 27: Various Ground Realities of Kafrul Thana (2003)

Population (Total)	Buildings (Number)	Risky Building	Open Ground	Community Centers	Educational Institute	Market Places
790,000	2,860	1,290	04	06	75	05

Source: Detail Plan for Earthquake Management: BAF Bashar (2003)

It is needless to say that the population of Kafrul Thana has gone further up by these 16 years after the estimation was made by BAF in 2003. On the other hand, it is also obvious that the number of buildings also increased by now to render the need for response operation of higher scale. Similarly, by these 16 years, the number of risky buildings would have also increased since all existing buildings eventually got older. This necessitates updating of the "Detail Plan for Earthquake Management: BAF Bashar".

6.5.3 **Command and Control**

As a disciplined military force, BAF Bashar maintains a proven chain of command that would take charge of the earthquake response operation with OC, Operations Wing as its main focal point. However, he would be closely supervised by the AOC of the Base. Again, Air Headquarters would also keep an eye on the unfolding of operations through Director of Air Operations, Air Headquarters.

6.5.4 **Major Responsibilities in the Post Earthquake Scenario**:

a. Activation of Earthquake Operations Room at the Base Headquarters.

b. Damage assessment of Biman Bandar Thana and intimating the same to Air Headquarters (DAO).

c. Assessment of required rescue equipment for debris removal and arrangement of relief and rehabilitation work.

d. Commencement of rescue work with available manpower and equipment, and bringing necessary equipment from BD Army or civil organisation to resume full swing SAR operation.

e. To extend technical and medical assistance to the affected people as per their requirement.

f. To coordinate with Government/Civil Organization, NGO and Ward Commissioner for smooth conduct of relief and rescue operation especially Food, Water, Medical and sanitation services.

g. To coordinate with voluntary organisation and key personnel/local leaders.

h. To re-establish the supply of water, electricity and gas in the affected area.

i. To prepare a list of real victims and coordinate with media.

6.5.5 **Earthquake Management at a Glance**

BAF Pamphlet (2004) describes the organizational structure and main functions of BAF Central Earthquake Operations Room at to be established at Air Headquarters. This Operations Room would have seven cells to facilitate overall earthquake response operations. Various cells and Directorates responsible are shown in the table below.

Table 28: Various Cells of BAF Central Earthquake Operations Room

Serial Number	Name of the Cell	Directorate Responsible
01	Logistics Cell	Directorate of Supply
02	Rescue Cell	Provost Marshal Directorate
03	Medical Treatment Cell	Directorate of Medical Services (Air)
04	Publication Cell	Directorate of Air Intelligence
05	Control Cell	Directorate of Air Operation
06	Coordination Cell	Directorate of Personnel
07	Communication Cell	Directorate of Communication & Electronics

Source: BAF Pamphlet Number - 32

6.5.6 **Response Capacity**: **Manpower**

With respect to manpower, BAF Bashar has about 1,300 uniform personnel in its strength as on 24April, 2017. In addition, there are 399 civilian employees (support staffs). However, this calculation does not include the manpower strength of its lodger units (detached units) located far away. Out of 1,300 personnel, about 1,000 (76%) personnel (1,007 was available on 24 April 2017) generally remain available at the main base and rest remains on detachment/deputation. Out of 1,000 personnel available, about 35% (350 by number) remains on essential duties like routine maintenance and administrative duties including the security. Thus, it would have about 650 people to consider while responding to any national emergencies. However, considering leave, sickness and personal emergencies, it is estimated that approximately 400 personnel would be finally available for the Earthquake response operation as opined by its OC Operations Wing. The manpower requirement, as estimated 13 years ago is projected in the table below (Table 29). However, with changed scenario, OC, Operations Wing of BAF Basher opined that at least 795 people (Table 30: Revised Manpower Requirement) would be required to be on duty dedicatedly. Thus, present available 400 people would meet approximately 50% of its desired capacity (795 people), the OC, Operations Wing

added. However, another 200 personnel is expected to be brought in from other stations/units (lodger units mostly) for reinforcement. In that case, another 25% capacity would increase to make the total manpower capacity 75%. But, still there would remain a gap of 25% (200 personnel) in terms of manpower. This gap is also expected to be filled in by BAF personnel from other stations provided their work stations are not affected or by the enlisted trained volunteers of FSCD provided they report to fire stations within sector-4 and are spared by FSCD to join BAF Bashar. Otherwise, this gap would continue to exist and the base has to operate with 75% of the desired capacity in terms of manpower.

Table 29: Manpower Requirement for Kafrul Area

Tasks	Duty Place	Number of Posts	Manpower per shift	Total shifts	Total Man-power	Task wise Total	Grand Total
Security	Security Points	5	3	3	45	63	393
	Kafrul PS	1	2	3	06		
	Police Camps	2	2	3	12		
Traffic	Traffic Points	50	1	3	150	150	
Task Force	Task Force Posts	4	15	3	180	180	

Source: Detail Plan for Earthquake Management: BAF Bashar (2003)

Table 30: Revised Requirement of Manpower for Sector-4 (Kafrul Thana Area)

	Each Shift	Total (3 Shift)	Total at HQ	Total for 5 Sub-Sectors	Grand Total
HQ	15	3x15=45	45	150x5=750	795
Sub-Sector(5)	50	3x50=150			

*Source: Officer Commanding, Operations Wing, BAF Basher (24 April 2017)

6.5.7 **Response Capacity**: **Training**

With regards to training, BAF Base Bashar has some personnel who participated in different workshops/seminars/drills on earthquake response as organized time to time by AFD or other organizations but the number is not worth mentioning. Otherwise, it has also been participating regularly in the annual Disaster Response Exercise and Exchange (DREE) as jointly organized by Bangladesh and United States through Bangladesh Armed Forces Division (AFD) since 2010. The area of operation for BAF Bashar is well known to its key personnel and the base had carried out some reconnaissance missions in

the AOR while preparing its detail plan, which has some training value. Like BAF Bangabandhu, BAF Bashar also maintains Task Forces and Ground Defence Forces to meet any emergency. These forces would better perform in case of earthquake response operation as expected.

6.5.8 **Response Capacity**: **Search and Rescue Resources**

In the field of aerial SAR, BAF is the pioneer with vast experience in carrying out operations and even in case of fire both at home and abroad after disasters like earthquake and Tsunami. However, Bangladesh Air Force (BAF) Base Bashar does not have mentionable search and rescue (SAR) ground equipment in their possession at the moment. They would coordinate, through AFD, with 14 Engineering Brigade and other civil sources available in the AOR to facilitate SAR operation as observed by Officer Commanding, Operations Wing. However, what type of SAR equipment they would get and by what number are not yet decided. However, it has a list of specialized equipment, which is shown as Appendix 2. The list has 26 types of heavy duty equipment for post-earthquake debris clearance but it is to be noted here that hardly any item is in possession of the Base now. So far, Base Bashar plans to get the equipment from other sources but the sources are not yet decided. Truly, in the aftermath of an earthquake, such equipment and vehicles will be extremely scarce and one is very unlikely to secure the desired type and number of specialized equipment. This demands peacetime coordination of sources of equipment. The 'Detail Plan of BAF Bashar meant for Kafrul Thana' says in its Annex-C that it does not have all the specialist vehicles and equipment and these are to borrowed from other sources. Importantly, it does not have sufficient skilled manpower to operate such equipment. Accordingly, it has to bring skilled operators of such equipment and vehicles from other agencies. With respect to SAR vehicle, it has a total of 20 vehicles that can be employed. Of them, it would be able to spare at least 05 trucks and 04 ambulances for carrying injured personnel and for any other purpose. It has 04 fire extinguishing vehicles (FIRE TENDERs) of its own that would be very useful in the initial response phase to control and extinguish fire incidents. Besides, the wrecker and two cranes would be handy for clearing the debris in the rescue phase. For aerial search, BAF Bashar would be 100% capable with whatever air assets it has. With its helicopters (18 available- 10 MI-17s & 8 Bell-212s), BAF Bashar would be able to evacuate nearly 168 personnel in stretcher or 300 personnel with stretcher. In addition, it has also two C-

130, which can be very useful in post-earthquake response operation especially in evacuating people from disaster-hit zone to some distant safe areas. Table 31 shows the state of dedicated SAR vehicles while Table 32 shows the numbers of general purpose vehicles. Table 33 shows the availability of aircraft while Table 34 projects the special vehicle to support air operation. The SAR equipment that BAF Base Bashar is supposed maintain as per own SOP is shown as Appendix VIII.

Table 31: SAR Vehicles- BAF Bashar

Ambulance	Truck	Wrecker	Crane (Wheel)	Fire Tender	Total
04	09	01	02	04	20

Source: OC Maintenance Wing, BAF Bashar

Table 32: General Purpose Vehicles held by BAF Bashar

Car	Jeep	Pickup	Microbus	Coaster	Motorbike	Coach	Total
30	21	05	11	08	19	09	103

Source: OC Maintenance Wing, BAF Bashar

Table 33: Aircraft State of BAF Bashar

MI-17	Bell-212	C-130	Total
10	08	02	20

Source: OC Maintenance Wing, BAF Bashar

Table 34: Vehicle State (Special for Air Operation) of BAF Bashar

Towing Truck	Fuel Bowser	Fork Lift	Mark Lift	GPU	Total
03	03	03	01	04	14

Source: OC Maintenance Wing, BAF Bashar

6.5.9 **Response Capacity**: **Other Material Resources**

Various other materials that can be used in the initial response phase after earthquake are appended below:

a. Communication Resources. With regards to communication equipment BAF Base Bashar is self-sufficient to operate during any earthquake response

operation in its own sector as observed by Officer Commanding, Operations Wing. He also adds, for inter-personal communication, the Base has 54 walkie talkie sets of which 40 would be available for earthquake response operation. Another 20 sets would be immediately brought from other stations or purchased 'off the shelf'. Thus, a total of 60 walkie talkie sets would be available for the earthquake response operation. This would meet 75% of the total requirement of the communication equipment for the sector. However, none of the communication equipment is said to be compatible with similar equipment used by other sectors. In fact, there is no compatibility study carried out so far, in this respect. In short, there would remain a gap of 25% walkie talkie sets which is, otherwise, 20 sets by number.

c. Medical Resources. BAF Bashar has a Medical Inspection (MI) Room, which is sufficient to look after the outdoor medical treatment of its own personnel during peacetime. However, a 25-bed hospital is underway for this base. It is needless to say that in the aftermath of earthquake, the medical care services would be inadequate due to acute disparity between need and demand. As such, for responding to earthquake victims it would require support (manpower and material) from DGHS and DGMS, Armed Forces. Nonetheless, BAF medical team would reach the affected people to render medical services. For that, it would establish two medical centers – one at the northern end of Tejgaon Runway and the other one at Police Staff College, Mirpur. Besides, it would be able to provide some administrative support to any medical team operating in its AOR from the government. Importantly, it would involve all the hospitals and clinic within the AOR to facilitate medical services to the earthquake victims.

d. Relief Materials. The BAF Base Bashar does not maintain any relief material to give support to the earthquake victims. The Base considers that it would be given the responsibility of distribution of relief materials by the government for which it has full preparation. So, provisioning of relief material for the earthquake victims is not done by the base at the moment. The limited shelter materials, field toilets etc whatever is available with BAF Bashar, would

be consumed for deployment of own troops in the field condition leaving no such support for the earthquake victims.

6.5.10 **Response Capacity**: **Regulatory Frameworks**

The BAF Base Bashar would operate in its AOR anytime AFD deems it necessary in the aftermath of earthquake. It has the SOD – 2010 to follow in this respect. However, it has also the copies of draft contingency plan as prepared by AFD and the BAF Pamphlet – 32 as compiled by Air HQ. It has also prepared a document named "Detail Plan for Earthquake Management: BAF Bashar (own SOP)", which orients them with the AOR and acquaints them with various facilities and infrastructures available in the AOR. This plan, in addition to normal SAR operations, has catered for many essential services like restoration of electric supply, water supply, gas distribution, sewerage lines etc. However, the information at times is scanty & little old and hence demands an updating. Importantly, many valuable documents like National Disaster Management Plan: 2010-15, Dead Body Disposal Policy etc were not found available with BAF Base Bashar during the interview.

6.5.11 **Response Capacity**: **Financial Resources**

BAF Base Bashar does not maintain any contingency money for disbursement to the earthquake victims. However, as the situation demands, some good amount of money can be arranged for such cause, provided the banking system is on. On the other hand, it is self-sufficient financially to meet own financial requirement for at least 10 days of initial response operation. It would be able to spend at least Taka 25 Lacs for 10 days of operation (estimated) @ Taka 200 per day for a single person (Table 35). Nonetheless, for disbursement of cash money to the earthquake victims, the arrangement is to be made with government's assistance.

Table 35: Money required for BAF deployment and operation in Kafrul Thana

Total Person	Per Day Per Head Cash(taka)	Total Cash Per Day(taka)	Total Cash for 10 Day(taka)	Others Contingency (taka)	Grand Total (taka)
795	200	159,000	1,590,000	910,000	2,500,000

Source: OC Operations Wing

6.5.12 **Capacity Need**

The perceived capacity need BAF Bashar with regards to earthquake response is depicted in the table below.

Table 36: Capacity Need (Gap) for BAF Bashar

Category	Desired	Existing	Gap (%)	Measure	Gap Remains	Type of Gap
Manpower	795	400	50%	Reinforcement of 400 persons	Nil	'No'
Training	100%	30%	70%	Training to be conducted	70%	'High'
SAR Equipment	100%	5%	95%	-	95%	'Very High'
Other Material Resources for own operation	100%	60%	40%	Procurement needed	40%	'Mode-rate'
Regulatory Frameworks	100%	75%	25%	Revision of Own plan & Collection of Policies	25%	'Low'
Financial Resource for own operation	100%	100%	Nil	-	Nil	'No'

Source: Officer Commanding, Operations Wing

Note: Gap 1%-25% (Low Gap), 26% to 50% (Moderate Gap), 51% to 75% (High Gap) and 76% to 100% (Very High Gap).

6.6 **Bangladesh Navy Administrative Authority Dhaka: Sector- 5**

6.6.1 **Area of Responsibility (AOR)**

As per AFD Draft Contingency Plan, Bangladesh Navy is responsible for earthquake response in Sector-5 of Dhaka City. BN in turn, made Naval Administrative Authority Dhaka responsible for Sector–5. On behalf of Naval Administrative Authority Dhaka, BNS Haji Mohsin would be primarily responsible to unfold the response operation. However, the newly commissioned unit, BNS Sheikh Mujib would also take part in the operation alongside BNS Haji Mohsin as the former is fully operational. The Sector-5 of the earthquake contingency plan for Dhaka City consists of Gulshan and Banani area within Gulshan Thana.

6.6.2 **Important Features of the AOR**

The 'Earthquake Response Group' of the proposed "Emergency and Disaster Response Center (EDRC) 2016" of Naval Administrative Area Dhaka maintains that Sector-5 is comprised, in one hand, of posh areas like Gulshan, Banani and Baridhara, and on the other hand, slum areas like "Mohakhali Slums". This sector houses various diplomatic missions, which are very much sensitive for obvious reason. On the other hand, it has numerous high-rise buildings alongside many poorly-constructed housing structures. Importantly, the busy Kuril Flyover is located in this sector, the damage of which may badly disrupt the road communication of the most busy and strategic airport road, kuril Biswaroad and 300 feet road towards Purbachol City.

6.6.3 **Command and Control**

Bangladesh Navy maintains a proven chain of command that would take charge of the earthquake response operation with Commander, Naval Administrative Authority Dhaka as its main focal point. As discussed earlier, BNS Haji Mohsin and BNS Sheikh Mujib would be engaged in the response activities. However, its operational activities would be closely supervised by the Directorate of Naval Operation at the Naval Headquarters. As such, Naval Headquarters would also keep an eye on the unfolding of operations through Directorate of Naval Operations.

6.6.4 **Major Responsibilities in the Post Earthquake Scenario**:

a. Assessing the damage caused in AOR and keeping the NHQ informed.

b. Carry out damage-assessment survey and assess requirements of rescue, relief and rehabilitation.

c. Carryout rescue operation utilizing available manpower/equipment.

d. Provide technical/medical assistance to the affected people/civil authority with the AOR.

e. Establish 'Control Cell' and 'Field Control Organization (FCO)' and operate the round the clock.

f. Make necessary coordination with Government organizations/ local civil authorities/ NGOs for smooth functioning of the relief/rescue operation especially for the provisioning of emergency shelter, food, water and medical services.

g. Coordinate restoration of emergency services of the utility service providers.

h. Maintenance of casualty/survivor related information and liaise with local and foreign media.

6.6.5 **Earthquake Management at a Glance**

The earthquake management in Sector–5 will be done primarily through establishment of a Control Cell, a Field Coordination Cell (FCO) and some subsectors. The 'Control Cell' will be established at NHQ Operations Room or at any suitable designated location selected by Directorate of Naval Operations. The Manning responsibilities of Control Cell for Sector 5 is shown in Table 37. The Cell would start functioning immediately after the occurrence of major earthquake and exercise overall control over FCO. The major functions of the 'Control Cell' will be as follows:

a. Initiate implementation of the ‘Earthquake Disaster Management Plan in own AOR.

b. Compile initial damage assessment report.

c. Coordinate with other Government and Non-Government Organizations and arrange logistical support for FCO.

d. Coordinate with other Naval Areas (not affected) for speedy disbursement of rescue equipment/vehicles, Communication sets other logistical supports, etc, and sending of Personnel (if required).

e. Coordinate with respective Government service agencies for restoration of utility services at the earliest.

f. Coordinate medical evacuation of seriously injured Personnel to hospital, as required.

g. Liaise with Bangladesh Army for service of 'sniffing dogs' for detection of trapped Personnel.

Table 37: The Manning responsibilities of Control Cell for Sector 5

Section	Primary Responsibility (If BN Personnel in Dhaka are not Affected)	Alternate (If BN Personnel in Dhaka are Affected)	Remarks
Log Section Rescue Section Medical Section Media Section Control Section Liaise Section Communication Section	Logistic Branch Material Branch Personnel Branch DNI Operations Branch Personnel Branch Operations Branch	NSD Ctg COMBAN BNS'PATENGA' COMBAN COMCHIT COMKHUL COMCHIT	If Chittagong is also affected total responsibility will rest with COMKHUL

Source: Draft Contingency Plan of AFD (Chapter 6)

On the other hand, the Field Control Organization (FCO) will be operated under the responsibility of Administrative Authority Dhaka of BN for controlling of all field activities related to earthquake disaster management in BN's AOR. The FCO HQ would be set up at Gulshan Wonderland Park area or at any other suitable designated area. It will coordinate overall activities through Sub Sector HQs. For the purpose of ease of coordination the AOR will be divided into 07 Sub Sectors as follows:

a. Sub Sector 51. NHQ Complex and neighboring Army Quarters/ Installations.

b. Sub Sector 52 . Banani Area (North of Kamal Atartuk Avenue).

c. Sub Sector 53. Gulshan Area (North of Kamal Atartuk Avenue and West of Gulshan Avenue).

d. Sub Sector 54. Gulshan Area (East of Gulshan Avenue and North of Madani Avenue).

e. Sub Sector 55. Gulshan Area East of road joining Gulshan 1 and Gulshan-2 Circle.

f. Sub Sector 56. Banani Area, South of Kamal Atartuk Avenue.

g. Sub Sector 57. Responsibility not yet assigned.

6.6.6 **Response Capacity**: **Manpower**

With regards to manpower, Naval Admin Area Dhaka has about 540 uniform personnel in its strength as on 14 November 2017. Of them, a total of 417 personnel were available on that particular day. Commander, BNS Haji Mohsin informed that at least 150 personnel would be required to meet the own security requirement. If other admin and logistic support requirement is catered for, only 50 personnel would be available for earthquake response purpose against the total requirement of 400 dedicated personnel to cover Sector-5. These 50 people would meet approximately 12.5% of its desired capacity (400 people). Nonetheless, about 100 naval personnel (25%) would join from other establishments to partially meet the requirement. But, still there would remain a gap of 62.5% (250 personnel) in terms of manpower. This gap is also expected to be partially filled in by the enlisted trained volunteers of FSCD provided they report to fire stations within sector-5 and are spared by FSCD to join Naval Administrative Area Dhaka. Otherwise, this gap, in terms of manpower, would continue to exist and the unit has to operate with only 37.5% of the desired capacity in terms of manpower.

6.6.7 **Response Capacity**: **Training**

With regards to training, Naval Administrative Area Dhaka has some personnel who participated in different workshops/seminars/drills on earthquake response as organized time to time by AFD or other organizations but the number is not worth mentioning at all. Otherwise, it has always some representation in the annual Disaster Response Exercise and Exchange (DREE) as jointly organized by Bangladesh and United States through Bangladesh Armed Forces Division (AFD) since 2010. Importantly, other naval areas have chalked out a simple training module “Shake out Drill” for BN establishments and facilities. This module primarily trains people to go for “Drop, Cover and Hold”. On the other hand, the AOR of BN is well known to its personnel working at Dhaka area. However, it is well understood from the interaction with senior Naval Officers that there is strong need for imparting training especially on SAR procedure and operation of heavy equipment.

6.6.8 **Response Capacity**: **Search and Rescue Resources**

In the field of aerial SAR, BN is gaining experience as she has couple of helicopters now. However, it does not have mentionable search and rescue (SAR) ground equipment in their possession at the moment. The list of equipment what BNS Haji Mohsin was holding during the interview is shown as Appendix IX. On the other hand, BN has asked for allocation of huge budget to procure DM equipment for its proposed EDRC, the list of which is given in Appendix X. They would coordinate, through AFD, with 14 Engr Bde and other civil sources available in the AOR to facilitate SAR operation as observed by Commander, BNS Haji Mohsin. However, what type of SAR equipment they would get and by what number are not yet decided.

6.6.9 **Response Capacity**: **Other Material Resources**

Director Medical Services (DMS) of BN will be overall in charge of medical activities in post-earthquake scenario. BNS Haji Mohsinhas a Medical Room wherefrom mostly outdoor treatment is given. It has some beds for temporary hospitalization of patients but it mostly depends on CMH Dhaka.Its plan says, each of seven sub-sectors will be covered by a small 13-member medical team including two doctors (volunteers). However, wherefrom these volunteer doctors would come has not been spelt out. Again, with regards to medical equipment, the contingency plan maintains that each sub-sector will be provisioned with 2 Oxygen Cylinders, 1 Sucker Machine, 1 Ambulance, 7 Stretchers, 1 Saline Stand, 1 First Aid Bag, 10 Blankets, 10 Bed Sheets and 4 Pillows. There would be two Casualties Surgical Stations (CSS) established at the parking areas of Gulshan 2 Market and Gulshan 1 Market to cover earthquake victims of Sector-5. Each CSS would be 50-bed field hospital to treat 100 wounded people of all types. Each 57-member CSS would have sufficient vehicles including 3 ambulances. Importantly, the Draft Contingency Plan dishes out various responsibilities to different naval agencies. Naval Administrative Authority Dhaka does not maintain any stock of shelter materials, relief materials and other support items for the earthquake victims. However, for own deployment and operation it has full preparation.

6.6.10 **Response Capacity**: **Regulatory Frameworks**

BNS Haji Mohsin and BNS Sheikh Mujib would operate in their AOR anytime AFD deems it necessary in the aftermath of earthquake. It has the SOD –2010 and has also

the copy of Draft Contingency Plan of AFD. BN has also prepared a standing order on Earthquake Response that is equally applicable for Dhaka area. This plan, in addition to normal SAR operations, has catered for many essential services like restoration of electric supply, water supply, gas distribution and etc. However, many important documents like National Disaster Management Plan: 2010-15, Dead Body Disposal Policy etc were not found available with BNS Haji Mohsin during the time of interview.

6.6.11 **Response Capacity**: **Financial Resources**

BNS Haji Mohsin does not maintain any contingency money for disbursement to the earthquake victims. However, any fund pouring in from any source and meant for the earthquake victims would be disbursed effectively among the distressed people following own unity of command system. Again, BNS Haji Mohsin is self sufficient to meet own financial requirement for at least 15 days of initial response operation.

6.6.12 **Capacity Need**

The perceived capacity need of Dhaka Naval Area of Bangladesh Navy with regards to earthquake response is depicted in Table below.

Table 38: Capacity Need (Gap) for BN Dhaka

Category	Desired	Existing	Gap (%)	Measure	Gap Remains	Type of Gap
Manpower	400	50	87.5%	100 persons from other Naval Areas	62.5%	'High'
Training	100%	20%	80%	Training is on to reduce gap by 20%	60%	'High'
SAR Resources	100%	07%	93%	10% from other Naval Area	83%	'Very High'
Other Material Resources for own operation	100%	20%	80%	Procurement needed	80%	'Very High'
Regulatory Frameworks	100%	30%	70%	Revision of Own plan	70%	'High'
Financial Resources for own operation	100%	05%	95%	-	95%	'Very High'

Source: Diving Officer, BNS Haji Mohsin

Note: Gap 1%-25% (Low Gap), 26% to 50% (Moderate Gap), 51% to 75% (High Gap) and 76% to 100% (Very High Gap).

6.7 **46 Independent Infantry Brigade: Sector-6**

6.7.1 **Area of Responsibility (AOR)**

The 46 IIB of Bangladesh Army is responsible for earthquake response in Sector-6, which is comprised of areas like Badda, Khilgaon, Rampura, Tejgaon, Tejgaon Industrial Area, Kalabagan, New Market, Dhanmondi, Shahbag and Ramna. The responsibility of operation has been distributed to various Regiments of the Brigade as shown in the Table below.

Table 39: AOR of different Regiments of 46 IIB in Sector - 6

SL	Unit	AOR	Remarks
01	Artillery Regiment	Dhanmandi, Kalabagan, Newmarket and Hazaribag	Names of the Regiment are not given since they are interchangeable
02	One East Bengal Regiment	Shahbag, Ramna, Tejgaon and Tejgaon Industrial Area	
03	Another East Bengal Regiment	Khilgaon, Rampura, Banani, Gulshan, Badda, Bhatara	
04	One Bangladesh Infantry Regiment	Lalbag, Chakbazar, Bangshal Kotwali and Kamrangirchar	

*Source: Major Sami, Brigade Major 46 IIB

6.7.2 **Important Features of the AOR**

The AOR of 46 IIB is generally a plain one but the eastern part of Khilgaon and Badda thana are especially vulnerable because townships in these areas have been built after earth filling of low-lying areas. Most of the areas under sector 6 are characterized by age-old and close-spaced buildings connected by narrow roads, streets and lanes, which would be largely inaccessible by motorized vehicles during any search and rescue effort after an earthquake. Similarly, debris removal would also be a difficult and challenging task in the aftermath of earthquake because of narrow road network. There are many important infrastructures in this sector like Dhaka University, BUET, National Museum, Children Park, Television Station, BSMMU etc. There are a good number of open spaces under Sector 6 namely Ramna Park, Hatirjhil Area, Siddheswary Balur Math, Modhubag Math, Shishu Park, Sohrawardy Uddyan, Osmani Uddyan, Army Museum Area, Bhasani Novo Theatre Ground, Dhanmondi Lake area, Tejgaon old Airport, Public Service Commission Area, Khamar Bari RD Park, Arong area, Dhaka Club, Tennis Complex,

Dhaka University Area etc. The Brigade contingency plan also says that almost all the embassies are located in its AOR.

6.7.3 **Command and Control**

Commander 46 IIB will be in charge of the overall command while Brigade Major will act as his coordinating staff. Commanding officers of different assigned battalions/regiments will act as coordinators of their respective sub-sectors to conduct all kinds of SAR, relief and rehabilitation operation under the guidance of Brigade Commander. As such, there will be 4 sub sectors and each sub sector will have a Sub Sector HQ each consisting of 15 persons having a Lt Col/Maj as the sub sector commander. Besides, there will be another Major, 2 Captains, 1 JCO and 10 other ranks (Ors). The present location of HQ 46 IIB, close to BNS Haji Mohsin, would be used as the operational headquarters. In case the HQ is badly damaged then another suitable location would be selected. .

6.7.4 **Post Earthquake Response Responsibilities**

As per contingency plan, in the post-earthquake scenario,the major responsibilities of the 46 Independent Infantry Brigade are as follows:

a. Set up ‘Earthquake Management Control Cell’ and ‘Media Management Cell’ at Thana level or within the AOR.

b. Make airport (which airport) operational on a priority basis.

c. Identify victims and rescue them to safe shelters.

d. Ensure relief collection, carrying and distribution in affected areas.

e. Coordinate to conduct SAR operation with government and non-government organizations.

f. Re-construct affected roads, bridges and culverts for better access to affected sites and restore life lines.

g. Arrange firefighting.

h. Arrange adequate doctors and medical assistants in the medical teams.

i. Coordinate with neighboring engineer unit/formation for required assistance with engineer equipment for rescue operation.

6.7.5 **Response Capacity**: **Manpower**

Unlike other normal infantry Brigades of Bangladesh Army, 46 Independent Infantry Brigade has some additional manpower since it has one extra Battalion, an Artillery Regiment. Thus, with regards to manpower, 46 Independent Infantry Brigade has a total of 2,500 personnel. Of them, about 1,500 personnel (60%) would be available for Earthquake response operation if there is no other special national commitment. Rest of the people would not be available for reasons like – normal administrative work, people on emergency leave and people on sickness. These 1,500 people would roughly meet 60% of its desired manpower requirement for earthquake response as opined by its Brigade Major. However, it would get one Brigade strength force from neighbouring Cantonment as per draft contingency plan of AFD, which would facilitate another 1,000-1,200 army personnel to join the emergency response operation in sector-6. As such, a total of 2,500-2,700 personnel would be dedicated for this sector in the aftermath of earthquake. Again, the manpower is likely to be boosted by some volunteers as already trained and enlisted by Bangladesh Fire Services and Civil Defence for Dhaka City. As such, it appears that there would not be any shortfall of manpower for this unit as per its operational plan.

6.7.6 **Response Capacity**: **Training**

With respect to training/drill, the 46 IIB did not participate in large scale in any worth-mentioning training on earthquake response, so far. However, some of its personnel took part in small training on Disaster Risk Reduction as organized by AFD time to time. Otherwise, it is also regularly participating in the annual Disaster Response Exercise and Exchange (DREE) as jointly organized by Bangladesh and United States through AFD. Importantly, the reconnaissance of the AOR was done by the Brigade, which appears to be a good beginning with regards to orientation of its personnel with the operational area. The findings of the reconnaissance would serve as an important tool for training of its

personnel too. However, the document prepared based on such reconnaissance has some weak areas especially with respect to validity of some information since many years has elapsed after its compilation. The Brigade Major has confessed that the training should be a continuous process since the regiments are getting out of the Brigade as a routine matter and new regiments are getting in. So, it is a big challenge for the Brigade to keep people updated with the latest situation. He also added that the personnel from non-commissioned stream need to be incorporated with annual exercise like DREE. However, the Brigade is ready to take part in any training organized by DDM, AFD or any other agencies.

6.7.7 **Response Capacity**: **Search and Rescue Resources**

The 46 Independent Infantry Brigade did not receive any kind of specialized equipment for earthquake response from any government source like CDMP or DDM. It has some integral SAR resources as shown in Appendix XI.However, it expects to get some support from 14 Engineers Brigade as it houses some equipment received from DDM and meant for Armed Forces. With regards to SAR team, each sub sector of 46 IIB will have 6 rescue teams and each rescue team will have 20 personnel consisting of 1 JCO, 2 NCOs, 7 ORs, and 10 Volunteers. On the other hand, each sub sector will also have 6 debris clearance teams and each such team will have 20 personnel consisting of 1 JCO, 2 NCOs, 7 ORs, and 10 Volunteers. Importantly, the Brigade has a plan to form "Volunteers Aid Coordination Team" and each sub sector will have 7 such groups with each group having 10 personnel including 1 Sergeant, 2 Other Ranks and 7 Volunteers. Various SAR equipment held by the Brigade are as shown in Table 40 below. Besides, the Brigade has a sizeable number of vehicles as shown in Table 41, some of these vehicles would be used to facilitate SAR operations once their own field deployments completes.

Table 40: SAR Equipment held by 46 IIB

Shovel	Crowbar	Hammer	Kneepad & Eye Protector	Gloves	Thermal Imager
291	14	09	41	126	08

Source: Brigade Contingency Plan

Table 41: The Vehicle State of 46 IIB

Ser	Type of Vehicle	Number per Battalion	Total in the Brigade (4 Battalion)	Grand Total
01	Jeep	05	20	117
02	3 Ton Truck	18	72	
03	Pickup	05	20	
04	Water Bowser	-	05	

Source: Brigade Contingency Plan

6.7.8 **Response Capacity**: **Other Material Resources**

The Brigade does not have integral medical facilities. In case of emergency, it would ask Army Headquarters to detach a field ambulance for working with them. Thus, it is not in a position to provide the medical facilities to the earthquake victims from its own resources at this moment. Nonetheless, it would be able to provide required administrative support to the medical teams operating in its AOR. Importantly, the Brigade Contingency Plan also includes a list of 30 hospitals of its AOR with number of available doctors, nurses, beds, ICU facilities and OT arrangements. The Brigade would coordinate with all these hospitals for facilitating emergency medical services to the earthquake victims. On the other hand, the 46 IIB does not also possess any relief material to give support to the earthquake victims. However, it has sizeable number of such resources wherefrom it would be able to spare some for the earthquake victims as the situation demands.Besides, it considers that relief material would come from other government/non-government sources and the Brigade would be given the responsibility of distributing the same. Following its established chain of command, distribution of any kind of relief material would be effective and timely. The integral 'Shelter and Housing Materials' possessed by the Brigade, its 'Communication Resources' and list of 'Medical and other Support Items' are shown in Table 42, Table 43 and Table 44 respectively. Most of these items are in good condition to operate in any emergency situation.

Table 42: Shelter and Housing Materials-46 IIB

Blanket	Store	Tarpaulin	Fencing Item	Tent	Toilet	Cook House	Water Tank	Water Pump
6638	08	01	01	757	02	05	04	06

Source: Brigade Contingency Plan

Table 43: Communication Resources- 46 IIB

Walkie Talkie	VHF	UHF	Head to Head	Megaphone
48	4	192	400	08

Source Major Sami, Brigade Major 46 IIB

Table 44: Medical & other Support Items – 46 IIB

Ambulance	Stretcher	Air Compressor	Gloves	Thermal Imager	Megaphone
01	45	02	126	08	08

Source: Brigade Contingency Plan

6.7.9 **Response Capacity**: **Regulatory Frameworks**

The main regulatory framework for the 46 Independent Infantry Brigade to operate in post-earthquake scenario would be the SOD-2010 of the government. The Brigade is also in possession of the Draft Earthquake Contingency Plan of AFD, which details various operational aspects. However, the Brigade Contingency Plan is the readily available primary regulatory document to start response operation. Nonetheless, the Brigade Contingency Plan needs to be updated as some information is quite old. Besides, the Brigade needs to collect various other documents published by the government on earthquake emergency.

6.7.10 **Response Capacity**: **Financial Resources**

The 46 Independent Infantry Brigade only maintains some contingency fund for meeting own operational requirement during earthquake emergencies. As such, it does not maintain any cash or kind for disbursing to the earthquake victims in their AOR. For any financial need of earthquake victims, the Brigade would ask the same from the government. However, for own deployment and emergency response operation for about 10-15 days, the 46 Independent Infantry Brigade would be able to arrange finance from own contingency fund.

6.7.11 **Capacity Need**

The perceived capacity need of the ‘46 Independent Infantry Brigade’ is depicted in Table 45 below.

Table 45: Capacity Need (Gap) for 46 Independent Infantry Brigade

Category	Desired	Existing	Gap (%)	Measure	Gap Remains	Type of Gap
Manpower	2500	1500	40%	40% Support from other Cantt.	Nil	'No'
Training	100%	25%	75%	Training to be conducted	75%	'High'
SAR Equipment	100%	20%	80%	10% Support from other Cantt.	70%	'High'
Other Material Resources for own ops	100%	70%	30%	Procurement needed	30%	'Mode-rate'
Regulatory Frameworks	100%	70%	30%	Revision of Own plan	30%	'Mode-rate'
Financial Resource for own ops	100%	100%	0%	-	0%	'No'

Source: Major Sami, Brigade Major, 46 IIB

Note: Capacity Gap: 1%-25% is "Low Gap"; 26%-50% is "Moderate Gap"; 51%-75% is "High Gap" and 76%-100% is "Very High Gap".

6.8 **14 Independent Engineers Brigade: Sector- 7**

6.8.1 **Area of Responsibility (AOR)**

The 14 Independent Engineers Brigade of Bangladesh Army is responsible for Sector-7 for earthquake response operation in Dhaka City as per Armed Forces Division (AFD) Draft Contingency Plan. This sector is comprised of areas under eight police stations namely "Paltan", "Motijheel", "Sobujbag", "Jatrabari", "Sutrapur", "Gendaria", "Demra" and "Shyampur" thana. The Sector Headquarter is located within the Brigade HQ, near the Staff Road, Dhaka Cantonment.

6.8.2 **Important Features of the Area**

The area is characterized by age old closed-spaced buildings and structures connected by narrow roads, streets and lanes. While constructing these buildings considerations were not given for earthquake threats. There are many high rise buildings in this sector especially, in Motijheel and Paltan areas. Rest of the places is extremely crowded with various business enterprises and other commercial structures. Vehicular movement is

too high and traffic jam is a regular feature on the roads of this sector. Mayor Hanif fly over is an important feature in this sector. There are a total of 28 parks, 04 graveyards, 54 mosques and 21 hospitals in this sector that may be of great use in earthquake management.

6.8.3 **Command and Control**

Commander 14 Independent Engineering Brigade will be in charge of overall command of this sector during earthquake response operations while Brigade Major will act as his coordinating staff. Commanding officers of 3 Engineering battalions will act as coordinators of their respective sub-sectors to coordinate all kinds of SAR, relief and rehabilitation operation under the guidance of Brigade Commander. As such, there will be 3 sub sectors namely 7A, 7B and 7C with their headquarters at Sobujbag thana, Sutrapur thana and Demra thana respectively. Each sub sector will have, besides its headquarter, a shelter station (for at least 1000 people), a medical team, six rescue teams, six debris clearance team, a cook house, a field communication team, a volunteer coordination team, a security team and a burial team. 14 Independent Engineer Brigade has allocated its AOR to its battalions as follows:

a. Shyampur Thana - 5 RE Battalion/replacing unit.

b. Motijheel, Sobujbag and Demra Thana - 2 Engineer Battalion/replacing unit.

c Sutrapur Thana - 10 RE Battalion/replacing unit.

d. 57 Engineer Company will be attached with 2 Engineer Battalion, 5 RE Battalion and 10 RE Battalion according to necessity.

6.8.4 **MajorPost Earthquake Response Responsibility**:

a. Troops' deployment as per directives of concerned authority (if not deployed on pre-earthquake phase).

b. Setting up of 'Earthquake Management Control Cell' at Thana level or within AOR.

c. Identification of victims and relocation to safe shelters (already earmarked during Pre-Earthquake phase).

d. Ensuring relief collection, carrying and distribution in affected areas.

e. Arrangement of medical teams for treating the victims after having a well-knitted coordination.

f. Arrangement of drinking water to arrest surge of epidemic diseases.

g. Establishment of relief centre in coordination with civil administration and preparation of relief cards for the victims at relief shelter.

h. Expediting rescue and relief activities with the assistance of civil authorities.

i. Reconnaissance to assess damage and needs, and provide feedback to local and state officials.

j. Assessment / shut off of utilities to houses and other buildings.

k. Debris clearance and search the victims with required equipment such as crane, dozers, compressor, motor grader, spreader, cutter etc.

l. Dead bodies should be removed as soon as possible.

m. Employment of 'Dog Squad' for search operation, if possible.

n. Arrangement of adequate doctors and medical assistants in the medical teams along with medicines in coordination with local civil surgeon, Red Crescent, and other organizations.

6.8.5 **Response Capacity**: **Manpower**

With regards to human resources, the 14 Independent Engineers Brigade has the establishment for 3,241 personnel of which there had been 2,589 personnel were in the posted strength. However, on the day of interview of Brigade Major, only 1,426

personnel were present, which is 55% of the posted strength. According to Brigade Major, generally 55-60% of the posted strength is available after catering for training, leave, sickness and detachments. Of them, about 1,000 personnel would be available for earthquake response operation as some personnel would be left for administrative and security jobs. However, as per AFD contingency plan, its manpower would be augmented by reinforcement from other army establishments. Though a brigade size force is supposed to join as reinforcement, truly, if required, more number of army personnel would be mobilized for this sector to meet any earthquake crisis as opined by its Brigade Commander. Thus it would operate with a total force of about 2,000 personnel in their AOR. In addition, its manpower is likely to get a boost with some enlisted volunteers, trained by Bangladesh FSCD. However, such reinforcement is subjected to their availability during such emergency. Importantly, 14 Engineering Brigade would get a Special Engineer Battalion with two SAR Companies to meet any disaster situation at Dhaka. This battalion is likely to boost the manpower strength by the first half of 2020.

6.8.6 **Response Capacity**: **Training**

With regards to training, 14 Independent Engineer Brigade arranges Situation Training Exercise (STX) on a quarterly basis where officers and troops are given a disaster situation (mostly earthquake) and the participants are judged on their timely arrival to the scene, their preparedness and their operational plan for the given crisis. Besides, in 2017, it has trained 32 operators of heavy SAR vehicles from other army installations and that database is maintained for meeting any earthquake response operation. Additionally, it has also regular training cycle on “Disaster Management” as per annual training programme where various “Plant” equipment are operated by the troops to keep them operationally ready on those heavy equipment. Otherwise, it regularly participates in the annual Disaster Response Exercise and Exchange (DREE) as jointly organized by Bangladesh and United States through Bangladesh Armed Forces Division (AFD). Importantly, a good number of operators have gained practical experience of working in different government construction projects managed by the Army. It is worth mentioning that the FTX of DREE-2019 was organized by this Brigade and this exposure itself has great training value. The area of operation for 14 Independent Engineer

Brigade is well known to its personnelas they had carried out some reconnaissance missions in the AOR and also because that they operate in the same area during peacetime.

6.8.7 **Response Capacity**: **Search and Rescue Resources**

The 14 Engineering Brigade is primarily the custodian of all SAR equipment provided by DDM. Importantly, it has its own heavy equipment for various SAR operations. Though the requirement of SAR equipment depends on the extent of earthquake damage, the 14 Engineering Brigade has little more than its required equipment. As the Brigade commander opined, it would be able to spare about 30% of SAR equipment to other operational sectors. In fact, all other operational sectors would be looking for SAR equipment from this Brigade but it does not really maintain equipment to give full support to others. Nonetheless, it would be able to pull some resources from other engineering battalions of Bangladesh Army but it would take considerable time to mobilize such heavy equipment. The Brigade would also coordinate with various civil sources working in the AOR and beyond to get some SAR resources. With respect to communication equipment the Brigade is self-sufficient to operate during any earthquake response operations in its own sector AOR. However, the compatibility of these SAR resources with those of other sectors was yet to be tested. Various earthquake response equipment held by different battalions of the Brigade is shown as Appendix XII. Besides, during the time of interview, it was supposed to get some more equipment from DDM.It is revealed from thisAppendix that this Brigade holds a good number of SAR resources and it would be able to spare some of its SAR resources for other sectors. With regards to vehicle, it is self-sufficient primarily for own movement and deployment. After deployment is over, it would be able to spare some of its vehicles for rescue operation especially for debris removal.

6.8.8 **Response Capacity**: **Other Material Resources**

With regards to medical resources, the Engineering Brigade has to depend on Bangladesh Army. It does not have any field hospital of its own but it would get some support from the Directorate General of Medical Services (DGMS) of Bangladesh Army. Nevertheless, this support would be too small to meet the requirement of the earthquake

victims. As such, it would coordinate with the local hospitals, clinics and diagnostic centers to facilitate medical support for the victims. Otherwise, this would be met by the DGHS, as expected. Accordingly, it would provide required administrative support to any medical team operating in its AOR. Regarding shelter materials, the Brigade does not really contain any material for the earthquake victims but it would manage shelter for 1,000 personnel in each battalion. Similarly, the Engineering Brigade does not possess any relief materials to give support to the earthquake victims. Nonetheless, limited support would be extended from its own stock only. In terms of distribution of relief material, it has full preparation.

6.8.9 **Response Capacity**: **Regulatory Frameworks**

The 14 Engineering Brigade would operate in its AOR as instructed by AFD, in the aftermath of earthquake. It has the SOD – 2010 and other documents as received from DDM to follow in this respect. It has also the copy of draft contingency plan as prepared by AFD. Most importantly, it has in possession the Standing Operating Procedure on "Structural Collapse" that was prepared by Bangladesh Army for DDM after the "Rana Plaza" collapse at Savar in 2013. It has also prepared a document (own SOP), which orients its personnel with the AOR and acquaints them with various facilities and infrastructures available in their AOR. Nonetheless, this document needs to be continuously updated to accommodate latest changes.

6.8.10 **Response Capacity**: **Financial Resources**

With respect to finance, the 14 Independent Engineering Brigade would be self-sufficient for own deployment and operation for about 15 days in the post-earthquake scenario as opined by its Brigade Commander. However, for any provisioning of financial assistance to the earthquake victims, necessary allocation is to be arranged from the government and other sources and the Brigade would be able to facilitate the disbursement of the same in its AOR. The Brigade has its own distribution mechanism of such fund following the normal chain of command.

6.8.11 **Capacity Need**

The perceived capacity need of the '14 Independent Engineering Brigade' is depicted in Table 46 below.

Table 46: Capacity Need (Gap) for 14 Independent Engineering Brigade

Category	Desired	Existing	Gap (%)	Measure	Gap Remains	Type of Gap
Manpower	2000	1000	50%	50% Support from other formation	Nil	'No'
Training	100%	80%	20%	Training to be conducted	20%	'Low'
SAR Equipment	100%	130%	-	30% Support to other sector	-	'No'
Other Material Resources for own ops	100%	90%	10%	Procurement needed	10%	'Low'
Regulatory Frameworks	100%	95%	05%	Revision of Own plan	05%	'Low'
Financial Resource for own operation	100%	100%	0%	-	0%	'No'

Source: Brigade Commander and Brigade Major, 14 Engineering Brigade

Note: Gap 1%-25% (Low Gap), 26% to 50% (Moderate Gap), 51% to 75% (High Gap) and 76% to 100% (Very High Gap).

6.9 **Border Guards Bangladesh (BGB): Sector- 8**

6.9.1 **Area of Responsibility (AOR)**

Border Guards Bangladesh (BGB) is responsible for Sector-8 for the earthquake response operation in Dhaka City as per Armed Forces Division (AFD) Draft Contingency Plan. This sector is comprised of areas under four police stations namely "Hazaribag", "Lalbag" "Kotwali" and "Kamrangirchor". The Sector Headquarter is located within BGB Headquarters at Pilkhana, Dhaka. Director Operation, BGB is primarily responsible to lead the earthquake response operation once BGB is called to do so. The area is a business hub with different kinds of whole-sale markets, factories and tannery industries making the AOR a crowded area. It is said to be a densely populated, age old and close spaced area where road networks are generally narrow that would render the rescue operation very difficult when there will be debris on the road out of collapsed structures.

6.9.2 **Important Features of the Area**

BGB has carried out a vulnerability assessment of different sensitive establishments of all the 4 Police stations under its jurisdiction. Accordingly, BGB has identified the major open fields and water bodies under its AOR. It has also made a list of important local leaders of all the four stations. Importantly it has identified all the major buildings that are apparently vulnerable. The list of open fields is given below.

a. Hajaribagh Police Station. The major open areas are Hajaribagh Park, Gojmohal Playground, Leather Eidgah College Field, Jorina Shikder Playground and Bosilah Playground.

b. Lalbagh Police Station. Important apen areas under Lalbag are Azimpur Govt. girls school and college ground, NoyaPaltan, Iraqi ground, Eden college playground, Shahidnagar haji delwar hossain playground, Nababganj park, Azimpur govt colony playground, Agrani girls school and college playground.

c. Kotwali Police Station. Mentionable open areas under Kotwali thana are Armanitola playground, Victoria park and Flood protection dam area.

d. Kamrangirchar Police Station. Ahsanmanjil field and Open area of flood protection dam are two large open areas under Kamrangirchar Police Station.

6.9.3 **Command and Control**

BGB is a paramilitary force under Ministry of Home Affairs. So, its command control lies with the concerned ministry. The DG, BGB is on deputation from Bangladesh Army. As such there would be any problem for AFD side to coordinate with BGB for earthquake response operation. The responsibility for earthquake operation is delegated to BGB HQ. As such, the overall command will lie with DG, BGB. BGB in turn, delegated the responsibilities of operation to different units as shown in Table 47. BGB forces will be grouped into 7 sub-sectors to work in four thanas (Police Stations) of Dhaka city during earthquake disaster. Each sub-sector will be commanded by an officer of the rank of Lt Col/Maj. The construction & EME branch and Border Hospital will be working as rescue and medical teams respectively.

Table 47: Operational Units of BGB and Demarcation of Area

Serial	Area (Thana) Concerned	Unit Responsible
01	Hazaribagh Thana	4 Rifle Battalion/Replacing Unit
02	Lalabagh Thana	20 Rifle battalion/Replaced unit
03	Kotowali Than	27 Rifle Battalion/Replaced unit
04	Kamrangirchar Thana	HQs BGB, Static Signal Sector, Record Wing.

Source: Draft Contingency Plan: AFD

6.9.4 **MajorPost Earthquake Responsibility**

As per the draft earthquake contingency plan of AFD, the major responsibilities of BGB are as follows:

a. Troops' deployment as per directives of concerned authority

b. Setting up of 'Earthquake Management Control Cell' at Thana level/ AOR.

c. Identification of victims and relocation to safe shelters (already earmarked during Pre-Earthquake phase).

d. Ensuring relief collection, carrying and distribution in affected areas.

e. Arrangement of medical teams for treating the victims after having a well-knitted coordination.

f. Arrangement of drinking water to arrest surge of epidemic diseases.

g. Establishment of relief centre in coordination with civil administration and preparation of relief cards for the victims at relief shelter.

h. Coordination with civil aid agencies for relief.

i. Information collection on relief goods, relief shelter, treatment facilities, affected people, crops, animals, and household etc and consequent distribution of relief according to the information collected.

6.9.5 **Response Capacity**: **Manpower**

With regards to human resources, BGB has two battalions (1,500 personnel) available. Of them, about 750 personnel (50%) would be available for Earthquake response

operation if there is no other special national commitment. Rest of the people would not be available for reasons like – normal administrative work, emergency leave and sickness. This 750 people would meet 50% of its desired capacity as opined by its Director Operations at the time of interview. However, it has two more battalions to come up shortly and to be positioned at Gazipur and Narayongonj, which would meet their manpower requirement for earthquake response. Until then, as per AFD contingency plan, its manpower would be augmented by reinforcement from Cumilla Sector (about 750 personnel for earthquake response operation). Thus it would operate with a total force of 1,500 personnel in their AOR. In addition, its manpower is going to get a boost with some volunteers, trained by Bangladesh FSCD.

6.9.6 **Response Capacity**: **Training**

With regards to training BGB has participated in a small scale exercise on earthquake response in 2004 that was held at Bangladesh Institute of Peace Support Operations Training (BIPSOT). Otherwise, it is participating in the annual Disaster Response Exercise and Exchange (DREE) as jointly organized by Bangladesh and United States through Bangladesh Armed Forces Division (AFD) on a regular basis. As part of its training, most of the key personnel of BGB were given orientation to its AOR. Thus the area of operation for BGB is well known to them and they had carried out some reconnaissance missions in the AOR.

6.9.7 **Response Capacity**: **Search and Rescue Resources**

The BGB HQ does not have mentionable search and rescue (SAR) equipment in their possession at the moment. They would receive some SAR resources from Comilla Sector on demand. Otherwise, they would coordinate various civil resources working in the AOR. Besides, it is expected to receive some rescue equipment through AFD as the situation demands. However, what type of SAR equipment they would get and by what number are not yet decided. With regards to communication equipment BGB is self-sufficient to operate during any earthquake response operation in its own sector. However, none of the communication equipment is compatible with equipments used by other sectors. In fact, there is no compatibility study carried out so far in this respect. BGB has one helicopter (Bell-212), which is given to BAF for operation and maintenance. However, two more helicopters are in the process of procurement. It has a

dog squad too. With regards to vehicle, it is self-sufficient primarily for own movement and deployment only. There is no vehicle available for rescue and response operation. However, once deployed it would be able to spare 50% of Truck 3-ton for removal of debris. It would also be able to spare at least 20 pickups for carrying injured personnel and for any other purpose. It doesn't have any fire extinguishing vehicle or (FIRE TENDER) of its own. The number of vehicles of the BGB HQ is appended in the table below.

Table 48: Number of Vehicles of BGB HQ

Type of Vehicle	Jeep	Pickup	Truck 3-ton	Total
Number	68	57	18	143

Source: Director Operations, BGB

The SAR task, as per AFD Draft Contingency Plan, that BGB would perform are as follows:

a. Making safe the collapsed and partly collapsed structures

b. Rescue the injured personnel from debris.

c. Road clearance for facilitating movement of transport and SAR operation.

d. Removal of debris to help road movement for people and transport.

e. Emergency electricity supply.

f. Arrangement of drinking water and its distribution.

g. Reactivation of important civil infrastructures.

6.9.8 **Response Capacity**: **Other Material Resources**

With regards to medical resources, the BGB HQ has its own 100-bed Hospital at the Pilkhana, Dhaka. It can offer round the clock medical services to its personnel with a total 41 (22 deputed from Bangladesh army + 19 Civil doctors) doctors and seven ambulances. In case of emergency, it can at best run one detached field hospitals for the earthquake victims to address 500 outdoor patients and 50 patients with surgical

requirement. Besides, it would be able to provide some administrative support to any medical team operating in its AOR. On the other hand, the BGB HQ does not also possess any relief and shelter materials to give support to the earthquake victims. However, it maintains sufficient materials for its own field deployment. With regards to relief materials to the victim, BGB considers that it would be given the responsibility of distribution of relief materials pouring from different sources including government.

6.9.9 **Response Capacity**: **Regulatory Frameworks**

The Border Guards Bangladesh HQ would operate in its AOR anytime AFD deems it necessary, in the aftermath of major earthquake. It has the Standing Order on Disaster (SOD) – 2010 to follow in this respect. It has also the copy of draft contingency plan as prepared by AFD. Again, it has also prepared a document (own SOP), which orients its personnel with the AOR and acquaints them with various facilities and infrastructures available in the AOR. However, the information, in most cases, is scanty and backdated and hence needs thorough revision. Importantly, many essential documents like National Disaster Management Plan: 2010-15, Disaster Management Act 2012, Dead Body Management Guide 2016 and etc were not found available with BGB during the time of data collection. As such, BGB needs to collect all documents published by the government with a view to regulating and bringing synergy in the earthquake response operation.

6.9.10 **Response Capacity**: **Financial Resources**

With regards to finance, BGB doesn't maintain any contingency money for meeting the requirement of earthquake response. However, it would be able to meet the operational expenses for their own cause during the response phase of about 10-15 days. Provision for financial assistance to the earthquake victims is to be made by the government or from any non-government sources. BGB would be able to facilitate the disbursement process in their AOR if it is asked to do so.

6.9.11 **Capacity Need**

The perceived capacity need of Bangladesh Border Guards (BGB) with regards to earthquake response is depicted in the table below.

Table 49: Capacity Need (Gap) for Border Guard Bangladesh-BGB

Category	Desired	Existing	Gap (%)	Measure	Gap Remains	Type of Gap
Manpower	1500	750	50%	50% Support from Cumilla Sector	Nil	'No'
Training	100%	30%	70%	Training to be conducted	70%	'High'
SAR Equipment	100%	10%	90%	10% Support from Cumilla	80%	'Very High'
Other Material Resources for own operation	100%	80%	20%	Procurement needed	20%	'Low'
Regulatory Frameworks	100%	70%	30%	Revision of Own plan & Collection of latest Policies	30%	'Mode-rate'
Financial Resource for own operation	100%	100%	0%	-	0%	'No'

Source: Director Operations, BGB

Note: Gap 1%-25% (Low Gap), 26% to 50% (Moderate Gap), 51% to 75% (High Gap) and 76% to 100% (Very High Gap).

CHAPTER VII: BASELINE CAPACITY OFOTHER STAKEHOLDERS

7.1 General

Earthquake response operations must be a coordinated effort from different stakeholders at different levels to secure synergy in operation and to ensure economy of effort. In the previous chapter, the capacities including the capacity needs of eight operational units, responsible for operating in eight sectors of Dhaka City, in the event of earthquake, have been discussed. However, it is well understood that there are many other stakeholders both in public and private sectors whose capacity would also matter in case of a major earthquake in Dhaka City. This chapter deals with the baseline capacities of various other stakeholders though the study of capacity gaps for them was not within the scope of this research. As such, efforts have been made to portray the existing capacity of some important stakeholders. The baseline information of different stakeholders only reflects the state of preparedness in that particular time and space when the study was conducted. Importantly, whatever information was disclosed to the researcher, form the basis of such baseline capacity. It would certainly differ from the findings of a study made in some other timeframe.

7.2 Bangladesh Meteorological Department

Bangladesh Meteorological Department (BMD) is the only governmental agency mandated with the responsibility of monitoring seismic observation in Bangladesh though different other institutions such as Dhaka University Earth Observatory (DUEO), Bangladesh University of Engineering and Technology (BUET) and Geological Survey of Bangladesh (GSB) also operate seismic monitoring networks separately. BMD has a number of stations installed with seismometers as shown in the table below. In 1954, BMD established first seismic observatory of Bangladesh at Chittagong and in 2007, it added three more observatories at Dhaka, Sylhet and Rangpur and also upgraded its Chittagong seismic observatory. Thereafter, gradually other observatories came into being. Identifying the location of epicenters of earthquake more accurately is the main motivation of establishing new seismic network. Importantly, BMD is planning to develop accelerometer network to measure intensity of earthquake at different places.

The Officer in Charge, Seismic Observatory and Research Center of BMD informed that two strong motion tri-axial accelerometers have already been installed at Dhaka station. One is installed on the ground and another on the top of the roof in order to measure the ground motion and also respective building motion. More so, Chittagong, Sylhet, Rangpur, Mymensingh and Comilla are also equipped with accelerometers to measure the Peak Ground Acceleration (PGA) value of those particular places. The 'Table 50' shows BMD Stations with Seismometer

Table 50: BMD Stations with Seismometer

Serial No	Station Name	Station Latitude	Station Longitude	Type of Seismometer
1	*Dhaka	23.78N	90.38E	BBS,BHS,SMS,S-60
2	*Chittagong	22.35N	91.49E	BBS,SPS,SMS
3	*Sylhet	24.90N	91.88E	BBS,SPS,SMS
4	*Rangpur	25.73N	89.23E	BBS,BHS,SMS
5	Panchagarh	26.35N	88.50E	BBS-GL-S120
6	*Mymensingh	24.73N	90.42E	BBS-GL-S120
7	Rajshahi	24.37N	88.7E	BBS-GL-S120
8	*Comilla	23.43N	91.18E	BBS-GL-S120
9	Khulna	22.78N	89.53E	BBS-GL-S120
10	Cox's Bazar	21.45N	91.97E	BBS-GL-S120

Source.: Earthquake monitoring network of Bangladesh Meteorological Department
* Stations fitted with accelerometer

As mentioned earlier, in the first phase, four broadband stations, Chittagong, Dhaka, Sylhet and Rangpur were completed in 2007. In 2016, another six broad-band stations were established by BMD in Panchagarh, Mymensingh, Rajshahi, Khulna, Comilla and Cox's Bazar. A Chinese company, Beijing Geolight Technology CO, LTD had done the up-gradation of BMD digital seismic network. With regards to early warning for earthquake incidence, BMD does not have any arrangement so far and it does not have any such equipment in the pipeline. Truly, there is no effective early warning system available in the market as observed by its Officer in Charge, Seismic Observatory and Research Center.

7.3 **SPARRSO**

Bangladesh Space Research and Remote Sensing Organization (SPARRSO) is an affiliated organization of Ministry of Defense in Bangladesh. It is primarily concerned with astronomical research and the application of space technology in Bangladesh and works closely with JAXA, NASA and the ESA in environmental and meteorological research. The peaceful use of space and remote sensing technology is its main objective. The SPARRSO deals with conducting research in space and remote sensing, forestry and environment, agriculture, fisheries, geology, cartography, water resource, land use, weather, geography, oceanography, etc. and thus plays an important role in aiding the Government and other related bodies with right research outcomes. The disaster-prone country of Bangladesh needs satellite-based technologies to reduce loss from various natural calamities. The SPARRSO could provide real-time or near real-time information regarding disasters to aid the Government to take necessary actions. However, at present the SPARRSO has some limitations and would not be able to provide the real-time information to the government for unfolding timely earthquake response operation.

With existing capability, the SPARRSO is not in a position to receive high resolution satellite images that can be used for damage assessment after an earthquake. Nonetheless, it enjoyed reception of satellite images from various famous satellites like MTSAT-2 of Japan, NOAA Series of USA, etc. but now it only receives the images of a Chinese satellite FY2 and these images are primarily meant for getting weather information. If the nation needs high resolution images for damage assessment, SPARRSO has to place the demand to local vendors who would supply the picture with a time gap of 2-3 days. So, no real time picture is available from the vendor too. Finally, the last option is to seek assistance from the international community especially the USGS and other sources. As such, for damage assessment in earthquake, one of the effective alternatives for satellite images would be pictures from drone as opined by a senior scientist and now Member (Technical) of SPARRSO. State of the art drones can give near real time pictures for effective use in a post-earthquake scenario. However, at the moment, the use of drones is controlled by CAAB and it is not in open use. Disaster management authority needs to have some drones with trained manpower for their efficient and effective surveillance operation, processing of data and interpretation of the

same for quick damage assessment to facilitate mobilization of SAR assets and relief materials in the critical disaster response operation.

7.4 **Armed Forces Division (AFD)**

Armed Forces Division (AFD), led by its Principal Staff Officer (PSO), is the coordinating body of three services (Army, Navy and Air Force) with Ministry of Defence and Prime Minister's Office. In case of an earthquake in Dhaka City, the AFD would play the most pivotal role, as part of overall national strategy, of unfolding the prime response operation as the Government calls for militaries in aid to civil power. As per the 'Comprehensive Guideline for Armed Forces in Disaster Management' to facilitate the deployment and operation of Armed Forces in Disaster Management, AFD would establish a monitoring cell primarily to coordinate with all concerned ministries including Ministry of Foreign Affairs, Ministry of Home Affairs, MoDMR, Ministry of Health, Ministry of Civil Aviation and Tourism and with friendly Armed Forces. To meet an earthquake contingency, AFD has already divided the whole Dhaka City into eight sectors and the responsibility of operation is given to different formations of the three services and BGB with defined role and task for each of them. Accordingly, a draft contingency plan for earthquake response has also been prepared in 2010.

As per the outcome of DREE 2015, AFD would activate various cells in response to a major earthquake like the Media & Information Cell, Medical Cell, Engineering Support Cell, Operation Cell, Logistics Cell, Communication Cell, Emergency Evacuation, Humanitarian Assistance Cell, Liaison Cell (DNCC, DSCC, MNCC, OSOCC), Air Traffic Movement Information Cell etc. Besides, AFD would also have components from Fire & Safety (Fire Brigade), SAR (ambulance), Medical/ Public Health (Health Hygiene), Utility Services (WASA, PDB, Gas, etc.), Public Security (Police, Ansar/VDP, BGB/BNCC), Volunteers (Scouts, Community Volunteers, etc.), Liaison Cell (coordination with the local administration), Public Works/ Engineering, Media, Logistics, Communication cell (including BTRC and representatives from different mobile companies), Relief Material Monitoring Cell etc.According to DREE-2015, the likely tasks of AFD in case of a major earthquake in Dhaka City would be as follows:

a. Mobilization of armed forces' emergency equipment

b. Coordination & control of activates of military deployed in the affected area

c. Identification of the sector-wise requirement

d. Conduct immediate need assessment

e. Distribute the emergency need to the affected areas

f. Maintain horizontal link with all stockholders

g. Plan and Execute the SAR operations

h. Coordinate/monitor the medical/health services

i. Monitor the relief services

For smooth operation, the AFD has to maintain horizontal coordination with various organizations like MoDMR, MoHA, MoFA, Services HQ, MNCC, OSOCC, DIMT (of DNCC and DSCC) and Information& Management Cell. With regards to communication, it is learnt that communication within and between the 3 services will not be a problem but with other agencies might be a problem due to difference in frequency or models of the equipment. However, there is need for standardization of the communication equipment within the military as opined by General Staff Officer–1 (Operations) of AFD. Besides, all the stakeholders should have at least a common platform of communication. Additional sets may be mastered from the services and handover to different HQ of cluster groups to meet the immediate requirement. However, a permanent approach may be taken to procure similar emergency wireless sets for the disaster management. In addition, different cluster groups may use their integral communication equipment for their internal use. Feasibility study to allot a designated frequency band may also be worked out.

The requisition and demand for foreign troops, if needed, would be placed through NDRCC. A second communication system will be utilized for regular communication with them after their arrival. Besides, the key personnel of foreign troops need to be accommodated in the operations center to facilitate smooth coordination during subsequent operations. The foreign troops would be asked to assist in SAR, emergency medical care, restoration of essential services, firefighting, emergency communication,

crisis decision-making, evacuation, protection of lives and properties, provision of emergency shelters for victims, debris removal, reestablishment of road and track communications, and for other specialized activities. The foreign military troops would be positioned in any of the following places with some forward bases:

a. Trishal (Mymenshing) Military Training Area

b. Somewhere around Savar cantonment area.

c. Ashulia, Diabari

With respect to training, AFD has great success through Disaster Response Exercise and Exchange (DREE). AFD has been conducting DREE, jointly with US ARMY Pacific (USARPAC), almost on a regular basis since 2010. However, MoDMR has also joined as one of the cosponsors of DREE from 2016. As such, it is now organized under the joint auspices of MoDMR, AFD and USARPAC. The main focus of DREE is earthquake since AFD has been entrusted with the responsibility of organizing annual drill on earthquake and other tasks of earthquake management. DREE has become very popular and effective training programme on earthquake in the region primarily because of its credibility with active participation of Bangladesh Armed Forces, FSCD, City Corporations, concerned Ministries, NGOs and other stakeholders. Though the objectives of DREE vary from one year to another, the common ones are as follows:

a. To enhance Bangladesh's ability of managing earthquake disasters.

b. To enhance knowledge and practice of international tools and services for integration of international systems into national systems.

c. Train divisional level planners/disaster coordinators (military and civilian) so that they can arrange similar exercise/training at divisional/local level.

DREE is generally an exercise spreading over five working days. First two days are dedicated for SMEE where speakers from across the globe speak to share their expertise, experience and views. Third day is for Table Top Exercise (TTX), which familiarizes the participants to the scenario and highlights their roles and responsibilities. Importantly, it refreshes the participants with basic functions like SAR, damage assessment, logistics, communication etc. On the fourth day, during the Field Training

Exercise (FTX), various concepts and plans are practiced and validated. Interestingly, for last couple of years, contingency plans of different sectors are being put into validation. For example, in 2017, the Contingency Plan of 6 Independent AD Artillery Brigade (Sector 3) was tested during the FTX. In 2018, DREE was not organized in Bangladesh. However, in 2019, the Contingency Plan of 14 Independent Engineers Brigade (Sector 7) was played during the FTX of DREE – 2019. This validation has got immense training value and it adds to operational readiness for the Unit whose Contingency Plan is under validation.

As the country faces major disaster, the National Disaster Response Coordination Group would submit recommendation to the Government for cooperation of Armed Forces and once Government directivesare received by the AFD for such assistance, Armed Forces are put into action. The procedure of Integration of Armed Forces is shown in the figure below.

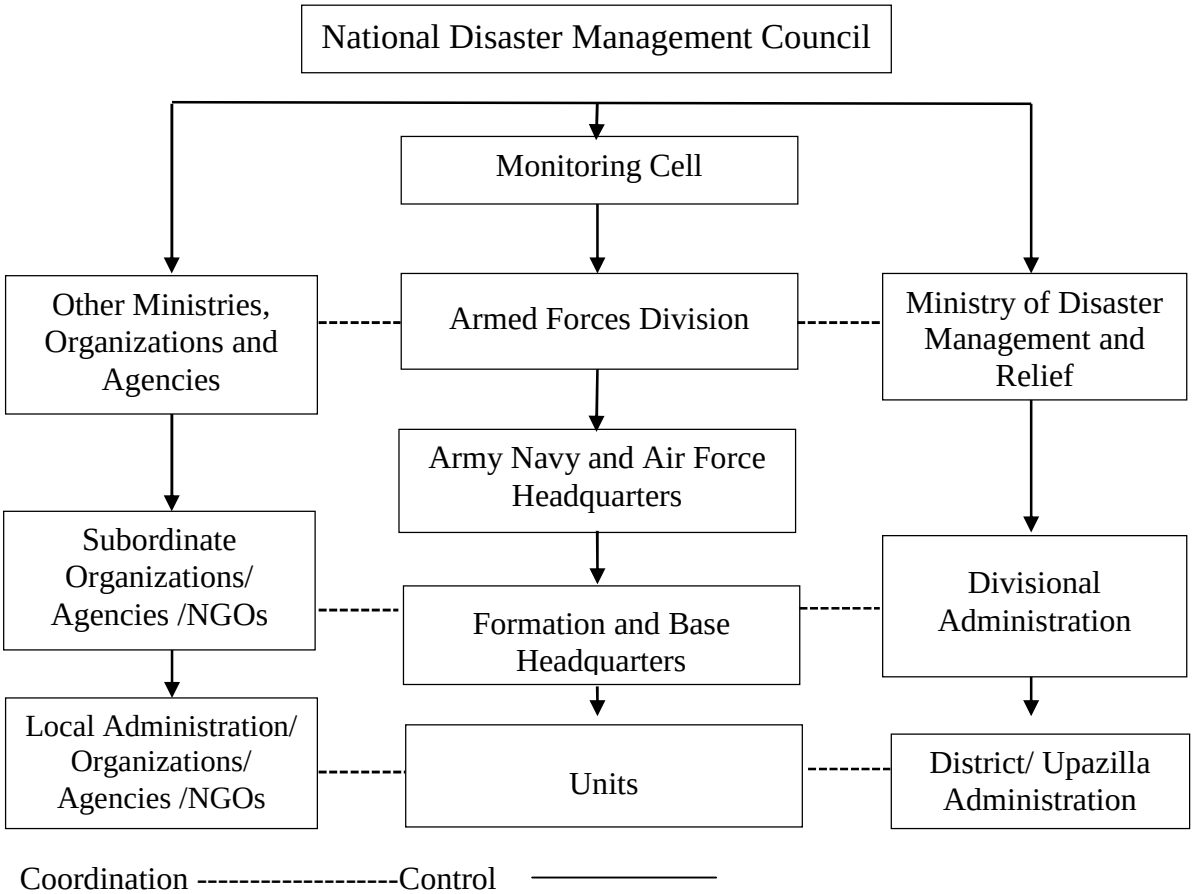


Figure 16: Procedure of Armed Forces Integration during any Disaster

Source: Comprehensive Guideline for Armed Forces in Disaster Management by AFD

7.5 **Dhaka South City Corporation (DSCC)**

The beginning of DSCC was on 01 August 1864 albeit in some other name. It was upgraded to a Municipal Corporation in 1978 and was given the status of a City Corporation (undivided DCC) in 1990. In 2011, DCC was bifurcated and DSCC came into being along with DNCC. DSCC has inherited 57 Wards and another 18 Wards are added after the Local Government Division issued a gazette notification on 26 July 2017. As such, DSCC has 75 wards now with a population of about 3.9 million as per 2011 census (BBS, 2011). The DSCC spreads over an area of 109.25 Square Kilometers with the inclusion of new 18 wards and there are 23 Police Stations under DSCC. It is to be noted here that these new 18 wards are yet to be included in the Draft Earthquake Contingency Plan of AFD. As far as earthquake response operation by DSCC is concerned, the priority tasks to be completed within 12 hours of the incident are as follows:

a. Establishment of EOC / Control Room with AFD & MoDMR.

b. Resource Mobilization: NDRCC.

c. Information & Communication: BTCL, Mobile Operators, Own Communication Set-up, Mosque, Religious Group Leader.

d. Emergency Security Arrangement: Civil Administration, Defense, Police & Ansar, BNCC, Scout, Community Police.

e. SAR: FSCD, Armed Forces, Police, Ansar, BNCC, Scout and etc.

f. Emergency Medical Support: DSCC Medical Unit, DMCH, Civil Surgeon and others concerned.

e. Emergency Water & Food: MoDMR, WASA, DPHE

On the other hand, the priority tasks those are to be completed within 24 hours of the incident include:

a. Media briefing

b. Resource Mobilization: NDRCC (To continue)

c. Information & Communication: BTCL, Mobile Operators, Own Communication Set-up, - Mosque, Religious Group Leader (To continue)

d. Preliminary Damage Assessment Team: WDMC

e. SAR: FSCD, Armed Forces, Police & Ansar, BNCC, Scout and Volunteers etc.

f. Gas Line Fire & Leakage Protection: TGTDCL, FSCD

g. Emergency Power: DPDC

h. Emergency Medical Support: DSCC Medical Unit, DMCH, Civil Surgeon and others concerned.

i. Emergency Water & Food: MoDMR, WASA, DPHE (to continue)

j. Removing Obstruction & Road Clearance: DSCC

k. Dead Body Management: Ward Disaster Management Committee, DSCC Medical Unit, DMCH, Red Crescent etc.

The initial damage and need assessment will be done by a team headed by the Chief Engineer of DSCC and comprising representatives from DC office, RHD, PWD, DPDC, WASA, BTCL, TGTDCL, RAJUK, WDMC, DDM, Red Crescent, INGO/NGO and UN agencies. Besides, the USAR Coordination Center (UCC) would be established with its head from AFD/Fire Service and representatives from AFD, Police, BGB, Ansar, BNCC, Scout, DSCC, BDRCS, DGHS, Volunteers, Technical Experts and Bangladesh Association of Construction Industry (BACI). Again, the Emergency Medical Team Coordination Center (EMTCC) would be organized with its head from the Ministry of Health or DSCC and representatives from Department of Health, BDRCS, Army Medical Corp, INGOs/NGOs, DSCC Health Department and Blood Banks like Sandhani, Quantam, Badhon etc. The DIMT would function under the leadership of its Mayor. It would be composed of representatives from DSCC, FSCD, Police, AFD, BGB, Ansar, BDRCS, WASA, Titas Gas, BTCL, DGHS, Urban Volunteers, Scout, BNCC, DPDC, BACI and other Technical Experts as shown in ‘Figure 17’.

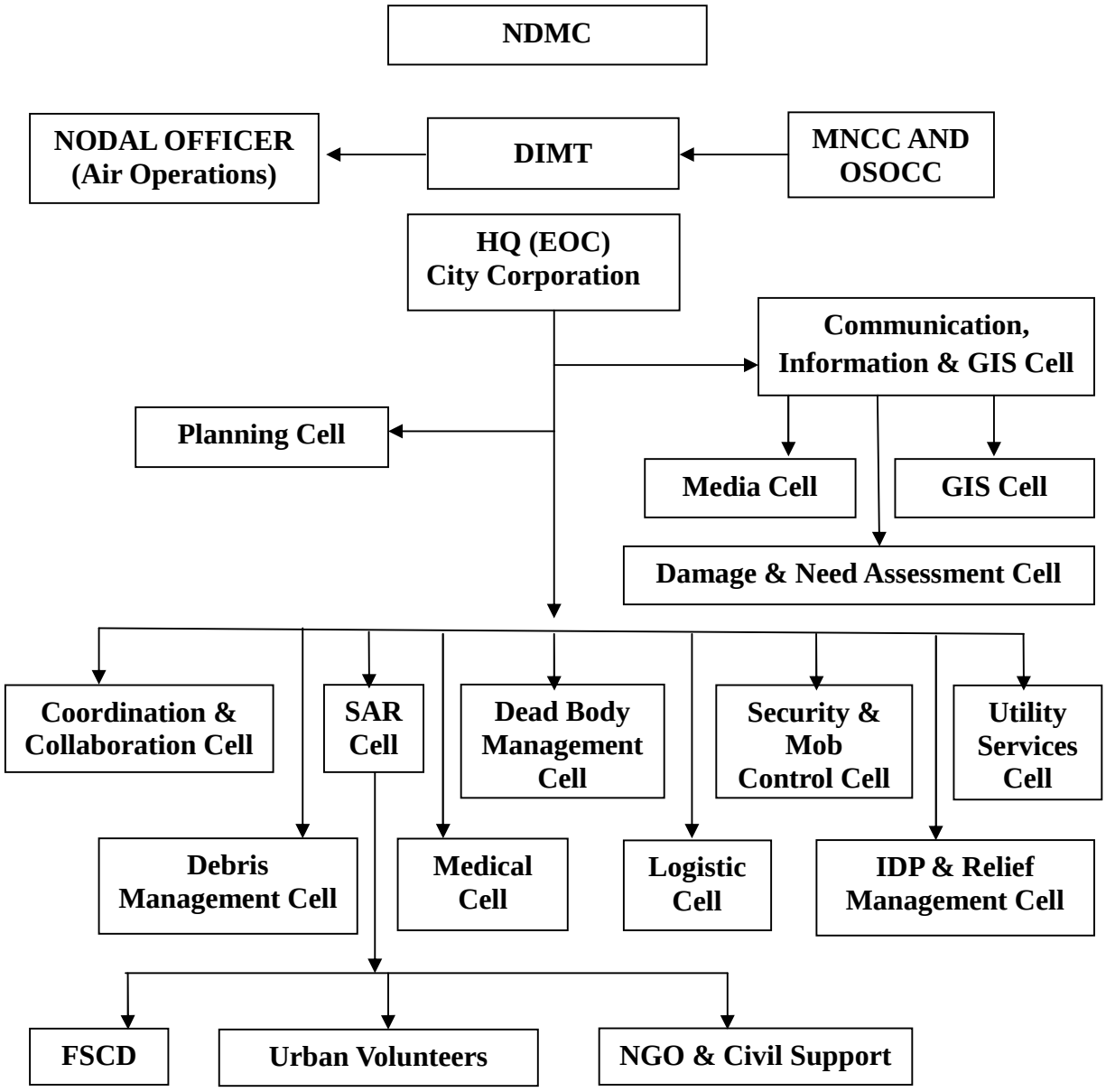


Figure 17: The composition of DIMT (DSCC)

Source: Chief Urban Planner, DSCC (DREE – 2019, 27 October 2019)

DSCC has no additional manpower catered for earthquake management. However, as per the organogram of 2016 it has an establishment of 2422 personnel to carry out routine works of DSCC. At the moment, 5216 personnel are working as cleaners in the business of waste management. This huge manpower would largely be used in earthquake response operation. It is needless to say that there would be thousands of FSCD trained volunteers to join the SAR effort. As per the SOD, the City Corporation Disaster Management Committee (CCDMC) will work in response to any disaster

including the earthquake. The CCDMC is comprised of 35 category members, where Mayor, DSCC is the Chairman.

With respect to regulatory frameworks, the actions of DSCC would primarily follow the contingency plan prepared for City Corporation. However, it would also follow the Local Government (City Corporation) Act, 2009; Disaster Management Act, 2012; Disaster Management Policy, 2015; National Plan for Disaster Management, 2010-2015; Standing Orders on Disaster, 2010; Disaster Management Rules, 2015; Bangladesh National Building Code, 2006; Dead Body Management Guideline, 2016. Besides, it has also prepared ward level contingency plans for 18 wards and the work is on for other wards. While preparing the Ward Contingency Plan, the content essentially includes ward profile with geographic location, boundary & area, its population – male, female & elderly, necessary training and capacity building at school level and volunteers, first responders in SAR operation, community based social volunteers, training and simulation for earthquake disaster preparedness in local areas, reporting and coordination mechanism, emergency route & open space for emergency evacuation, list of schools, colleges, park-playgrounds, graveyards etc., list of emergency medical healthcare centers& hospitals, inventory for available rescue equipment, food & nutrition in that area, risky buildings as identified by RAJUK and resettlement planning,vulnerability assessment for electric, gas, water supply, sewerage & drainage systems by relevant departments,and maps (social map, hazard map & resource map).

As far as training is concerned, DSCC has participated in large scale in the Disaster Response Exercise and Exchange (DREE)–2012 conducted on 19 September at the Armanitola Playground, Dhaka. The training was also participated by Armed Forces Division (AFD), FSCD, UNICEF, USAID, Foreign Armed Forces & 20 other Organizations. Besides, it has conducted a Disaster Drill on 12 August 2018 at the Nagar Bhaban (DSCC Headquarters). Importantly, it has been regularly participating in the annual DREE, organized by Bangladesh Government with US since 2010.

With respect to SAR resources, DSCC is getting prepared with equipment through Bangladesh Urban Resilience Project funded primarily by WB. The SAR resources being procured for DSCC is shown as Appendix XIII. The project includes innovations like early warning systems, new and improved SAR equipment, contingency communication

infrastructure. The DSCC has got following benefits from this project so far (Islam, 2019):

a. Warehouse for Disaster equipment and training built in Zone-2, 3 & 5.

b. Light and heavy equipment are being purchased for disaster management.

c. Emergency Operation Centre (EOC) is being established at Nagar Bhaban (DSCC Headquarters).

DSCC has a good number of vehicles for waste management and other purposes as shown in Appendix XIV. Some of these vehicles and equipment might be used for debris clearance purposes. In addition, more vehicles would be procured on rental basis to meet the emergency.

In terms of other material resources, the DSCC has 153 vaccination centers, 28 Primary Health Care Centers, and 5 Maternity Centers of its own. These centers would render medical services to the earthquake victims. On the other hand, it has also a good number of government and private hospitals in the area of DSCC. Importantly, it has 19 universities, 178 colleges and 328 schools &madrasas within the DSCC area which might serve as the temporary shelters to the earthquake victims.

7.6 **Dhaka North City Corporation (DNCC)**

As already discussed, DNCC came into being after the bifurcation of Dhaka City Corporation (DCC) in 2011 and is run by its Mayor. Like DSCC, the CCDMC will work in response to any disaster including the earthquake where Mayor is the head of the committee. In case of any major earthquake, the Mayor would convene emergency meeting calling all officers and ward commissioners to carry out the following tasks:

a. Situation assessment.

b. Immediate establishment of Emergency Operating Center in DNCC.

c. Deployment of corporation’s staff/volunteers/first responders in SAR.

d. Coordination of requests for medical Transportation/Ambulance.

e. Dead body management.

f. Coordination of requests for formal search & rescue by FSCD and AFD.

g. Coordination of requests for Medical Facilities through DGHS.

h. Coordination of requests for ensuring security in the affected area through Armed forces, Police and paramilitary forces.

i. Coordination of requests to utility service providing agencies for immediate restoration of basic services like water and electricity.

j. Coordination to establish field hospitals and medical operations.

k. Coordination of emergency appeals to the media for humanitarian help.

l. Coordination with DRR, NGOs/volunteer organizations for relief.

m. Coordination of activities for establishing temporary shelter and maintain sanitation and hygiene.

The City Corporation Earthquake Contingency Plan, SOD & the Local Government (City Corporation) Act 2009 are the foundations to unfold any earthquake response operation. However, it also maintains various other documents published by DDM and other agencies in this respect. Again, DNCC also feels that it should develop its own SOP afresh, delineate functional plans for all service providers and structure the WDMC. The capacity building of the agencies concerned is also a priority for DNCC (Yousuf, 2019). The DRR administration of DNCC is as shown in 'Figure 18' below.

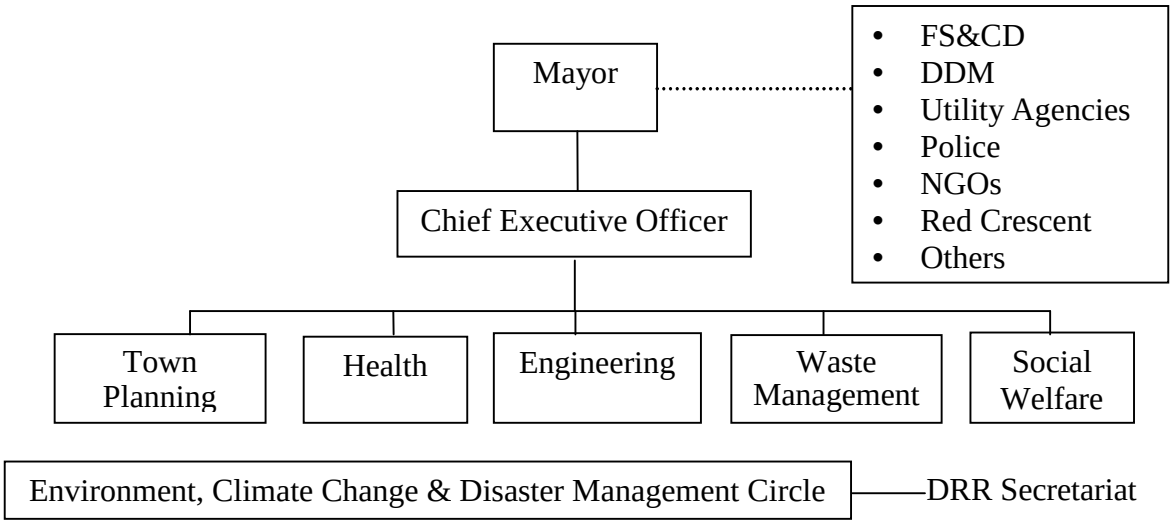


Figure 18: DRR Administration of DNCC

Source: Presentation of Project Director, URP in DREE, 2019

On the other hand, the zonal level disaster management committee is headed by Zonal Executive Officer as shown in 'Figure 19' below.

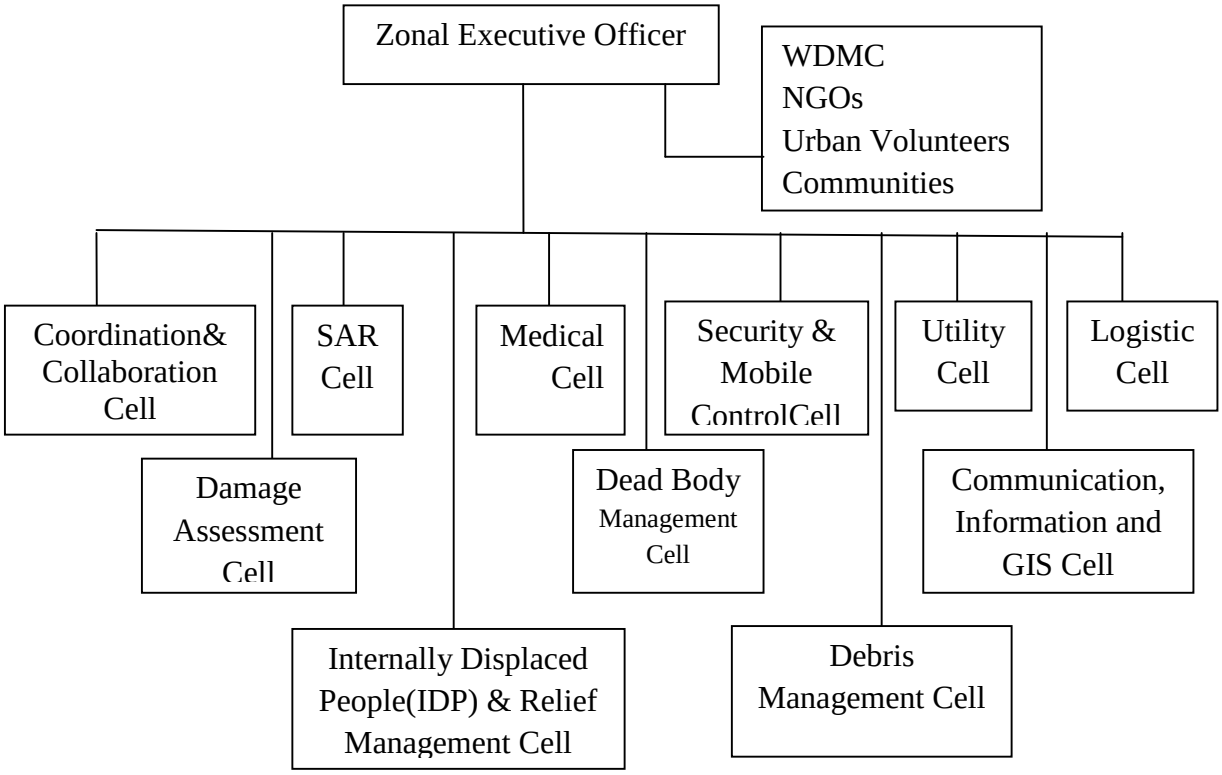


Figure 19: Emergency Management Team at Zone Level

Source: Presentation of Project Director, URPin DREE, 2019

The DIMT for DNCC would be composed of representatives among others from FSCD, Police, AFD, NGOs, BDRCS, WASA, DESCO, Titas Gas, BTCL, DGHS, Urban Volunteers, Scout, BNCC, Girl Guides, Blood banks like Shandhani, Quantum, Medicine Club and Anjuman-e-Mofidul Islam like the DIMT of DSCC as shown in Figure 17. The time for commencement of various activities at Ward level is as follows:

a. Within 12 hours: Establishment of EOC/Control Room, Information & Communication with all service providers, Ensuring SAR and Emergency Medical Support through DGHS and other private health services

b. Within 24 hours: Press briefing, Resource Mobilization, Preliminary Damage Assessment, SAR; Ensure Emergency Power services, Emergency Medical Support, Emergency Water & Food and commodity, safe evacuation, Dead Body Management and Clearing of road obstacles.

c. Within 36 hours: Information & Communication with BTCL, Mobile Companies., Own Communication Set-up, Loss & Damage Assessment through WDMC, Continue SAR operation, Restoration of utility services, Coordination with OSOCC, clusters, UN, I/NGO and media.

The initial damage and need assessment would be done through aerial survey by using drone/helicopter, agency-wise assessment report, feedback from local councilor and collection of secondary information from Govt. officials, print and electronic media. However, DNCC does not have any aerial platform to carry out damage assessment and it would rely on other agencies to some extent in this respect.

The DNCC has got some SAR resources from URP as shown in Appendix XV. As per DNCC's plan, the Urban Search and Rescue Coordination Center (UCC) would be established under the leadership of Ward Councilor by including Urban Volunteers and Fire Service & Civil Defence. On the other hand, the Emergency Medical Team Coordination Center (EMTCC) would be organized in the respective zone led by Assistant Health Officer. Yousuf (2019), in his presentation to DREE-2019, maintains that in line with Target 'e' of Sendai Framework i.e. "Making Cities Sustainable and Resilient: At the Local Level" various projects are in hand for capacity building of DNCC:

a. Urban Resilience Project (World Bank).

b. Capacity Building for Community-Based DRR in Urban Areas of Bangladesh

c. DRR Strategy & Action Plan of Dhaka City under International Cooperation and Development project.

The objective of USD173 million Project (URP) of the Government is to strengthen the response capacity of responsible agencies and to strengthen systems to reduce the vulnerability of future buildings. The project has three distinct domains as follows:

a. Develop City level disaster response system including incident command centre, transportation, rescue and communication.

b. Reduce the vulnerability of key public infrastructure such as hospitals, schools and transportation system through physical strengthening.

c. Integration of disaster risk into development planning, including better code and land use enforcement.

Besides, DNCC has got a good number of vehicles for its day-to-day waste management as shown in Appendix XVI. Mentionable, some of these vehicles will be used for debris removal in case of earthquake emergency.

7.7 **Directorate General Health Services (DGHS)**

Directorate General Health Services is the largest implementing authority under the Ministry of Health and Family Welfare (MOHFW) with more than one hundred thousand officers and staff members. So, it is the main body to ensure healthcare for the citizens of Bangladesh. One of nine aims and objectives of DGHS reads as "To ensure instantaneous emergency health care services in case of natural disaster". The word 'instantaneous' has special significance here because it leaves no scope to delay in rendering the healthcare services in case of disaster. Accordingly, the health Emergency Preparedness and Response (EPR) program of DGHS actively focuses on adequate disaster preparedness and quick responses. To meet such emergencies, two programs namely the National Health Crisis Management Center and Control Room (NHCMC&CR) of the DGHS and the WHO-supported Emergency Preparedness and Response (EPR) work in close collaboration. Importantly, DGHS, with technical assistance from World Health Organization, prepared the "Health Sector Contingency Plan for Earthquake Preparedness and Response" in 2011. This plan depicts the operating procedure in case of an earthquake emergency. Since DGHS is mandated for meeting any earthquake emergency at Dhaka, it is pertinent to study its baseline information in this regard.

The manpower situation in DGHS is found to be inadequate to handle operations during large-scale earthquake as revealed during gap analysis by DGHS in its Contingency Plan. Alam (2019) observes that Bangladesh lags behind in the ratio between patients, and their doctors and nurses; when compared to other neighboring countries. Accordingly, it falls behind, as compared to WHO benchmark, in maintaining the

minimum number of doctors, and nurses for every 10,000 population. The current doctor-patient ratio in Bangladesh is only 5.26 to 10,000 (1:1900) that places the country at second position (after Bhutan) from the bottom, among the South Asian countries, according to the WHO. The same report adds, based on findings of the leading British medical journal, 'The Lancet' that Bangladesh is improving and is currently ahead of Pakistan, India, Nepal and Afghanistan in providing access to quality healthcare to her citizens. The 'Table 51' below shows that 27.72% posts of different categories are still lying vacant against the approved strength of DGHS. On the other hand, how many of them are available at Dhaka City for operating in earthquake emergency is yet to be known. On inquiry, this data was readily available with the DGHS.

Table 51: Manpower State under DGHS

Category of the Post	Sanctioned Posts	Filled-up post		Vacant	
		Number	%	Number	%
Class I Doctors	25980	20,914	80.5	5066	19.50
Class I Non-Doctors	526	227	43.15	299	56.84
Class II (Excluding Nursing)	953	618	64.85	335	35.15
Class III	51246	36553	71.33	14693	28.67
Class IV	25038	16673	66.59	8365	33.41
Total	103743	74985	72.28	28758	27.72

Source: Health Bulletin 2018, DGHS

Now, how far the earthquake emergencies would be addressed from available doctors, nurses and other staffs of DGHS is again a question to be answered. It certainly depends on the severity level of casualties that would result from the earthquake as the Deputy Director Hospitals opined. The DGHS would take steps based on the injuries caused and attention required for them. In different earthquake case scenarios, the likely casualties in Dhaka will be as shown in Table 52.

Table 52: Likely Earthquake Casualties in Dhaka - different Cases

Time and Case	Severity Level of Casualties			
	Level 01	Level 02	Level 03	Level 04
2AM				
Case 01	152,307	50,905	9,028	17,884
Case 02	23,965	6,952	1,139	2,251
Case 03	110,753	37,265	6,671	13,216

Time and Case	Severity Level of Casualties			
	Level 01	Level 02	Level 03	Level 04
2PM				
Case 01	137,582	45,810	8,221	15,892
Case 02	32,021	9,433	1,572	3,021
Case 03	91,863	30,759	5,586	10,804

Source- Hazus calculation based on database, engineering geology and seismic hazard in Health Sector Contingency Plan for Earthquake Preparedness & Response, WHO, 2011.

Here various severity levels have following connotations:

a. Level 01: Injuries will require medical attention but no hospitalization.

b. Level 02: Injuries will require hospitalization but not life threatening.

c. Level 03: Hospitalization required, life threatening if not promptly treated.

d. Level 04: Victims are killed by earthquake.

In post-earthquake scenario, DGHS plans to run their proceedings in any open allocated space such as school grounds, open fields etc. by establishing remote centers to provide medical services. The number of such 30-man remote centers would depend on the injury by the earthquake. Required Manpower for each shift of such centre would include one Medical Officer, one Anesthetist, one Orthopedic Surgeon, one Medicine Expert, three Operation Theatre Assistant, four Medical Assistants, three Cleaners, three MLSSs, two Intensive Care Assistants, two Cooks, three Ward Boys, three Nurses, and three ambulances with drivers.Regarding medicines and hospitals supplies, presently DGHS maintains a central medical store depot (CMSD). Besides, only certain medicines are provisioned through local purchase. At present, there is no central buffer stock maintained by DGHS to cater for any emergency but it is a requirement as opined by Deputy Programme Manager (NCDC) of DGHS. While making procurement, DGHS always gives priority to procure medicines from Essential Drug Company Limited (EDCL), a government owned company while Intra-Venus (IV) fluids and Orsalines are taken from Institute of Public health.

The hospitals and their number of beds would be a critical issue in earthquake response operation. An assessment was made from the concerned office of DGHS about the number of beds available in major hospitals of Dhaka City. It was found that there are

about 18,600 beds in 26 major hospitals of Dhaka City as shown in Appendix XVIII. Nonetheless, there are many more like that in other hospitals, which were not taken into consideration in this study. For example, the earthquake contingency plan of Dhaka City Corporation (DCC) says that there were about 59,849 hospital beds available in Dhaka in 2009. With respect to training, EPR programme of the DGHS organized 381 training programmes of different kinds to train a total of 16,482 personnel in just four and a half a year of time as shown in the table below.

Table 53**.** Training organized by EPR program of the DGHS (January 2012-June 2016)

Activity	Sessions	Trainee
Workshop on comprehensive health-sector emergency preparedness and response for health and disaster management professionals	07	245
Training on public health risks and interventions in emergencies for health professionals	06	210
Training on prevention and control of post disaster communicable diseases for health professionals	04	140
Health cluster meetings	06	180
Training on risk communication for health professionals	02	74
TOT on emergency medical services for master trainers	03	110
Training on search, rescue and evacuation for community level health workers	03	105
Advanced training on psychosocial health for health professionals	02	68
Workshop on EPR and post disaster health management for doctors, nurses, paramedics and fieldworkers at Upazila Level	300	14,000
Training on health emergency preparedness and response for primary health care level physicians from disaster prone districts	48	1,350
Total	381	16,482

Source: Health Bulletin 2016, DGHS

7.8 **Customs**

In case of any mega-disaster caused by earthquake, as observed historically, international aid would mainly follow the air routesbecause of its faster reach across the globe. In case of Bangladesh, a great chunk of such support might come following land routes too. Accordingly, efforts were made to appreciate the customs formalities and capabilities of Dhaka Customs House in handling an earthquake disaster. Dhaka Customs House is entrusted with the responsibility of looking after the customs duties atHSIA.

As far as regulatory frameworks are concerned, it is gathered that in Bangladesh, customs formalities are implemented as per the provision by The Customs Act 1969. Time to time, National Board of Revenue (NBR) circulates some Statutory Regulatory Orders (SRO) to simplify customs process for particular items or gives exemption of custom duties for certain emergency item on national interest. From submission of Bill of Entry to delivery process, it is more or less automated wheremost of the documents are assessed at the Revenue Officer Level and ASYCUDA World System controls the assessment process. Now electronic Letter of Credit (LC) is also connected with this system. Importantly, every customs points such as sea, land, and air are connected with this automation system.

With respect to disaster customs procedure, the Dhaka Customs House did not have any policy readily available with them during the interview of key personnel on 02 January 2017. For granting any waiver for disaster response equipment or disaster relief goods, the concerned agency is the Intelligence and Auction Desk in NBR. If any person or organization applies for waiving tax duties for such humanitarian goods, NBR can waive this through proper approval from the concerned ministry. If some approval is promulgated, the custom house would follow the same to facilitate faster delivery of items. A standing policy, if made available, would better facilitate handling of emergency cargo during emergency period, Joint Commissioner, Customs house told while interviewed.

With regards to manpower, it is learnt that Dhaka Customs house has been suffering from acute shortage to maintain the shift duties. It is disappointing to note that it is running with only 46% (290 out of 632) of approved manpower. In a crisis like an earthquake, there would be requirement of more personnel to deliver the duties round the clock under stress. As such, it needs to augment its manpower immediately. Presently only 30 personnel works per shift, which is to be at least 50 per shift and the number of shifts also to be increased from present three to four. Thus the Dhaka customs house needs at least 150 personnel especially in the 2nd Class and Class III category as opined by its Joint Commissioner during interview on 02 January 2017. The Table 54below projects the shortage of manpower of Dhaka Customs House under different categories against their approved establishments.

Table 54: Manpower Details of Dhaka Customs House

Category	Approved Vacancy	Existing Manpower	Shortage of Manpower (No.)	Shortage of Manpower (%)
1st Class	63	50	13	20.7
2nd Class	261	132	129	49.4
Class- III	290	100	190	65.5
Class- IV	18	08	10	55.6
Total	632	290	342	54.2

Source: Customs Commissioner (08 Jan 2017)

The following 'Figure 20' presents the category-wise shortage of manpower in the Dhaka Customs house in graphical form.

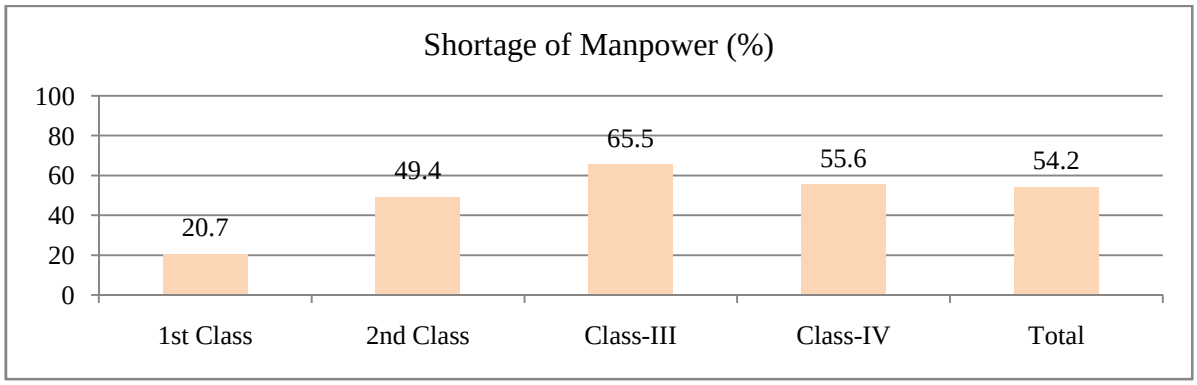


Figure 20: Category-wise Shortage of Manpower

Like the shortage of manpower, the Dhaka Customs House also suffers from shortage of basic operational equipment (Table 55). To meet the emergency requirement in case of earthquake, more communication equipment would be required. When interviewed, one Assistant Commissioner opined that they need at least one vehicle-mounted scanner and three more baggage scanning machines for smooth operation. Besides, they would also require another 45 walkie-talkie sets.

Table 55: State of Operational Equipment at Dhaka Customs House

SL	Name of the equipment	No of Equipment	Remarks
1	Baggage Scanning Machine	06	Needs to be augmented immediately
2	Walkie-Talkie	66	
3	Weighing Bridge (1 Ton)	02	
4	Metal Detector	10	
5	Base Station	02	

Source: Assistant Commissioner, Dhaka Customs (as on 07 April 2016)

During the interview period, there was no manpower available with Dhaka Customs House, who has training experience on disaster management. Proper training on this vital subject should be arranged immediately to train a good number of officers irrespective of their posting as opined by Joint Commissioner Customs. There was no specific Training Manual and documents available with Dhaka Customs on emergency handling. The important point to note is that there is no reserve store house for keeping relief goods. However, there is a warehouse maintained by Biman Bangladesh Airlines with limited capacity only.

7.9. **Immigration**

It is needless to say that there would be a flow of rescue workers, medical workers, journalists and other professionals from across the globe to assist countries efforts for earthquake response. Historically, these people are stopped in the port of entry to complete their visa formalities. Presently, many countries enjoy on arrival visa in Bangladesh and they would not face much difficulty to get their visa issued by Immigration authority. However, there are many countries for which on arrival visa provision is not available and for them a waiver would be required from the Security Services Division of the Ministry of Home Affairs as opined by OC, Immigration, HSIA on interview.

7.10 **Biman Bangladesh Airlines**

During any large-scale emergency relief operation, goods and personnel comes from across the globe to the country in distress generally following the airport. Thus ground handling capacity, cargo handling capacity, cargo storage and aerodrome facilities are very vital in the aftermath of any disaster when donor agencies and friendly countries send relief goods, rescue personnel and other aid workers with heavy equipment at times. Functioning of Biman Bangladesh Airlines is very important in any post-disaster scenario since it is the only Cargo and Ground handling agent at HSIA.

With respect to ground handling services, it is gathered that the equipment meant for cargo handling are part of Ground Support Equipment (GSE). One Deputy General Manager (DGM) heads this business under the supervision of General Manager (GM), GSE under the Directorate of Flight Operations. The list of major GSE that supports

ground handling of both outgoing and incoming aircraft is appended in the Table 55 below. Mentionable that Biman has procured a good number of GSE in the recent past and is in the procurement of more equipment by 2023 as already approved by its Board of Directors. Accordingly, a comparison is projected in the Table below.

Table 56: State of Major Ground Support Equipment (BIMAN)

Ser No	Name of the Equipment	Available on 05 Sep 16	Available on 20 Nov 19	By 2023 (Approved)
1	General Power Unit (GPU)	20	21	33
2	Start Cart	05	06	09
3	Air Conditioning Unit	05	06	11
4	Push Back Tow Tractor	12	12	16
5	Tow Tractor (Baggage)	35	47	57
6	Water Cart	05	07	11
7	Flush Cart	04	05	09
8	Container Pallet High Loader	16	17	28
9	Crane	01	01	02
10	Container Pallet Transporter	12	17	07
11	Belt Loader	12	17	25
12	Fork Lift	09	12	17
13	Narrow Aisle Stacker	04	16	16
14	Catering High Lift	11	10	10
15	Ambu-lift	02	02	05
Total Number		153	196	256
Increase in General from 2016		-	28%	67%

Source: DGM, GSE on 05 Sep 2016 and 20 Nov 2019

There was no large forklift to offload cargo coming in containers in 2016. However, one 10-ton capacity forklift has been procured in 2017. There is need for procurement of 20-Ton forklift to make such provision, which is already approved by the Board and Biman would receive it by 2020. Personnel need to be trained for the operation of such heavy duty forklift in sensitive 'Cargo Handling Area'. Accordingly, training is being arranged regularly to meet IOSA standard. Some of the GSE like forklift and trolleys can be operated by members of the armed forces or other volunteers but after with a minimum of 3-day training.

The specialized business of cargo handling needs trained manpower. For offloading one cargo aircraft (747,777, AN 124 etc.) – minimum 08 persons are required. If the Auxiliary Power Unit (APU) of the cargo aircraft is unserviceable, another 5 persons are required to operate various support equipment like start cart, trolley, GPU etc. In each shift of 8 hours, 40-45 personnel work and there are 4 such shift groups. Three shifts cover the day and one shift enjoys off duty. However, the shortage of manpower is met by employing people on overtime duty but in case of strenuous work environment they cannot work days together on such overtime duties. Total manpower requirement is about 200 to run 4 shifts (4X50 = 200) with another 100 personnel for admin, maintenance and planning. However, if personnel are not put on overtime, another 100 personnel is required to make the total 400. During emergency like earthquake response, if one passenger flight runs per shift, maximum 4 cargo aircraft can be offloaded per shift with present manpower strength. So, with three shifts in a day, maximum 12 cargo aircraft can be offloaded. If shift personnel are kept for doing overtime duty then maximum 20 cargo aircraft can be offloaded per day. Such surge capacity can be for a period of maximum 10 days only.

Reinforcement ofmanpower from other stations like Sylhet and Chittagong is possible to a very small extent only. Sylhet has 10 people and Chittagong has 16 people from which maximum 6 personnel (25%) can be brought to Dhaka to allow their own operation to go unhindered. Reinforcement from civil airlines is possible to some extent but they operate push carts mostly. Importantly, the personnel working in private airlines are mostly the retired GSE personnel of Biman. With these reinforcements another 4 cargo aircraft (total make the total 24 aircraft per day) can be offloaded provided the manpower detailing plan is well drafted and judiciously executed. Personnel from armed forces especially from air force can be used to some extent but they should at best be deployed to clear the cargo from the ‘Cargo Area’ to facilitate subsequent offloads.

7.11 Civil Aviation Authority of Bangladesh (CAAB)

The Civil Aviation Authority of Bangladesh (CAAB) is responsible to facilitate air operation from and to the airports of Bangladesh. In case of any major earthquake over Dhaka City, the CAAB has to regulate the air movement to maximize the relief

operation. As such the various facilities of CAAB that would determine the success of response operation to a great extent have been studied.

a. Navigation (NAV) Aids. There are two VHF Omni-directional Range (VOR) at HSIA which covers round the clock service with each operating for 12 hours to provide primary navigational service. Besides, there is one Non-Directional (radio) Beacon (NDB) as a secondary means. It also has Delta Alpha Navigation system, Air Traffic Service (ATS) Radar, ground equipment for Instrument Landing System (ILS) and importantly, the GPS aided area Navigation (RNAV) facilities to aid safe landing. However, the up-gradation issue of ILS system is still pending. Present ILS Category does not permit Instrument Landing with zero visibility. As such, in case of an earthquake occuring in Winter Season, morning flights might be compelled to divert to alternate airport like Kolkata or Bangkok. Such diversion will have serious impact on supply chain management of relief and SAR goods. On the other hand, the RNAV Approach is a method of IFR navigation utilizing GPS that enables a pilot to guide his aircraft to a landing in low visibility situations. Instrument flight rules (IFR) is one of two sets of regulations governing all aspects of civil aviation aircraft operations; the other is visual flight rules (VFR). There is no standby navigation equipment but since there are many alternatives navigation aids available with HSIA, it is expected that the air operation would go smooth even in the aftermath of earthquake at Dhaka city. The Tejgaon Airfield does not have any NAV aids of its own. The NAV aids of HSIA would serve primary purpose but thereafter the aircraft are to follow Visual Flight Rules (VFR).

b. Air Traffic Controllers. At present there are 24 active controllers in ATS of HSIA. Considering off duty, leave, sickness, training etc. only 12 are available on any day to perform 3 shifts of duties (considering 4 controllers in each shift). At the moment the controllers are just managing the show. There are another 15 controllers positioned in Dhaka but not doing professional duties. They, however, maintain their category. They can be pulled back for normal controller duties but since they are not in day to day operation, they would not be able to sustain the stress of strenuous duties under crisis situation. Besides, there

are another 8 Dhaka–Rated controllers posted at Chittagong and Sylhet who can be brought back to Dhaka but that would affect the operation from those airfields. In case of emergency like earthquake in Dhaka city, the amount of flying and consequent stress would be increased. Besides, additional controllers would be required for exercising caution in the ground too. Again, as per the assumption that 10% manpower would quit their duties to look after their own families in distress, at least 12 additional controllers need to be added in the strength. To supplement the strength of the civil controllers, Bangladesh Air Force (BAF) can contribute at least 4-6 controllers to maintain a shift at HSIA but in coordination with civil controllers there. BAF has a pool of 18 controllers available who are Dhaka-rated. Such sparing of controllers would not impact the normal Search and Rescue (SAR) missions and normal flying operational/commitment flying by BAF.

c. Airfield Capability. The Pavement Classification Number (PCN) of the airfield is 116 and the airport category is 4E as per ICAO standard. The only airfield at HSIA is 10,500 feet long and capable of allowing landing of large aircraft like 747-400, Boeing 777-300 etc. However, Airbus – 380 can't land because the runway requirement for the same is 11000 feet. At present a total of 200 aircraft lands/takes off in 24 hours with limited military flying. In case of emergency, if jet flying by BAF fighters is kept withheld, a maximum of 300 landings/takes off could be accomplished. In any particular hour, to ensure highest safety allowance, not more than 20 aircraft can be accommodated to land/take off.

d. Parking Area. At present, HSIA can allow parking areas for 28 aircraft of which 14 can be wide-bodied ones like Boeing 747-400, Boeing 747-800 (Cargo Version), Boeing 777-300 etc. These 28 parking area includes 8 boarding bridges too. Rest 14 should be medium/small aircraft like Boeing 737, Dash – 8, ATR-72 etc. On extreme emergency, one of the taxiways can be closed and used for parking of another 3 aircraft.

e. Firefighting Capability. The firefighting capability of HSIA is Cat-9 type as per ICAO. ICAO holds that Category – 9 must have minimum 24,300

liters of water in the fire vehicles and there must be at least three vehicles to have this total capacity. On the contrary, HSIA maintains a capacity of 26,000 ltrs with three vehicles (10,000+10,000+6,000). Two additional fire tenders are lying unserviceable. However, in case of emergency support, BAF extends fire tender support to meet any fire emergency.

f. Training on Emergency Management. To meet the ICAO requirement, one emergency drill is conducted involving all emergency actors including BAF.

g. Use of Existing Hangars. At present the largest Hangar is used as the maintenance hangar for Biman. Besides, there are 9 medium sized hangars that are occupied by Meghna Aviation, Arirang, R&R Aviation, Square Aviation, South Asia (Aero Tech), Bangla International, MAF Air, Tresco and Bangladesh Flying Academy. In the proposed expansion plan, third terminal building is likely to come up for which these hangars would be shifted to the extreme northern side.

h. Rapid Runway Repair (RRR) Capability. HSIA does not have any Rapid Runway Repair capability of its own. In case of any crater caused by earthquake or major repair required due to sustained operation, the airport authority has to fall back to private contractors. Presently some vendors does this kind of repair work.

i. Cargo Area. There is a big cargo shed, which is generally used as the space for “Export Cargo”. On the other hand, the area for ‘Import Cargo’ is practically the open tarmac area. At present 12 aircraft (09 from United Airways) are lying stranded in the open space occupying the invaluable maneuvering space, which could be used for keeping incoming cargo. However, there is inadequate shaded cargo space at HSIA.

j. Expansion Plan. The CAAB has undertaken a mega-project for the massive expansion of Terminal facilities at HSIA. However, this mega project, primarily financed by JICA would be completed in phases as informed by the concerned Project Director (PD) on 12 December 2019. The Honourable Prime

Minister of People's Republic of Bangladesh has formally inaugurated the expansion work on 28 December 2019 and the first phase of work would be completed by 2024. As the expansion work completes, the PD adds, the HSIA will have another 12 Boarding Bridges to make the total number 20 to handle another 12 million passengers per year in addition to existing capacity of handling 8 million passengers per year. In the subsequent phases another 14 Boarding Bridges would be provisioned to facilitate travel of more number of passengers to and from HSIA. Importantly, the Cargo village would be expanded substantially to accommodate additional 500,000 MT of export Cargo and 250,000 MT of Import Cargo. This huge cargo area would facilitate storing of emergency relief cargo and other SAR equipment after offloading from the cargo planes. Besides, the runway length would also be increased to 12,000 feet from existing 10,800 feet to facilitate landing and takeoff of larger aircraft. The addition of Tarmac (apron) area would be about 230,000 square meters to facilitate parking and maneuvering of more number of cargo and passenger planes. In a nutshell, the overall capacity of HSIA would get a boost by 150%. However, there is no provision of Humanitarian Staging Area (HSA) in the third terminal project.

7.12 **Bangladesh Fire Service and Civil Defence (FSCD)**

Bangladesh Fire Service and Civil Defence (FSCD) is one of the first responding government organizations, which remains alert 24 hours a day for the management of any disaster including earthquake. Its mission is to protect and save lives and properties for a safe and secure Bangladesh. As per DG FSCD on 10 October 2017, it has 328 stations across the country. However, with completion of some ongoing projects, the number of fire stations would rise to 552.

Bangladesh FSCD has a total of 8516 personnel in its strength to operate across the country (as on 10 October 2017). However, with completion of some ongoing projects, the number of manpower would stand at 15,000 (approximately). Again, for operating in post-earthquake phase in Dhaka City, its working manpower is likely to be augmented by another 18,200 volunteers as 200 volunteers are earmarked for each 91 wards of Dhaka City Corporations. As the ward number increases, the number of such volunteers

would also increase @ 200 per ward. FSCD already has trained 40,000 urban community volunteers. Importantly, FSCD has developed USAR team following the guideline of INSARAG.

On the date of interview, the FSCD of Bangladesh had 8 Medium USAR team and 12 light USAR team consisting of a total of 300 Regional Level Master Instructor & Rescuer on USAR. DG FSCD also outlined the concept of operation of FSCD, in general (Figure 21). The figure below shows how it functions after receiving a disaster call from the community. This simple and self-explanatory diagram shows how all out efforts are made to concentrate resources from all available sources in case the disaster is huge in nature (Earthquake for example).

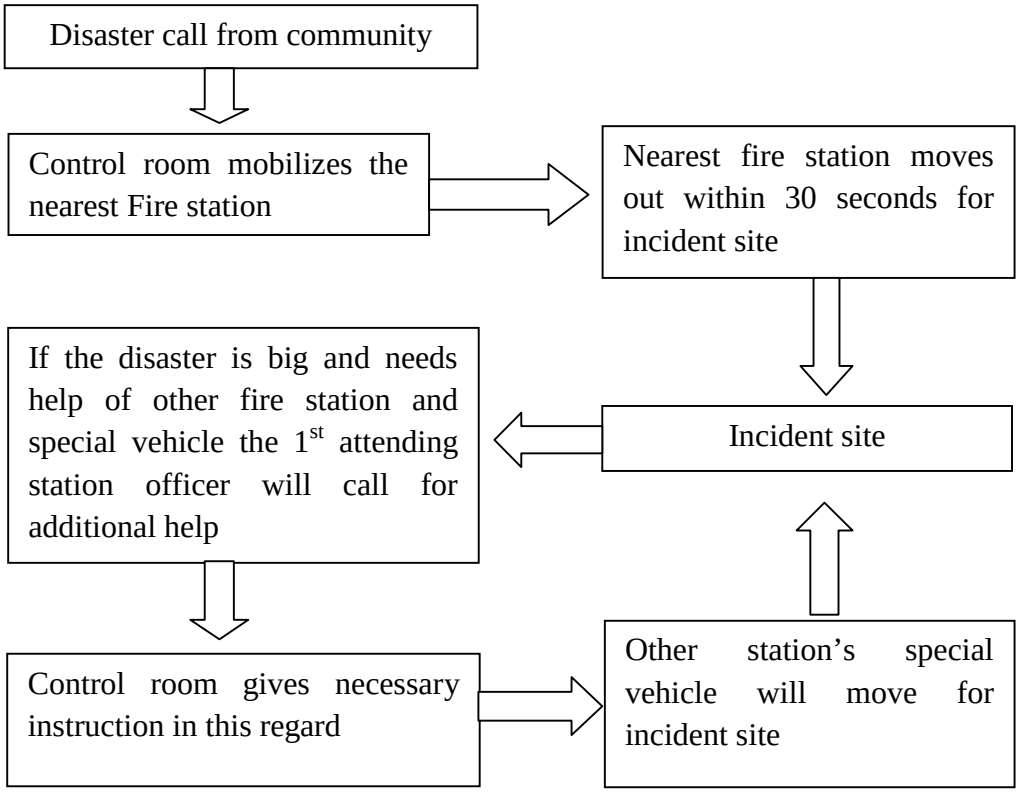


Figure 21: Concept of Operation of FSCD

DG, FSCD of Bangladesh, during DREE-2017, has outlined how the strength of firemen would be boosted up by community volunteers in SAR operations. The figure below (Figure 22) shows how a group of 43 personnel consisting of only 3 Firemen and 40 Volunteers would form two Search teams, two Rescue teams and one First Aid team to operate during any emergency situation. It is evident that one fireman would guide and

lead two Search teams; another fireman would guide and drive two Rescue teams and the third fireman would lead the First Aid team.

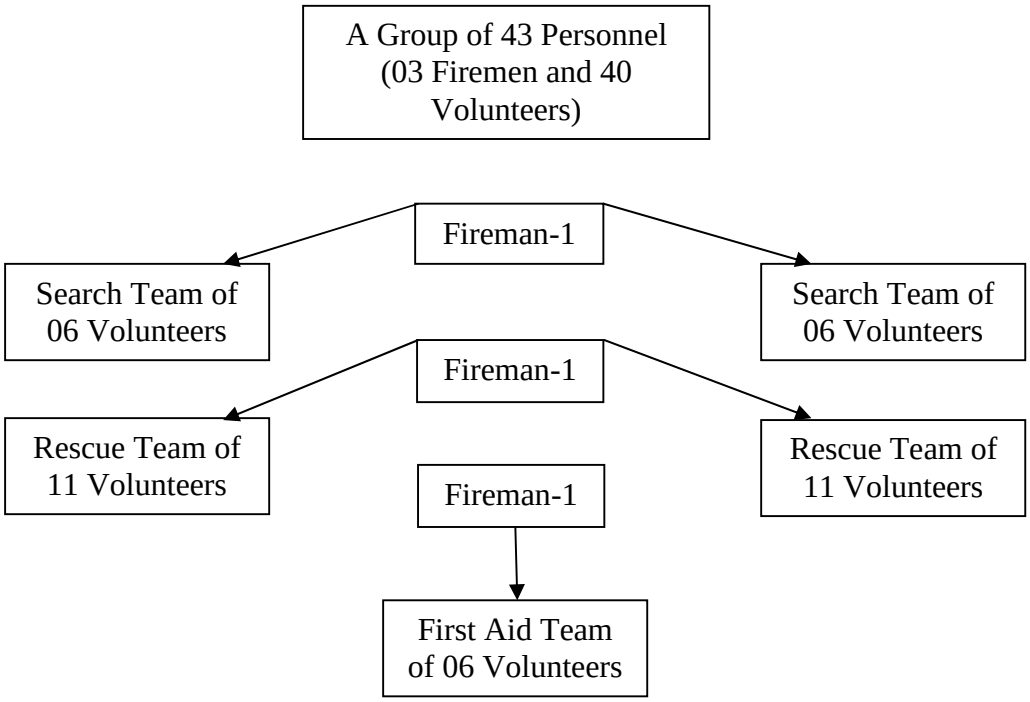


Figure 22: Operational Procedure of Community Volunteers

As already mentioned, there are 18200 urban volunteers earmarked for 91 Wards of Dhaka City with 200 volunteers per ward. The Senior Staff Officer, FSCD has confirmed that these volunteers have already been issued with personal protection gears and operation dress. These volunteers would report to nearest fire stations or straightway to the incident place. So, roughly 200 volunteers are expected to join the DM activities per Ward. Any volunteer leaving a station reports to his concerned fire station and accordingly, his name is discarded and a new volunteer fills that place. Generally, the maximum age of volunteers is forty. However, local elites can join without any age bar.

Training in Bangladesh FSCD is a routine affair primarily to enhance its operational excellence. It always endeavours to keep its personnel trained as far as possible despite having resource constraints. The personnel of FSCD have received various types of specialized training from abroad. Some of the important training courses completed by them and concerned with earthquake response operations are as follows:

a. Structural fire fighting

b. Fire investigation

c. Fire Inspection

d. Hazardous material training

e. Medical First Responder

f. Collapsed Structure SAR

g. Bomb Disposal training etc.

During last couple of years (2011-2014), a total of 835 personnel of FSCD received different training as projected in the Table below.

Table 57: Training Received by FSCD Personnel

SL No	Name of the training course	Number of Trainees			
		2011	2012	2013	2014
01	Firefighting, Rescue and nursing the injured	87	23	46	74
02	Medical fast responder	48	24	-	-
03	Special fire fighting and rescue	50	-	50	761
04	Collapsed structure, Search and rescue	93	-	-	-
Total		78	47	96	835

Source: Agni Protirokhya: Fire Service and Civil Defence Week 2016

The SSO, FSCD observes that the manpower and other resources are certainly inadequate to address all incidents and accidents where Bangladesh FSCD would operate as per its mandate. However, efforts are on to secure continuous improvement in all concerned fields for capacity enhancement. Nonetheless, the areas where improvement is much needed are as follows:

a. There is no dog squad for Bangladesh FSCD at the moment.

b. Compatibility of equipment especially the communication equipment is not tested yet. So, communication with other services especially with armed formed might not be smooth.

c. Sufficient liquid fund for each station and for the Headquarter is required. For SAR operation in the post-earthquake scenario it would be required.

d. Training budget is still inadequate. Capacity building training with respect to fire-fighting, SAR, first aid etc. need to be strengthened.

e. Maps and charts of the operational area especially that involves utility services like gas, water, electricity and telephone are not readily available. Importantly, most of them are old and needs updating.

f. Water refilling points across the city area of Dhaka are inadequate. Most of the high rise buildings do not have the provision of water hydrants/reservoirs.

DG FSCD, on the other hand, has highlighted following developments that would lead to enhancement of their capacity for earthquake response in Dhaka City:

a. More than 500 FSCD personnel have received advanced training from Malaysia, Thailand, Singapore, China, Korea, Japan, India, USA, Germany and UK (2014 to 2017).

b. Modern rescue equipment worth TK 200 crore has been procured. Department of Disaster Management(DDM) has provided 250 sets of rescue equipment to FSCD. In addition, Asian Disaster Preparedness Center (ADPC) has provided 36 set of rescue equipment to FSCD.

c. Government has allotted 17 acres of land at Purbachal to establish a modern Fire Academy.

d. A new HQ Building (10 storied) of FSCD will be constructed and 10 other risky fire station building will be retrofitted by JICA (One already done)

e. KOICA will build an EOC for FSCD. Besides, the World Bank is providing rescue equipment to FSCD and constructing warehouses for the same.

f. China has provided 100 vehicles, 50 Ambulances, 150 fire fighting motor cycles and other rescue equipment to FSCD as grant.

Various Challenges as identified by DG FSCD in 2017 and the ‘Way Forward’ for the same are appended in the table below (Table 58).

Table 58: Challenges and Way Forward of Bangladesh FSCD

Challenges	Way Forward
Up-gradation of contingency plan of all Stakeholders	Contingency Plan to be upgraded and tested by practicing on ground
Better Communication & Coordination among stakeholders	- Establish NEOC with Disaster Resilient Communication System and Maintain Database of Resources of Stakeholders in NEOC
Enforcement and compliance of BNBC	Establish Building Regulatory Authority (BRA) for monitoring & enforcement of BNBC
Revision and update of Acts, Rules & Regulations	Policy for the revision of Acts, Rules & Regulations after certain time and big incidents/disaster
Implementation of SOD on ground	- Regular Exercise on SOD, Revision of SOD on need basis and making all stakeholders aware
Existing Risky Buildings in old Dhaka area	- Identify & Demolish Risky Buildings, Retrofitting & Rebuilt of the vulnerable buildings on priority basis and Implementation of Land Use Plan
Building Construction in Seismic Zones	- Policy Formulation on Seismic Design of buildings
Sustainability of Community Volunteers	-Institutionalization of Community Volunteers -Maintaining database of Community Volunteers and engagement through regular training, exercise and etc.
Insufficient Urban Search & Rescue Teams (USAR)	Development of adequate National USAR Teams following INSARAG guidelines
Open Space for Temporary Shelter	Air mark open spaces for temporary shelters
Safety of Utility Services (Gas, Electricity, Water supply etc)	- Introduction of Auto Shutdown System - Backup Plan for Restoration of Utility Services
Dead body Management	- Policy on Dead Body Management required
Vulnerable Industrial Infrastructures (e.g RMG)	Retrofitting of risky infrastructures required
Reluctant to carry out fire and evacuation drill	- Developing Social Practice Culture, Policy for Drill to be enforced nationally, - Mass Awareness Program to be taken and incorporated in Education Program and Involvement of Mass Media
Centralized Concentration of Response Resources	- Decentralization of resources (Rescue Equipment, Medical equipment etc)
Preparedness on Receiving International Assistance (Rescue)	- Policy for Receiving International Rescue teams - Simulation Exercise as per the policy following INSARAG Guideline

Source: DG FSCD

7.13 **DDM**

Department of Disaster Management (DDM) under the Ministry of Disaster Management and Relief came into being in November 2012 following enactment of the Disaster Management Act 2012. Qayyum (2016) maintains that the government has restructured and established the Disaster Management Department as the main organ or instrument in the field for implementing and coordinating various forms of disaster management activities. Merging two organizations – the Disaster Management Bureau (established after the 1991 cyclone) and the Directorate of Relief and Rehabilitation established earlier. The DDM has the mandate to address DRR and emergency response for any disaster including earthquake. So, DDM would coordinate, on behalf of the government, all activities in connection with disaster management in Bangladesh. It is regularly bringing out various policy documents and updating them to streamline the disaster response and management activities of different stakeholders; procuring and distributing earthquake response equipment to different stakeholders especially to Bangladesh Armed Forces and Bangladesh FSCD. The Mission of DDM clearly spells its mandate for the nation, which reads, "The Department of Disaster Management (DDM) would serve the Ministry of Disaster Management and Relief to implement the objectives of Disaster management Act 2012 by undertaking risk reduction activities; responding to disaster events efficiently as well as strengthening and coordinating programs undertaken by different stakeholders related to DRR and DRM."

DDM is headed by its Director General and focuses on networking and collaborating with all governmental and non-governmental agencies at home and abroad on various aspects of disaster risk reduction and response management. It is also mandated to organize workshops and training programmes on disaster response. It regularly publishes its reports and other documents to facilitate disaster response by all concerned. It procures equipment for earthquake response on behalf of the government and distributes the same to stakeholders of earthquake response.

The Department of Disaster Management is yet to finalize its organogram. However, it has eight wings to look after the business of the department namely Administration, Planning and Development, Food for Work (FFW), Relief, Monitoring and Information Management (MIM), Training and Research, Monitoring and Evaluation

and Vulnerable Group Feeding. Nonetheless, as the Government is putting more emphasis on 'Disaster Management", the DDM is also strengthening it network to help facilitate capacity building of different stakeholders. The DDM directs its activities following the Disaster Management Regulatory Framework of the Government as depicted in the figure 13 (Page 69)

7.14 Capacity of Civil Engineering Firms to Clear Debris

As already said, a total of 20 civil engineering firms were selected for studying their capability with regards to earthquake response. The name of the engineering firms of Dhaka City along with the number of different equipment they are holding is shown as Appendix XVIII. To get a primary estimation of the capacities of the civil engineering firms, the recent case of debris clearance from the collapsed building of DNCC Market was referred to with the following assumptions:

a. The average capacity of the engineering equipment used in DNCC Market and those held by civil engineering firms are more or less similar.

b. The operators for the equipment of the civil engineering firms would be available.

c. The immediate dumping places for debris removal in case of earthquake would be available at a distance of 1-2 km on average.

d. Two normal trucks of Civil Engineering Firms would serve the purpose of one Dumper with 10 tons of capacity.

After the collapse of DNCC market located at Gulshan-1 due to the fire incident that took place on 03 January 17, the debris clearance operation was conducted by 12 Engineers Battalion of 14th Engineers Brigade of Bangladesh Army. The debris clearance operation started on 11 January 2017 and came to a successful end after a week, on 18 January 2017. By the end of the operation, it has been estimated that a total of 707 dump truck trips were operated to clear approximately 7070 tons of debris from the collapsed structure. The dumping place was about 7 km apart from the collapsed market. The 7-day operation was completed by a team of 50 Army personnel working

for every day. Here, the 12 Engineers Battalion equipped 2 excavators; 1 Dozer, 4 Dumpers and 3xHydraulic cutters. Besides, from the DNCC's Mechanical Engineering Department, another excavator, 2 Loaders, 14 Dumpers were used to work in conjunction with the Engineering team of Army. As such, in total, 3 excavators, 3 hydraulic cutters, 1 dozer, 2 loaders and 18 dumpers were used for a total of 7 days to remove this amount of debris. A comparison was made between the resources used in clearing the burnt and collapsed DNCC market and those held by 20 civil engineering firms in the 'Table 59' below.

Table 59: Comparison of Resources used in DNCC Market and those held by Civil Engineering Firms

Name of the Resources	Used in DNCC Market	Held by 20 Engineering Firms	Equipment in terms of DNCC	Remarks
Excavator	03	219	73 Times	Nearly 70 Times
Dozer	01	70	70 Times	
Loader	02	127	63.5 Times	
Dumper	18	338	18.7 Times	Less travel considered
Concrete Cutter	03	19	6 Times	Natural debris mostly

Source of DNCC Case: Company Commander of 14 Engineering Brigade

It is observed that the engineering firms under study held nearly 70 times of resources than that were used in DNCC market clearance except the dumper and concrete cutter. It is also important to note that in case of earthquake there would be huge debris created by the earthquake itself, which was not the case in DNCC market. After any major earthquake, concrete cutting would be a big issue primarily to rescue lives. However, demolition of main structure would not be required much in the immediate response phase. As such, the limitation of concrete cutter was disregarded to make a generalized calculation. On the other hand, the limitation of dumper was also disregarded since consideration was made that the immediate dumping place for earthquake response would be somewhere close to the collapsed structure (within 1-2 km only).

With some generalization and assumptions it was taken that the capacity of civil engineering firms is roughly 70 times than that of capacity used in DNCC market

clearance. Now, since 7070 tons of debris was removed in DNCC case in 7 days of operation, within the same time frame civil engineering firms would be able to clear 7070X70 = 494900 tons of debris in seven days.

Other than debris removal assets, these firms have many other important resources that could also be effectively used in response operation. For example, these firms have 151 cranes of different type and capacity that would help conduct SAR operation and clearing of roads. Besides, 11 fuel bowsers, 33 water tankers, 31 forklifts and 310 generators of different capacities would be great help in any crisis of large magnitude. Some of these firms like Abdul Monem Ltd took part in the SAR operation after the RANA PLAZA collapse in 2013. As such the personnel behind these machines have unique experience that could add value to any future response operation of similar kind.

CHAPTERVIII: AWARENESS AND PREPARATION OF CITY DWELLERS

8.1 General

City dwellers' awareness and preparation for earthquake was studied from two different considerations. Firstly, the state of awareness and preparation was studied for a total of 715 respondents representing Modern Dhaka, Semi-Modern Dhaka and Old Dhaka. As such, these findings primarily represent the observed awareness and preparation of the respondents. Secondly, the same respondents were asked to express their perception about the awareness and preparation for earthquake of Dhaka City dwellers, in general, through a 5-point Likert scale. The questionnaire is shown as Appendix 1.

8.2 City Dwellers' Awareness of Earthquake

City dwellers were asked some dichotomous ('Yes'/'No') questions to learn their awareness regarding earthquake. The aim of these questions was to know the followings:

a. City dwellers' general awareness regarding earthquake.

b. Whether they were informed by any source about their actions in the aftermath of earthquake.

c. Their willingness to render voluntary service in post-earthquake scenario.

The findings are appended below with a comparison among different categories of city dwellers.

8.2.1 General Awareness

The City dwellers were asked whether they were aware of the likelihood of earthquake occurrence in Dhaka City. A very appreciable 96.6% (691 out of 715) of them responded positively while rest 3.4% showed their ignorance about such possibility. Interestingly, 98.3% people from Modern Dhaka and 97.9% people from Semi-Modern Dhaka were found aware. On the other hand, 93% respondents from Old Dhaka

expressed their awareness leaving a significant 7% of them totally unaware of the likelihood of earthquake incidence in Dhaka. These findings emphasized the need for strengthening earthquake awareness program in Dhaka with particular emphasis to dwellers of Old Dhaka. So, the state of city dwellers unaware of likelihood of earthquake occurrence stands as follows:

Old Dhaka (7%) > Semi-Modern Dhaka (2.1%) > Modern Dhaka (1.7%)

The figure below shows a comparison of general awareness of three categories of people.

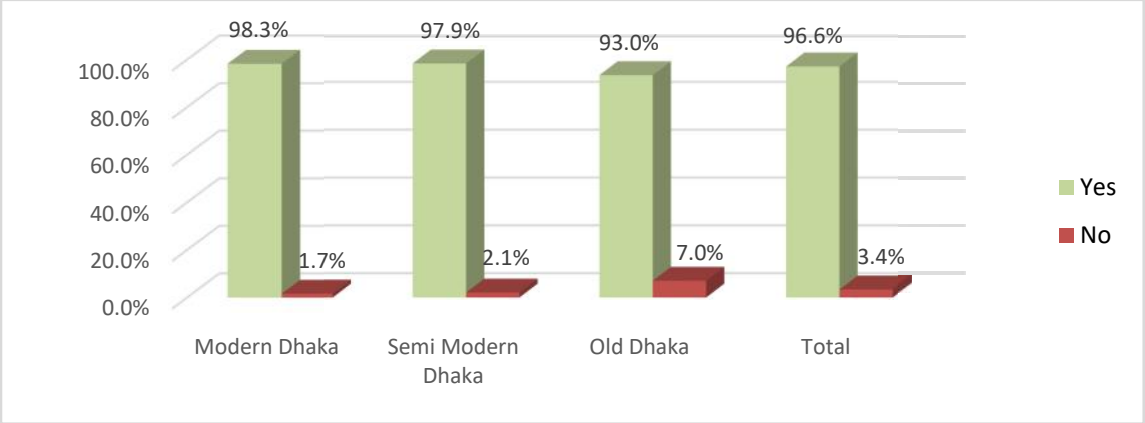


Figure 23: Comparison of City Dwellers' General Awareness regarding Earthquake

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their earthquake awareness.

Ha: There exists significant association between the categories of respondents and their earthquake awareness.

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**11.422[a]**	**2**	**.003**
Likelihood Ratio	10.121	2	.006
Linear-by-Linear Association	8.623	1	.003
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 6.01.			

Inference: There is no cell with expected cell count <5. So, Pearson chi-square test is used here. From the test table, we observe that Pearson chi-square test statistic is 11.422 with 2 degrees of freedom and the p-value is 0.003 (<0.05). Accordingly, at 5% level of significance we may reject the null hypothesis and conclude that there exist significant association between the categories of respondents and their earthquake awareness.

8.2.2 What to Do (actions) in Earthquake

An important question, asked to the respondents, was whether they were informed by some sources about their actions in earthquake. The findings were noteworthy since 42% of the respondents were never told by any source about their actions in Earthquake. The three categories of city dwellers showed varied degree of awareness with 79.3% people of Modern Dhaka and 61.6% people of Semi-Modern Dhaka expressing that they were told by some sources about their actions in earthquake. On the other hand, only 33% people of Old Dhaka informed that they were told by someone about what action they should take during earthquake. Thus, a very significant 67% people of Old Dhaka, 38.4% people of Semi-Modern Dhaka and 20.7% people of Modern Dhaka are still ignorant about their much critical actions in earthquake. In summary, the people remaining ignorant about their actions in earthquake stand as follows:

Old Dhaka (67%) > Semi Modern Dhaka (38.4%) > Modern Dhaka (20.7%)

This finding also reinforces the need for strengthening awareness programme in Dhaka City with particular emphasis to people of Old Dhaka and Semi-Modern Dhaka. The figure below shows a comparison in this regard.

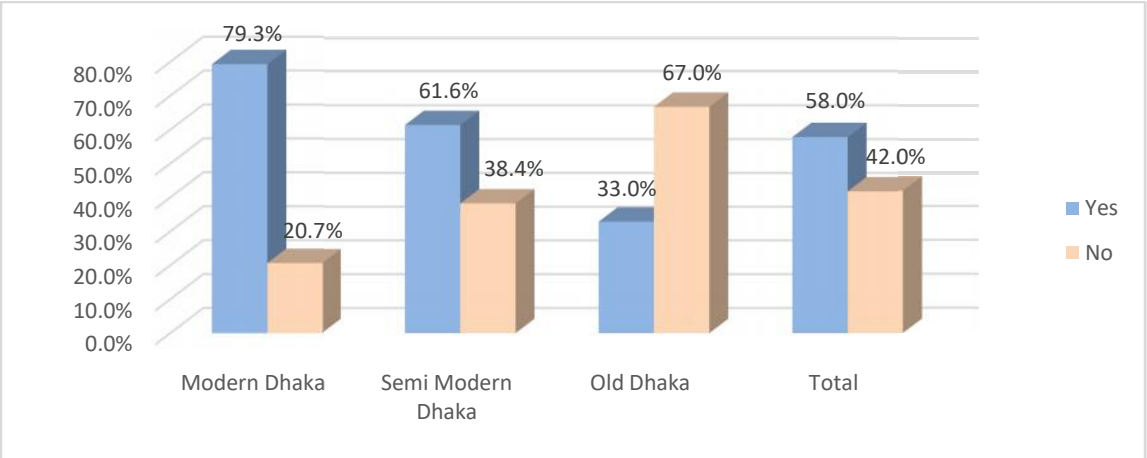


Figure 24: City Dwellers knowing their actions in case of Earthquake

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their actions during earthquake.

Ha: There exists significant association between the categories of respondents and their actions during earthquake.

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**86.562[a]**	**2**	**.000**
Likelihood Ratio	89.009	2	.000
Linear-by-Linear Association	84.281	1	.000
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 75.10.			

Inference: There is no cell that has expected cell count <5 and accordingly, Pearson chi-square test is used here. From the test table we observe that Pearson chi-square test statistic is 86.562 with 2 degrees of freedom and the p-value is 0.000 (<0.05). So, at 5% level of significance we may reject the null hypothesis and conclude that there exists significant association between the categories of respondents and their actions during earthquake.

8.2.3 **Willingness to Render Voluntary Service in Earthquake**

It is very heartening to note that in general 90.6% city dwellers are ready to render voluntary services if the situation demands so. Here, the people of Old Dhaka were found to be the most agile (93.5%) group followed by people of Semi-Modern Dhaka (91.4%) and Modern Dhaka (86%) in rendering voluntary service. Percentage-wise willingness of all groups was encouraging but the respondents from affluent community of Modern Dhaka expressed less fellow feeling or less concern for the society in case earthquake. On the whole, the people showing willingness to render voluntary service stand as follows:

Old Dhaka (93.5%) > Semi-Modern Dhaka (91.4%) > Modern Dhaka (86%)

The figure below shows a comparison in this regard.

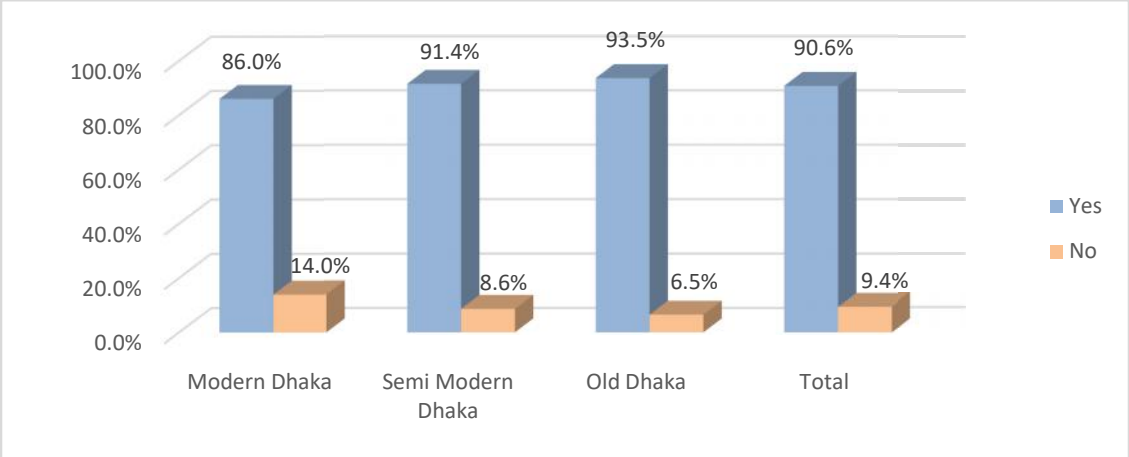


Figure 25: City Dwellers' willingness to render Voluntary Service

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their willingness to render voluntary service.

Ha: There exists significant association between the categories of respondents and their willingness to render voluntary service.

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**6.609[a]**	**2**	**.037**
Likelihood Ratio	6.299	2	.043
Linear-by-Linear Association	6.063	1	.014
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 16.77.			

Inference: There is no cell with expected cell count <5 and hence, Pearson chi-square test is used here. From the test table we observe that Pearson chi-square test statistic is 6.609 with 2 degrees of freedom and the p-value is 0.037 (<0.05). So, at 5% level of significance we may reject the null hypothesis and conclude that there exists association between the categories of respondents and their willingness to render voluntary services.

8.3 City Dwellers' Preparation for Earthquake

City dwellers were also asked some dichotomous questions in the form of 'Yes'/ 'No' to know their preparation for earthquake under following heads:

a. General preparation for earthquake.
b. Storage of dry food.
c. Storage of drinking water.
d. Exposure to Training/drill.
e. Ability to cut off power supply
f. Ability to cut off gas supply

The findings are appended below in the form of graphs with a comparison among the categories.

8.3.1 General Preparation

In general, a significant 67.3% people of Dhaka city do not have any preparation for earthquake response. A disappointing 74% people of Old Dhaka expressed their unpreparedness for earthquake followed by 65.9% people of Modern Dhaka and 64% people of Semi-Modern Dhaka with no preparation for earthquake response. As such, the general unpreparedness of respondents for earthquake stands as follows:

Old Dhaka (74%) > Modern Dhaka (65.9%) > Semi-Modern Dhaka (64%)

The figure below shows a comparison of general preparation.

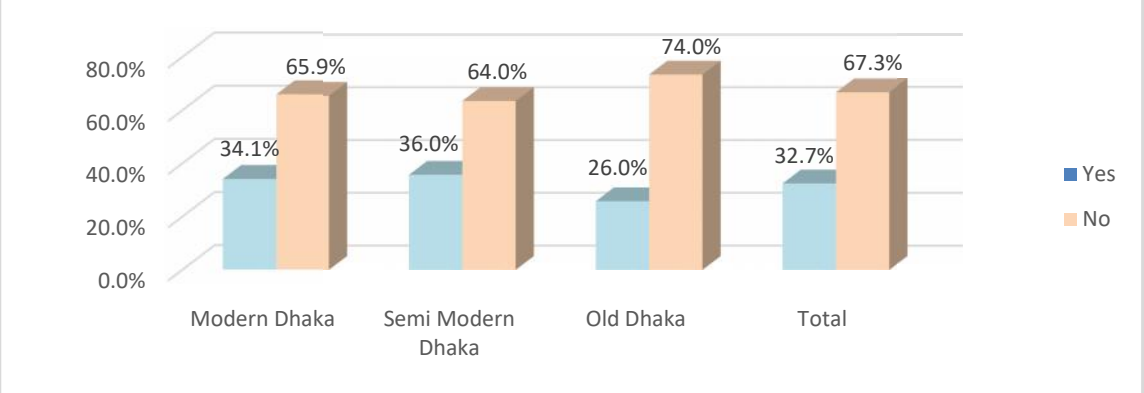


Figure 26: Comparison of City Dwellers' General Preparation for EQ

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their earthquake preparation.

Ha: There exists significant association between the categories of respondents and their earthquake preparation.

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**5.906[a]**	**2**	**.052**
Likelihood Ratio	6.048	2	.049
Linear-by-Linear Association	3.020	1	.082
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 58.58.			

Inference: There is no cell that has expected cell count <5. So, Pearson chi-square test is used here. From the test table we observe that the Pearson chi-square test statistic is 5.906 with 2 df and the p-value is 0.052 (>0.05). So, at 5% level of significance we may not reject the null hypothesis and conclude that there is no association between the categories of respondents and their earthquake preparation.

8.3.2 **Storage of Dry Food**

While furnishing information about the stock of dry food, the people living in different areas of Dhaka responded more or less similar with about 72% of them saying that they maintained dry food stock at least for 3 days. Here, people of Old Dhaka topped with an appreciable 74.5% of them saying that they do maintain food stock at least for 3 days. This was followed by 73.7% people of Modern Dhaka and 69.9% people of Semi-Modern Dhaka giving similar answers of maintaining 3-day food stock. In summary, the holding of food stock by the respondents stands as follows:

Old Dhaka (74.5) > Modern Dhaka (73.7%) > Semi-Modern Dhaka (69.9%)

This finding is very significant since about 28% of Dhaka dwellers, in general, do not maintain stock of dry food even for 3 days. Thus, a huge number of city dwellers would be looking for immediate food supply in case of any emergency emanating from earthquake and would result in increased burden of immediate relief to be delivered to them.

The figure below shows a comparison of holding of dry food by three categories of people under study.

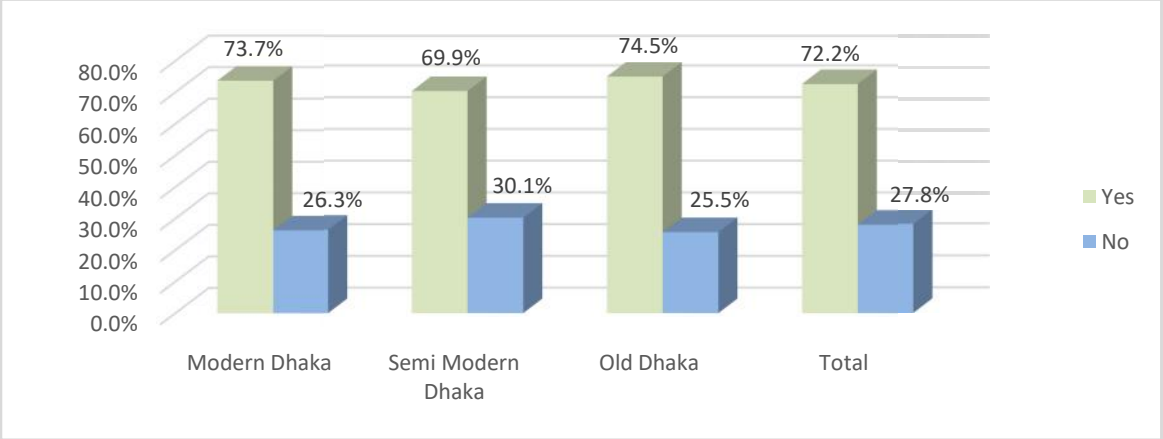


Figure 27: Comparison of City Dwellers' maintaining Stock of Dry Food

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their storing of dry food.

Ha: There exists significant association between categories of respondents and their storing of dry food.

Chi-Square Tests			
	Value	df	p-value
Pearson Chi-Square	1.593[a]	2	.451
Likelihood Ratio	1.592	2	.451
Linear-by-Linear Association	.045	1	.833
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 49.82.			

Inference: There is no cell that has expected cell count <5. So, Pearson chi-square test is used here. From the test table we observe that Pearson chi-square test statistic is 1.593 with 2 degrees of freedom and the p-value is 0.451 (>0.05). So, at 5% level of significance we may not reject the null hypothesis and conclude that there is no association between the categories of respondents and their storing of dry food.

8.3.3 **Maintenance of Drinking Water**

While giving information about maintaining of drinking water, the people living in different areas of Dhaka again responded more or less similar with an average of 85.7% (Figure-3) of them saying that they maintained stock of drinking water at least for 3 days. Nonetheless, people of Old Dhaka, again, scored the highest with an appreciable 87% of them saying that they maintained drinking water for 3 days or more. This was followed by 85.7% people of Semi-Modern Dhaka and 84.4% people of Modern Dhaka giving similar answers of maintaining drinking water at least for 3 days. To sum up, the maintenance of drinking water by the respondents stands as follows:

Old Dhaka (87%) > Semi Modern Dhaka (85.7%) > Modern Dhaka (84.4%)

This finding is also very significant because approximately 15% of Dhaka dwellers still do not maintain stock of drinking water even for 3 days and they would be naturally looking for immediate water supply in case of any emergency emanating from earthquake. The Figure - 3 below shows a comparison in this regard.

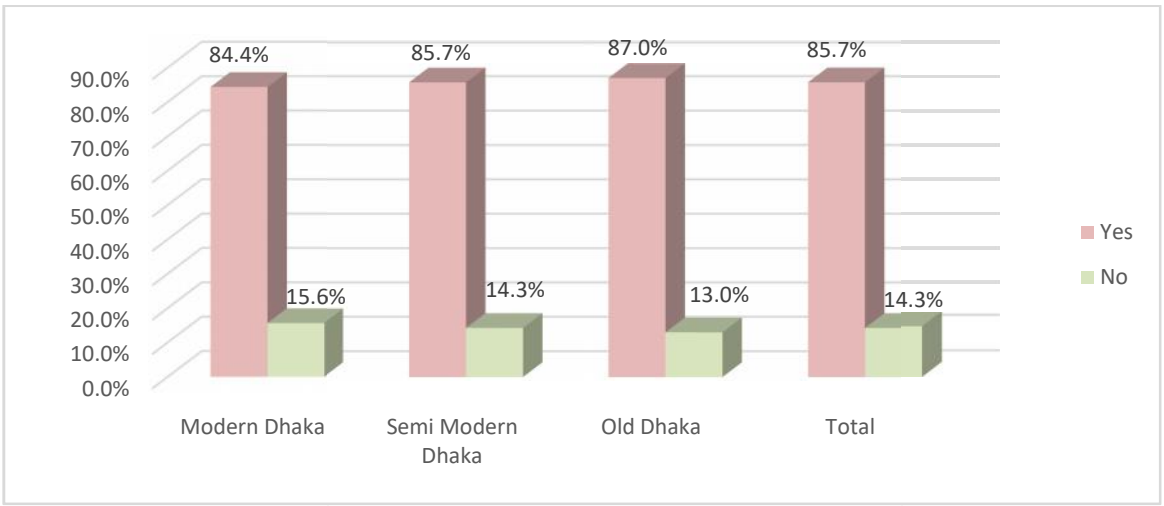


Figure 28: Comparison of City Dwellers' Maintenance of Drinking Water

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their storing of drinking water.

Ha: There exists significant association between the categories of respondents and their storing of drinking water.

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**.539[a]**	**2**	**.764**
Likelihood Ratio	.539	2	.764
Linear-by-Linear Association	.539	1	.463
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 25.54.			

Inference: There is no cell that has expected cell count <5. So, Pearson chi-square test is used here. From the test table we observe that Pearson chi-square test statistic is 0.593 with 2 degrees of freedom and the p-value is 0.764 (>0.05). So, at 5% level of significance we may not reject the null hypothesis and conclude that there is no association between category of respondents and storage of drinking water.

8.3.4 Exposure to Training/Drill on Earthquake Response

While comparing City Dwellers' exposure to some kind of drill/training, it is observed that a noteworthy 88.1% respondent from Semi-Modern Dhaka and 87.5% respondents from Old Dhaka never received any kind of drill/training. On the contrary, 83.8% respondents from the Modern Dhaka were never exposed to such training/drill. Thus, a very negligible 16.2% people from Modern Dhaka, 11.9% from Semi-Modern Dhaka and only 12.5% people from Old Dhaka had exposure to some kind of drill/training on earthquake response. In conclusion, the exposure to training/drill by the respondents stands as follows:

Modern Dhaka (16.2%) > Old Dhaka (12.5%) > Semi-Modern Dhaka (11.9%)

This finding is very significant because nearly 87% of Dhaka dwellers remained without exposure to any kind of Training/Drill on Earthquake Response (Figure – 4).

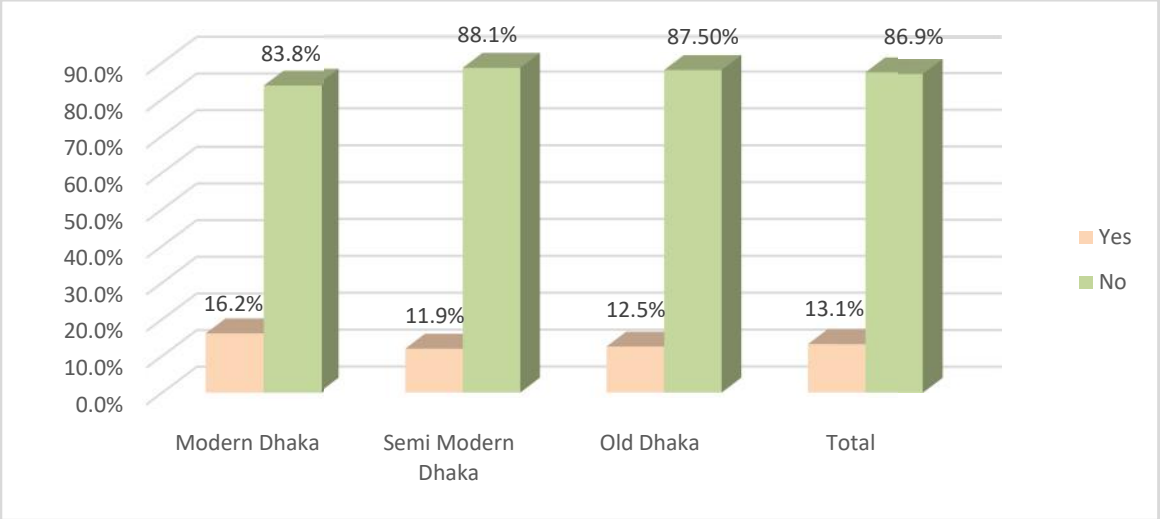


Figure 29: Comparison of City Dwellers' Exposure to Training/Drill

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their exposure to training/drill.

Ha: There exists significant association between the categories of respondents and their exposure to training/drill

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	1.990	2	.370
Likelihood Ratio	1.917	2	.383
Linear-by-Linear Association	1.056	1	.304
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 23.53.			

Inference: There is no cell that has expected cell count <5 and accordingly, Pearson chi-square test is used here. From the test table we observe that Pearson chi-square test statistic is 1.990 with 2 degrees of freedom and the p-value is 0.370 (>0.05). So, at 5%

level of significance we may not reject the null hypothesis and conclude that there is no association between the categories of respondents and their exposure to training or drill on earthquake.

8.3.5 **Knowing how to cut off Power Supply (Electricity)**

While inquiring about the respondents' ability to put off the power supply (electricity), it was revealed that the people living in Modern Dhaka, Semi-Modern Dhaka, and Old Dhaka responded with a wide variability. The percentage of people knowing this emergency operation ranged from 45% to 60% with an average of 53%. Thus a significant 47% of the city dwellers are totally unaware of this simple but critical action of putting off the power supply. Area-wise, people of Old Dhaka showed the highest preparation for such action with as high as 60% answering positively, which was followed by 53% from Semi-Modern Dhaka and 45.3% people of saying that they knew the procedure of cutting off power supply. Alarmingly, 54.7% people of Modern Dhaka do not know this operation. This finding has special bearing as it reflects that people of affluent class are reluctant to know this safety practice. In total, people knowing this simple operation stands as follows:

Old Dhaka (60%) > Semi Modern Dhaka (53%) > Modern Dhaka (45.3%)

The figure below shows a comparison of people of different areas in respect of their awareness about putting off the power.

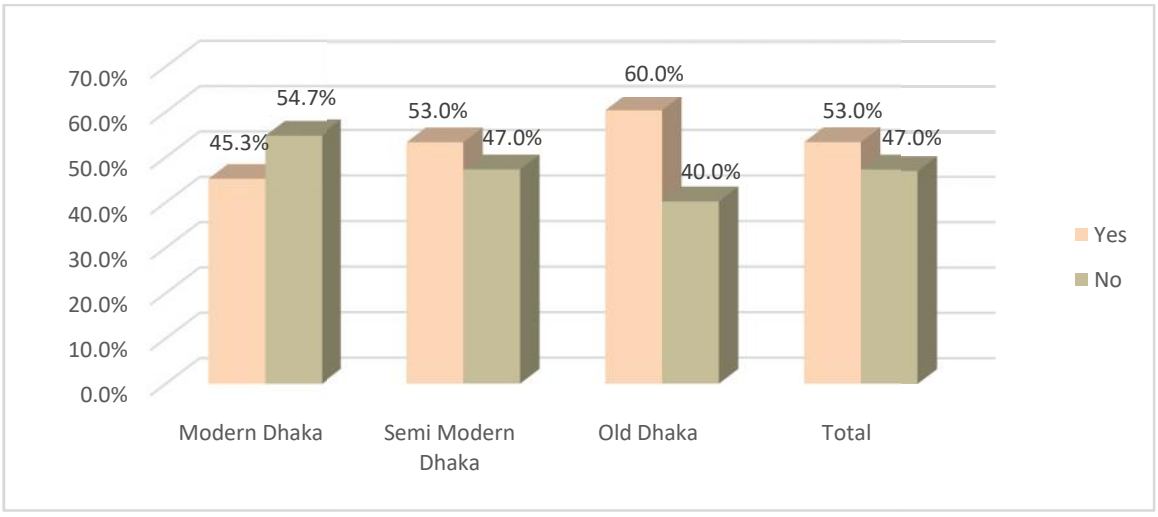


Figure 30: City Dwellers' Preparation for cutting off the Power

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their knowing how to cut off power supply.

Ha: There exists significant association between the categories of respondents and their knowing how to cut off power supply.

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**8.249[a]**	**2**	**.016**
Likelihood Ratio	8.275	2	.016
Linear-by-Linear Association	8.229	1	.004
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 84.12			

Inference: There is no cell with expected cell count <5. So, Pearson chi-square test is used here. From the test table we observe that Pearson chi-square test statistic is 8.249 with 2 degrees of freedom and the p-value is 0.016 (<0.05). So, at 5% level of significance we may reject the null hypothesis and conclude that there exists significant association between the categories of respondents and their knowing how to cut off power supply.

8.3.6 **Knowing how to cut off Gas Supply**

As the city dwellers were asked whether they knew how to cut off the gas supply of their residential buildings in case of earthquake, the people living in Modern Dhaka, Semi-Modern Dhaka and Old Dhaka responded more or less similar showing their great ignorance for this emergency procedure. In case of Modern Dhaka, a very alarming 76.5% people responded negatively expressing that they did not know how to stop the gas supply leaving only 23.5% people knowing to do so. Similarly, a very significant 76.5% people of Semi-Modern Dhaka and 74.5% people of Old Dhaka showed their total ignorance about this emergency practice. Overall, the people knowing about this simple procedure stand as follows:

Old Dhaka (25.5%) > Semi-Modern Dhaka (23.5%) > Modern Dhaka (23.5%)

The figure below shows a comparison of people of different areas in respect of their preparation about Cutting off the Gas Supply.

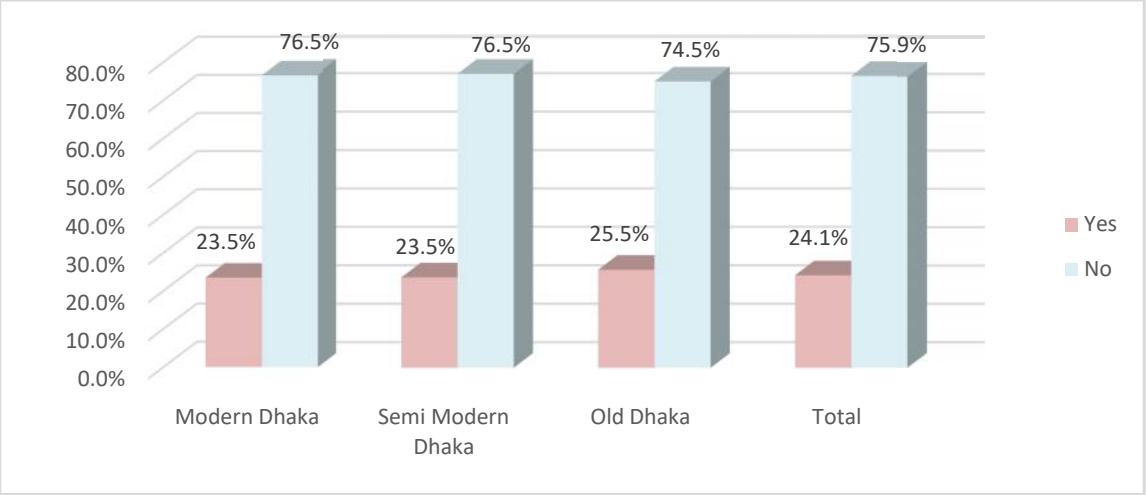


Figure 31: City Dwellers Preparation about Cutting the Gas supply

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their knowing how to cut off the gas supply.

Ha: There exists significant association between the categories of respondents and their knowing how to cut off the gas supply.

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**.317**	**2**	**.853**
Likelihood Ratio	.315	2	.854
Linear-by-Linear Association	.225	1	.635
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 43.06.			

Inference: There is no cell, which has expected cell count <5. So, Pearson chi-square test is used here. From the test table we observe that Pearson chi-square test statistic is 0.317 with 2 degrees of freedom and the p-value is 0.853 (>0.05). So, at 5% level of significance we may not reject the null hypothesis and conclude that there is no

association between the categories of respondents and preparation about cutting off the gas supply.

8.4 Perception of City Dwellers about Awareness and Preparation

Statement 1: There is Need for Strengthening Awareness Program for Earthquake Response

City dwellers expressed their attitude towards the statement, "There is need for strengthening awareness program for earthquake response in Dhaka City" as depicted in the figure below.

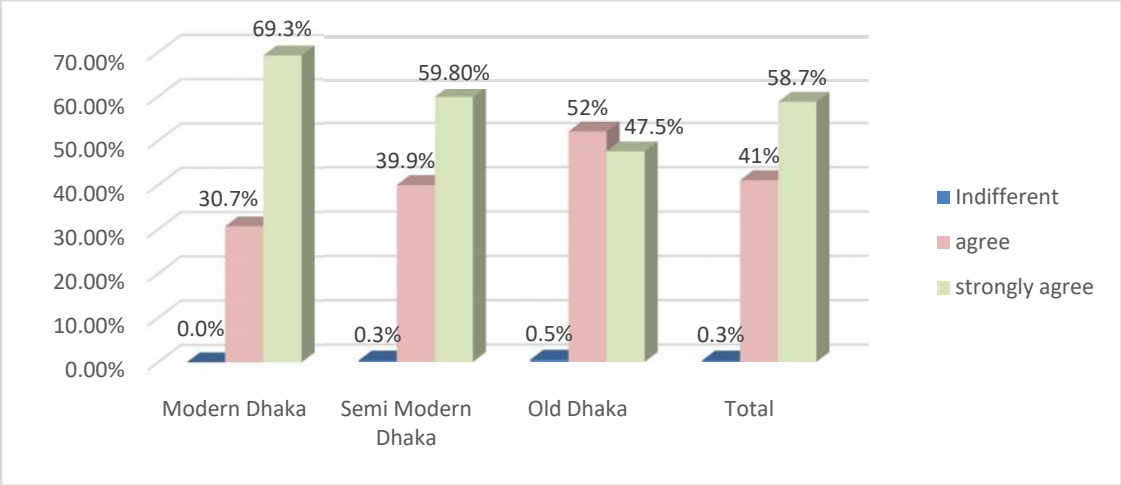


Figure 32: Respondents' Attitude towards Need for Strengthening Awareness

A very appreciable 99.7% of the total respondents either agreed or disagreed to the statement under study while only 0.3% of the total respondents remained indifferent to it. It is observed that 69.3% people living in 'Modern Dhaka' have "Strongly Agreed" with another 30.7% "Agreeing" that there is need for strengthening the awareness program for earthquake response. Thus 100% people of 'Modern Dhaka' have either 'Strongly Agreed' or 'Agreed' leaving no record for other three options in the Likert Scale. In case of people of Semi-Modern Dhaka, again a very significant 59.8% responded opted for "Strongly Agree" option with another 39.9% of them choosing "Agree" option making a total of 99.7% either strongly agreeing or agreeing with the given statement. Rest 0.3% remained "indifferent" against the statement. So, none of them expressed their disagreement. In case of people of Old Dhaka, a substantial 52% respondents 'Agreed'

with the statement while another very significant 47.5% of them 'Strongly Agreeing' with it. Only 0.5% of them stayed "Indifferent" with none showing any kind of disagreement with the statement under study. In summary, the priority of respondents for the statement stands as follows:

Strongly Agree (58.7%) > Agree (41%) > Indifferent (0.3%)

Test of Hypothesis:

Ho: There is no association between categories of respondents and need for strengthening awareness.

Ha: There exists significant association between categories of respondents and need for strengthening awareness.

Chi-Square Tests						
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	19.220[a]	4	.001			
Likelihood Ratio	19.743	4	.001	.000		
Fisher's Exact Test	**19.382**			**.000**		
Linear-by-Linear Association	18.987[c]	1	.000	.000	.000	.000
N of Valid Cases	715					
a. 3 cells (33.3%) have expected count less than 5. The minimum expected count is .50.						

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Inference: Here 33.3% cells have expected cell count <5. So, Fisher's Exact Test is used here. From the test table we observe that Fisher's Exact Test statistic value is 19.382. The p-value is 0.000 (<0.05). So, at 5% level of significance, we may reject the null hypothesis and conclude that there exists significant association between the categories of respondents and need for awareness strengthening in Dhaka City.

Statement 2: The Mass Media needs to play More Active Role for Awareness Building

The next statement in the 'Likert Scale' was about the "Need for More Active Role of Mass Media in Awareness Building for Earthquake Response. In the figure below the attitudes of different groups of respondents are appended.

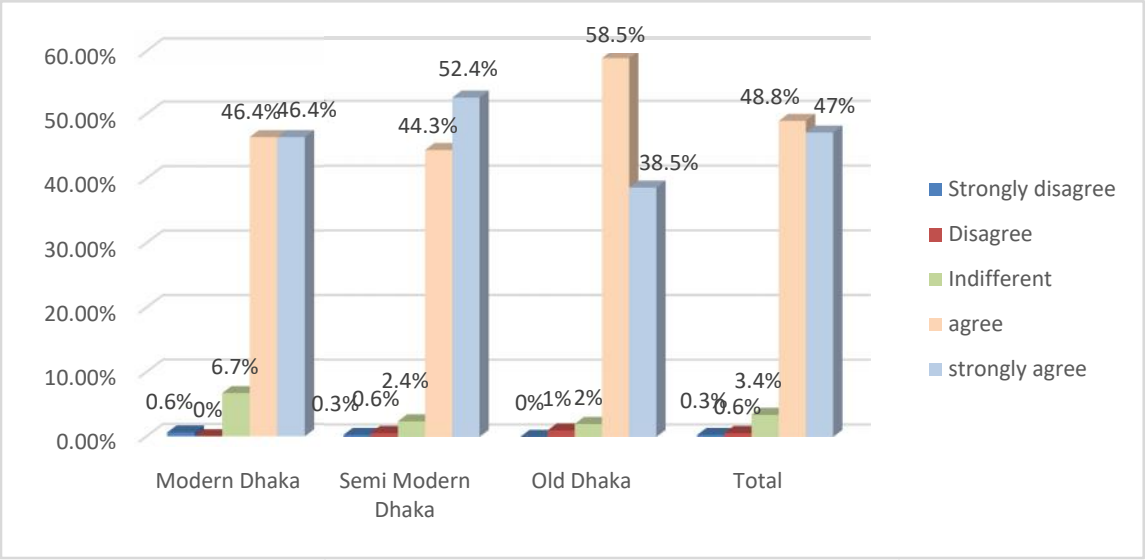

Figure 33: Respondents' Attitude towards more Active role of Mass Media for Earthquake Awareness Building

Coming to the question whether role of mass media should be increased to create earthquake awareness, people living in Modern Dhaka, Semi-Modern Dhaka and Old Dhaka have responded with some difference though primarily reflecting some sort of agreement with the statement. A notable 95.8% of the respondents either strongly agreed or agreed to the statement under study. While only 0.9% of them expressed their 'Disagreement' and 3.4% remained 'Indifferent' to the statement. If we make comparison among the categories of people, we see that an appreciable 46.4% people of Modern Dhaka responded for "Strongly Agree" option while another 46.4% opted for "Agree" option. Only 6.7% remained "indifferent" while a very insignificant 0.6% expressed their "Strong Disagreement" with the statement. On the other hand, a very appreciable 52.4% respondent chose the "Strongly Agree" option with another 44.3% sided for "Agree" option. Only 2.4% of them remained "Indifferent" with a very insignificant 0.6% expressing "Disagreement" and rest 0.3% showed "Strong Disagreement" to the statement. Again, the people of Old Dhaka responded with huge 58.5% with the option "Agree" followed by another appreciable 38.5% responding to "Strongly Agree" option. Respondent remaining "Indifferent" and showing some kind

of disagreements are very insignificant in this case too. So, the priority of respondents for this statement stands as follows:

Agree (48.8%) > Strongly Agree (47%) > Indifferent (3.4%) > Disagree (0.6%) > Strongly Disagree (0.3%)

Test of Hypothesis:

Ho: There is no association between categories of respondents and the need for more active role of mass media for awareness building.

Ha: There exists significant association between categories of respondents and the need for more active role of mass media for awareness building.

Chi-Square Tests						
	Value	df	Asymptotic. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	21.387	8	.006			
Likelihood Ratio	21.586	8	.006	.005		
Fisher's Exact Test	**20.088**			**.003**		
Linear-by-Linear Association	.420[c]	1	.517	.531	.272	.027
N of Valid Cases	715					
a. 6 cells (40.0%) have expected count less than 5. The minimum expected count is .50.						

Inference: Here 40% cells have expected cell count <5 and accordingly, Fisher's Exact Test is used here. From the test table we observe that Fisher's Exact Test statistic value is 20.088 and the p-value is 0.003 (<0.05). So, at 5% level of significance we may reject the null hypothesis and conclude that there exists significant association between categories of respondents and the need for more active role of mass media for awareness building.

Statement 3: City Dwellers do not have Adequate Preparation for Earthquake

Respondents were asked to put forward their attitude towards the statement "City Dwellers do not have Adequate Preparation for Earthquake." The figure in the next page (Figure 35) shows the responses of different categories of respondents. It is observed from the figure above that people living in Modern Dhaka, Semi-Modern Dhaka and Old Dhaka have responded more or less same depicting that there is dearth of peoples' preparation for earthquake.

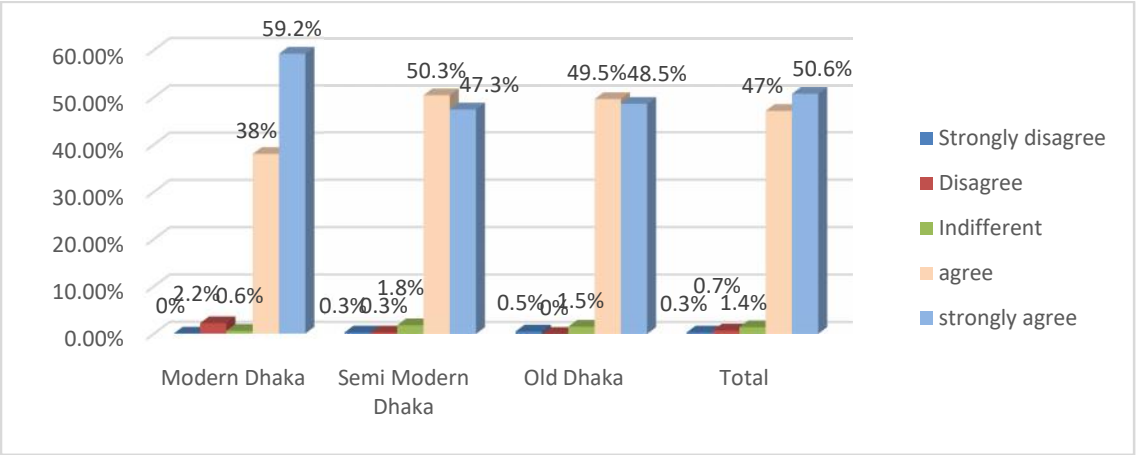

Figure 34: Respondents' Attitude towards City Dwellers' Preparation for Earthquake

In total, an encouraging 97.6% of the respondents either strongly agreed or agreed to the query and 1.4% of them remained indifferent while only 1% people expressed their disagreement. An appreciable 59.2% people of Modern Dhaka have responded to "Strongly Agree" option while another significant 38% of them have just "Agreed" with the statement recording only 0.6% remaining "Indifferent" and 2.2% opting for "Disagree" option. Importantly, none of them strongly disagreed with the same statement. On the other hand, a majority of 50.3% respondents of Semi-Modern Dhaka have recorded their "Agreement" and an appreciable 47.3% strongly agreed with the statement. In this case also, a very negligible 1.8% remained "Indifferent", 0.3% "Disagreed" and rest 0.3% chose for "Strongly Disagree" option. In case of Old Dhaka, a substantial 49.5% respondents 'Agreed' with the statement while another very significant 48.5% of them 'Strongly Agreeing' with it. Only 1.5% of them stayed "Indifferent" with only 0.5% "Strongly Disagreed" with the statement. In conclusion, the priority of respondents for the statement stands as follows:

Strongly Agree (50.6%) > Agree (47%) > Indifferent (1.4%) > Disagree (.7%) > Strongly Disagree (0.3%)

Test of Hypothesis:

Ho: There is no association between categories of respondents and their perception about city dwellers' preparation for earthquake.

Ha: There exists association between categories of respondents and their perception about city dwellers' preparation for earthquake.

Chi-Square Tests						
	Value	df	Asymptotic. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	17.987	8	.021	-		
Likelihood Ratio	18.117	8	.020	.026		
Fisher's Exact Test	**15.745**		-	**.017**		
Linear-by-Linear Association	1.885	1	.170	.180	.092	.013
N of Valid Cases	715					
9 cells (60.0%) have expected count less than 5. The minimum expected count is .50.						

Inference: Here 60% cells have expected cell count <5 and hence, Fisher's Exact Test is used here. From the test table we observe that Fisher's Exact Test statistic value is 15.745 and the p-value is 0.017 (<0.05). So, at 5% level of significance we may reject the null hypothesis and conclude that there exists association between categories of respondents and their perception about city dwellers' preparation for earthquake.

Statement 4: There should be right Representation of Volunteers from different Wards of Dhaka City for Earthquake Response

City dwellers'response against the above statementis depicted in figure below:

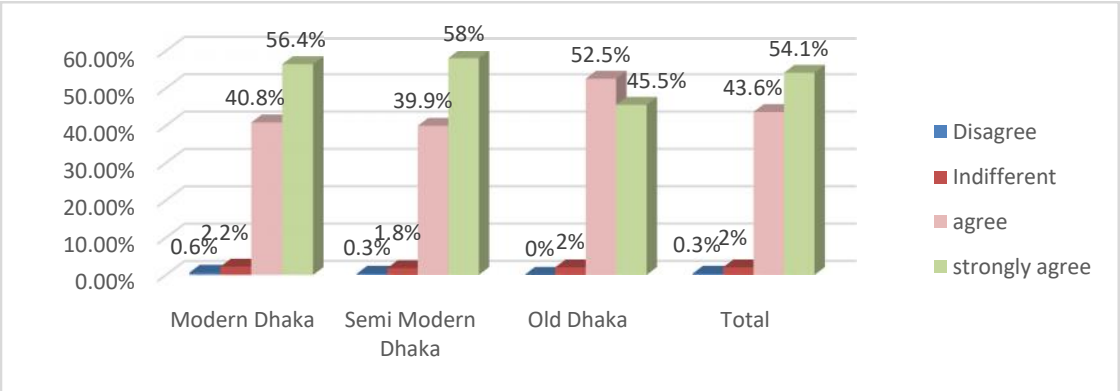

Figure 35: Respondents' Attitude towards Volunteer Recruitment

With regards to this statement, people living in Modern Dhaka, Semi Modern Dhaka and Old Dhaka have responded though little differently but in general, highlighted the need for judicious representation of volunteers from different wards of City Corporation. A very significant 97.7% (699 of 715) respondent either opted for 'Agree' or 'Strongly Agree'options here. People expressing 'Disagreement' were very negligible while 2% of them remained 'Indifferent'. People living in Modern Dhaka have responded largely with 56.4% for "Strongly Agree" and 40.8% for "Agree" option while another 2.2% remained "Indifferent". None of them showed 'Strong Disagreement' with the statement while a very negligible 0.6% showed 'Disagreement' with the same. On the contrary, a great majority of 58% respondents of Semi-Modern Dhaka have confirmed their "Strong Agreement" with the statement with another appreciable 39.9% of them just 'Agreeing' with it. A very negligible 1.8% remained "Indifferent" and only 0.3% "Disagreeing" with the statement. In Old Dhaka, a huge 52.5% of the respondents 'Agreed' with the statement followed by a very significant 45.5% of them 'Strongly Agreeing' with it. Rest 2% of them stayed "Indifferent" with none expressing their any kind of 'Disagreement' with it. In total, the priority of respondents for this statement stands as follows:

Strongly Agree (54.1%) > Agree (43.6%) > Indifferent (2%) > Disagree (0.3%)

Test of Hypothesis:

Ho: There is no association between categories of respondents and their attitude towards volunteer recruitment.

Ha: There exists significant association between categories of respondents and their attitude towards volunteer recruitment.

Chi-Square Tests						
	Value	df	Asym Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	10.078	6	.121	-b		
Likelihood Ratio	10.476	6	.106	.120		
Fisher's Exact Test	**10.346**		-	**.070**		
Linear-by-Linear Association	3.064	1	.080	.086	.044	.008
N of Valid Cases	715					
a. 5 cells (41.7%) have expected count less than 5. The minimum expected count is .50.						

Inference: Here 41.7% cells have expected cell count <5 and as such, Fisher's Exact Test is used here. From the test table we observe that Fisher's Exact Test statistic value is 10.346 and the p-value is 0.070 (>0.05). So, at 5% level of significance we may not reject the null hypothesis and conclude that there is no association between the categories of respondents and their attitude towards volunteer recruitment.

Statement 5: There is Need for Arranging Regular Earthquake Drill in Wards of City Corporations

The next statement in the 'Likert Scale' was about the "Need for Arranging Regular Earthquake Drills in different Wards of Dhaka City Corporation". The attitudes of different groups of respondents are appended in the figure below:

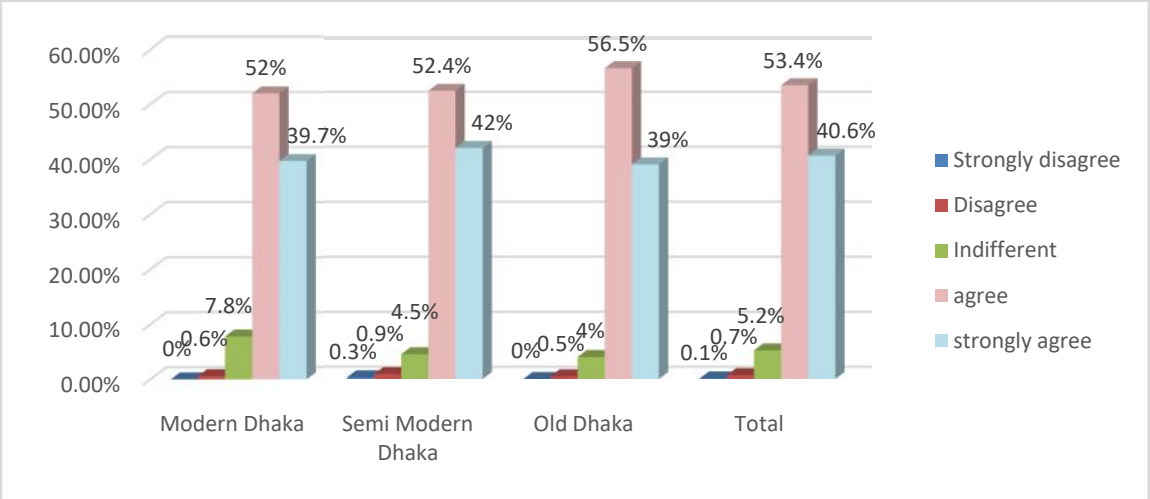

Figure 36: Respondents' Attitude towards Need for Arranging Earthquake Drill

A very appreciable 94% (672 out of 715) of the respondents either 'Agreed' or 'Disagreed' with the question under study. Again, 5.2% respondents remained 'Indifferent' while people expressing 'Disagreement' were very negligible. It is evident that a great majority of 52% people living in Modern Dhaka have responded to "Agree" option followed by another 39.7% with a "Strongly Agree" choice. An insignificant 7.8% of them remained "Indifferent" while a very insignificant 0.6% expressed their 'Disagreement'. In case of Semi-Modern Dhaka, a very appreciable 52.4% people responded with the "Agree" option followed by 42% of them responding to "Strongly Agree" choice. Again, 4.5% ticked with "Indifferent" option and rest 1.2% of them expressed their some kind of 'Disagreement' with the statement. Against this finding, 56.5% respondents of Old Dhaka checked with the option "Agree" followed by another

39% responding with “Strongly Agree” option. Only 4% of them stayed “Indifferent” while a very insignificant 0.5% expressed their ‘Disagreement’. Overall, the priority of respondents for this statement stands as follows:

Agree (53.4%) > Strongly Agree (40.6%) > Indifferent (5.2%) > Disagree (0.7%) > Strongly Disagree (0.1%)

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their attitude towards the statement “There is need for arranging regular earthquake drills in different wards of Dhaka City Corporation”.

Ha: There exists significant association between categories of respondents and their attitude towards the statement “There is need for arranging regular earthquake drills in different wards of Dhaka City Corporation”.

Chi-Square Tests						
	Value	df	Asym Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.570	8	.695			
Likelihood Ratio	5.678	8	.683	.786		
Fisher's Exact Test	**5.482**			**.736**		
Linear-by-Linear Association	.243	1	.622	.649	.326	.029
N of Valid Cases	715					
a. 6 cells (40.0%) have expected count less than 5. The minimum expected count is .25.						

Inference: Here 40% cells have expected cell count <5 and accordingly, Fisher's Exact Test is used here. From the test table we observe that Fisher's Exact Test statistic value is 5.482 and the p-value is 0.736>0.05. So, at 5% level of significance we may not reject the null hypothesis and conclude that there is no association between the categories of respondents and their attitude towards the statement “There is need for arranging regular earthquake drills in different wards of Dhaka City Corporation.”

Statement 6: There is need for Pre-designation of Open Space as Immediate Shelter.

The respondents were asked to put forward their opinion for the statement "There is need for Pre-designation of Open Space as Immediate Shelter". The attitudes of different groups of respondents are appended in the figure below.

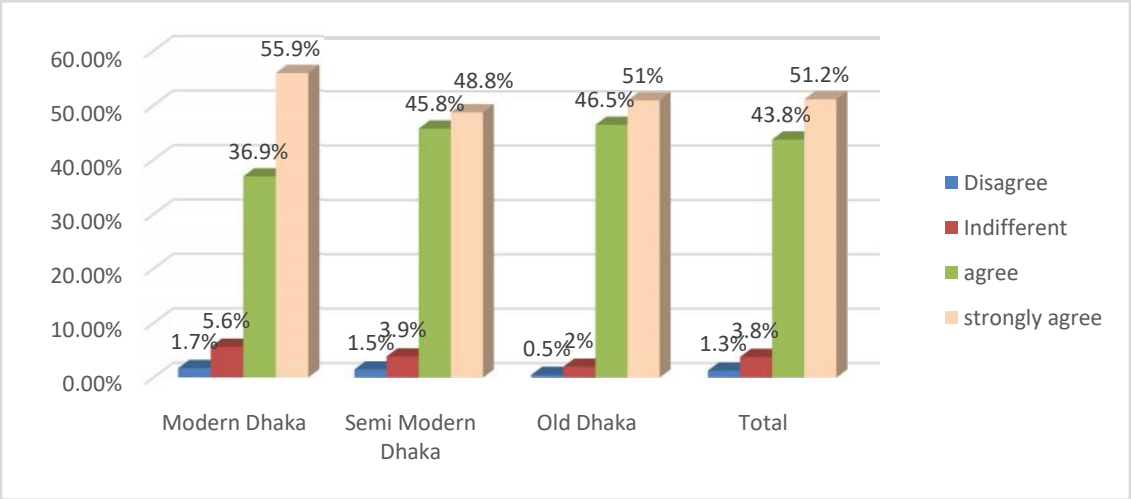

Figure 37: Respondents' Attitude towards need for pre-designation of open space

A worth mentioning 95% of the total respondent either 'Agreed' or 'Disagreed' with the statement under question. Only 1.3% people expressed their 'Disagreement', 3.8% of them remained 'Indifferent' to the statement. It is evident from the figure above that a great majority of 55.9% people living in Modern Dhaka have responded to "Strongly Agree" option followed by another 36.9% with the "Agree" choice. An insignificant 5.6% of them remained "Indifferent" while a very insignificant 1.7% expressed 'Disagreement'. In case of Semi-Modern Dhaka, again a very appreciable 48.8% people responded with the "Strongly Agree" option followed by 45.8% of them responding to "Agree" one. Responses to other options were insignificant. Against this finding, 51.0% respondents of Old Dhaka checked with the option "Strongly Agree" followed by another 46.5% responding with "Agree" option though the responses to other options were insignificant. The priority of respondents against different options for this statement stands as follows:

Strongly Agree (51.2%) > Agree (43.8%) > Indifferent (3.8%) > Disagree (1.3%)

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their attitude toward the statement "There is need for Pre-designation of Open Space as Immediate Shelter".

Ha: There exists significant association between the categories of respondents and their attitude toward the statement "There is need for Pre-designation of Open Space as Immediate Shelter".

Chi-Square Tests						
	Value	df	Asym Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	8.286	6	.218			
Likelihood Ratio	8.759	6	.188	.223		
Fisher's Exact Test	**8.344**			**.199**		
Linear-by-Linear Association	.044	1	.834	.839	.433	.032
N of Valid Cases	715					
a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is 2.25.						

Inference: Here, 25% cells have expected cell count <5 and hence, Fisher's Exact Test is used here. From the test table we can see that Fisher's Exact Test statistic value is 8.344 and the p-value is 0.199 (>0.05). As such, at 5% level of significance we may not reject the null hypothesis and conclude that there is no association between categories of respondents and their attitude towards the statement "There is need for Pre-designation of Open Space as Immediate Shelter".

Statement 7: Given Training, Pharmacy Workers may boost First Aid

The respondents' attitudes against the above statement are appended in the figure below.

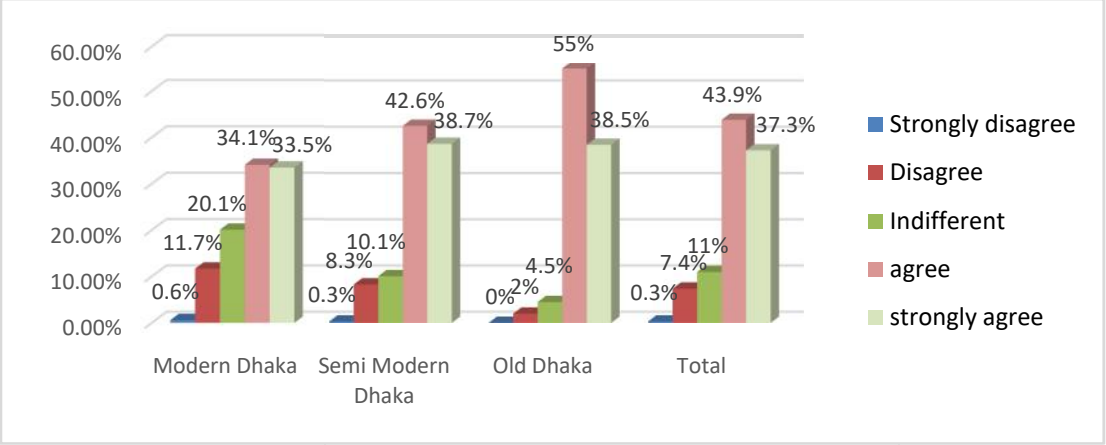

Figure 38: Respondents' Attitude towards Possibility of engaging Trained Pharmacy Workers in 'First Aid'

A remarkable 81.2% of the total respondents either 'Agreed' or 'Disagreed' with the statement under question. While 11% of the total respondents remained 'Indifferent' for the question and only 7.7% people expressed their 'Disagreement'. From the above figure, it is evident that 33.5% people living in Modern Dhaka has responded to "Strongly Agree" option with another 34.1% replied with "Agree" option. A very significant 20.1% remained "Indifferent" with another 12.3% showing some kind of "Disagreement". Thus, a total of 32.4% did not give their concurrence with the statement. Similarly, 38.7% respondents of Semi Modern Dhaka responded with "Strongly Agree" option with another 42.6% responding to "Agree" one. Besides, a considerable 10.1% stayed "Indifferent" with 8.3% expressing their "Disagreement" and 0.3% showed "Strong Disagreement" with the statement. Against this finding, 55% people of Old Dhaka just "Agreed" with the statement followed by another huge 38.5% recording their "Strong Agreement". However, 4.5% stayed "Indifferent" with another 02% expressing their "Disagreement" with the statement under study. On the whole, the priority of respondents for this statement stands as follows:

Agree (43.9%) > Strongly Agree (37.3%) > Indifferent (11%) > Disagree (7.4%) > Strongly Disagree (0.3%)

Test of Hypothesis:

Ho: There is no association between the categories of respondents and their attitude towards the statement "Given Training, Pharmacy Workers may boost First Aid".

Ha: There exists significant association between the categories of respondents and their attitude towards statement "Given Training, Pharmacy Workers may boost First Aid".

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**45.804[a]**	**8**	**.000**
Likelihood Ratio	48.400	8	.000
Linear-by-Linear Association	20.615	1	.000
N of Valid Cases	715		
a. 3 cells (20.0%) have expected count < 5. The minimum expected count is .50.			

Inference: Here 20% cells have expected cell count <5 and so, Pearson chi-square test is used here. From the test table we can find that Pearson chi-square test statistic is

45.804 with 8 df and the p-value is 0.000 (<0.05). So, at 5% level of significance we may reject the null hypothesis and conclude that there exist association between category of respondents and their attitude towards the statement "Given Training, Pharmacy Workers may boost First Aid".

Statement 8: Trained Construction Workers may effectively be used in SAR Operation

This statement in the 'Likert Scale' was about the possibility of engaging construction workers in SAR operation after imparting training to them. The attitudes of different groups of respondents are appended in the figure below.

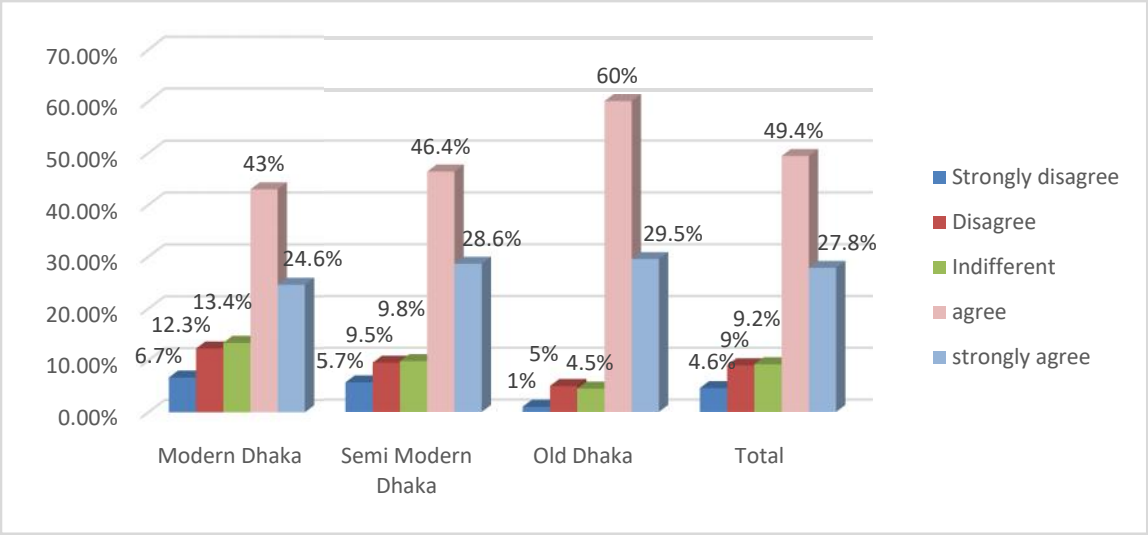

Figure 39: Respondents' Attitude towards the possibility of Engaging Construction workers in SAR operation

A noteworthy 77.2% of the total respondents either 'Strongly Agreed' or 'Agreed' with the statement under study while 9.2% of them remained 'Indifferent'. Only 13.6% people expressed their disagreement in this regard. The figure above shows that an appreciable 43% people living in Modern Dhaka has "Agreed" with statement while another important 24.6% of them "Strongly Agreeing" with the same. A considerable 13.4% of them remained "Indifferent" while 12.3% expressed their "Disagreement" and 6.7% expressed their "Strong Disagreement" with the statement making a total of 32.4% not giving their concurrence in favor of the statement studied. In case of people of Semi-Modern Dhaka, a significant 46.4% responded positively to "Agree" option and 28.6% sided for "Strongly Agree" option. In this case, about 25% of the respondents either

remained “Indifferent” or showed some kind of “Disagreement”. On the other hand, 60% people of Old Dhaka responded for “Agree” option followed by another 29.5% responding to “Strongly Agree” one. However, 4.5% of them remained “Indifferent” and another 6% expressed some kind of “Disagreement” with the statement under study. Overall, the priority of respondents for this statement stands as follows;

Agree (49.4) > Strongly Agree (27.8%) > Indifferent (9.2%) > Disagree (9%) > Strongly Disagree (4.6%)

Test of Hypothesis:

Ho: There is no association between categories of respondents and their attitude towards the statement “Trained construction workers may effectively be used in SAR operation”

Ha: There exists significant association between categories of respondents and their attitude towards the statement “Trained construction workers may effectively be used in SAR operation”

Chi-Square Tests			
	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	**29.918[a]**	**8**	**.000**
Likelihood Ratio	33.293	8	.000
Linear-by-Linear Association	17.631	1	.000
N of Valid Cases	715		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 8.26.			

Inference: Here 0% cells have expected cell count <5 and accordingly, Pearson chi-square test is used here. From the test table we see that Pearson chi-square test statistic is 29.918 with 8 df and the p-value is 0.000 (<0.05). So, at 5% level of significance we may reject the null hypothesis and conclude that there exist significant association between the categories of respondents and their attitude towards the statement “Trained construction workers may effectively be used in SAR operation”

CHAPTER IX: MAJOR FINDINGS OF THE STUDY

9.1 General

The study covered a wide variety of issues involving more than eight hundred respondents of various categories and hence the findings are also enormous. For better understanding, the findings are presented as per the objectives of the study. Nonetheless, only the major findings are discussed so that concerned stakeholders can improve upon their response architecture and take up respective capacity building programmes.

9.2 Capacity Need (Gap) of the Main Operational Units

9.2.1 86 Independent Signal Brigade

The 86 Independent Signal Brigade of Bangladesh Army would operate in Sector 1 (Mainly Uttara and neighborhood) of Dhaka city in post earthquake disaster management. The SOP/Disaster Management Database that was available during the interview had been prepared in 2011 and needed updating. The information regarding educational institute, hospitals, local leaders, utility service providers, open areas all need to be updated. Nonetheless, the Disaster Management Database, if completed and updated, would be a very handy document for the Brigade. The Brigade is a specialized one (dealing with communication) and has unity of command with its Headquarter within the Cantonment and hence located close to the AOR.

In respect of 'Manpower', the Brigade would not suffer from any capacity need since it would get reinforcement of a Brigade size force (1200-1500 personnel) from Savar Cantonment in case of earthquake. The AOR is well known to its personnel but the Brigade is yet to carry out any large-scale earthquake drill involving majority of its personnel. Nonetheless, it has limited exposure to DREE, the annual event on earthquake response training. The 'Training' gap of this Brigade is perceived to be 'High'. For 'SAR Resources', the Brigade is largely dependent on 14 Independent Engineering Brigade. However, it has got surplus capacity of communication equipment from which other main operational units would be able to take some support. Besides, it has 100 vehicles of different types that would be of good use in SAR operation. The Brigade opined that it has 'Very High Gap' in terms of 'SAR Resources'. At present, the Brigade is not in a position to provide any relief good (food), shelter and medical to the

earthquake victims from its own stock. Nonetheless, it is nearly self-sufficient in this respect (Low Gap only) to meet own operational requirement. On the other hand, in terms of 'Regulatory Frameworks' it has 'Moderate' capacity gap. Finally, it maintains a contingency money from which it can meet up own deployment and operation at least for 15 days.

9.2.2 **BAF Base Bangabandhu**

BAF Base Bangabandhu of Bangladesh Air Force is entrusted with operational responsibility for Airport Thana area (Sector 2) in earthquake management operation. This Operational Base of BAF maintains a unique chain of command where Officer Commanding Operation Wing would be the focal point of earthquake management operations. From exiting manpower of about 1400 personnel, it would be able to spare about 675 personnel against a revised requirement of 795 personnel for the earthquake management. So, there would remain a capacity need of 180 personnel, which the Base plans to fill up by bringing about 200 personnel from other unaffected stations of BAF.

In respect of 'Training', the capacity gap appears to be 'Very High' as it could so far meet only 20% of the training need. In case of 'SAR Resources,' the Base has only about 10% of its required capacity. As such, it would make effort, through AFD, to secure some assets from other sources, failing which the much needed SAR operation would be hampered. On the other hand, the debris clearance assets are also very negligible in case of BAF base Bangabandhu. There is big mismatch between what all equipment was supposed to be in possession and what actually the Base possessed, during the study. Importantly, the desired list of equipment is also inadequate considering the likelihood of damage on account of a major earthquake. Couple of Dozers, loaders and excavator is certainly insufficient for an earthquake response operation. As such, the capacity need for 'SAR Resources' remained as 'Very High'.

BAF Base Bangabandhu has a well established medical center called 'MI Room' with a 25-bed hospital at Kurmitola that would be able to extend limited medical facilities to the earthquake victims. For own operational deployment in the field (under open sky), the Base would require some other material resources (shelter etc) and hence the gap remains as 'Moderate'. 'Moderate' gap is also there in respect of 'Regulatory Frameworks' since the Base has to update its Detail Plan for Earthquake Management,

prepared in 2003. For own earthquake response operation, the Base would not require any financial support during the initial response phase.

9.2.3 **6 Independent AD Brigade**

The 6 Independent AD Brigade is responsible for operating in Sector 3 of Dhaka City in case of earthquake emergency. The AOR primarily covers Mirpur and Muhammadpur area and is subdivided into three subsectors. The Brigade has awarded responsibility of these subsectors to different integral Regiments and other Independent Units. However, in respect of manpower capacity, it would have 'Moderate' gap, which has to be met by placing fresh requirement from other army establishments.

In respect of 'Training', the Brigade is in good shape since it got the exposure of arranging the FTX in DREE-2017. The said FTX was attended by almost all the important stakeholders of earthquake response for Dhaka City. The 'Training' need assessment for this study was made before the FTX of DREE-2017 and hence the capacity need was also found to be 'High'. It is well understood that the capacity need of the unit has lowered with rare exposure of arranging the FTX.

The 'SAR Resources' held by the Brigade is too less and reflects a capacity gap termed 'Very High'. The Brigade has also 'Very High' capacity gap in respect of 'Other Material Resources' and 'Moderate' gap in terms of 'Regulatory Frameworks'. The Brigade does not maintain any readily available money for earthquake response operation and hence the capacity gap in respect of 'Financial Resources' is also 'Very High'.

9.2.4 **BAF Base Bashar**

BAF Base Bashar of Bangladesh Air Force is given the responsibility of Kafrul Thana area (sector 4) as per Draft Earthquake Contingency Plan of AFD. The Officer Commanding Operation Wing is the focal point for earthquake management operations in Sector 4. From exiting manpower of about 1300 uniform personnel, it would be able to spare about 400 personnel against a revised requirement of 795 personnel. So, there would remain a capacity need of 395 personnel (Approximately 50%), which the Base plans to fill up by bringing personnel from other unaffected stations, as the situation demands.

In respect of 'Training', the capacity gap as perceived by the Base is 'High' while in case of 'SAR Resources', it has only about 05% of its required equipment making the capacity gap 'Very High'. There is hardly any heavy-duty earthquake response equipment available with this base. The unit expects that such equipment would be made available through AFD.

BAF Base Bashar has a well established medical center called 'MI Room' at Tejgaon area that would be able to extend limited outdoor medical facilities to the earthquake victims. More so, once the 25-bed hospital comes up, it would be able to extend its medical support to earthquake victim. For own operational deployment in the field (under open sky), the Base would need some shelter materials. So, the capacity gap in respect of 'Other Material Resources' would be 'Moderate'. 'Moderate' gap is also there in respect of 'Regulatory Frameworks' since the Base has to update its 'Detail Plan for Earthquake Management', prepared in 2003. For earthquake response operation, the Base would not require any financial support for initial response phase.

9.2.5 **Bangladesh Navy Administrative Authority Dhaka**

The Administrative Authority Dhaka of Bangladesh Navy would be operating in Sector-5, which is comprised of Gulshan Thana covering Gulshan and Banani area. During earthquake emergency operation, the whole area would be covered by establishing 7 subsectors with designation of well-defined AOR for them. The deployment of manpower for earthquake response operation would be one of the prime challenges since it would have only about 50 personnel to spare from own strength of 540 personnel. Rest personnel would be required for maintaining routine works. However, it would get another 100 naval personnel from different units to partially meet the capacity gap but still having a 'High' capacity gap.

Training aspect is also not well addressed so far and hence there exists a 'High' capacity need for this Main Operational Unit. However, if the proposed EDRC is approved by the Government, there would be some improvement. On the other hand, as AFD entrusts the responsibility of arranging FTX for any DREE in the near future, its training capacity would also improve. With respect to 'SAR Resources', the Gap is 'Very High' as it has only 7% of the required capacity. Again, as the proposed EDRC is approved it would

get a good number of SAR resources, which in turn, would reduce the capacity gap here. In respect of 'Other Material Resources,' the capacity gap is again said to be 'Very High'. For Dhaka area, BNS Haji Mohsin has only limited medical facilities wherefrom some outdoor treatment would be possible. For deployment under open sky with own resources, it needs to procure some materials. In case of 'Regulatory Frameworks,' the capacity need' is 'High' as it needs to update own SOP thoroughly. Finally, in respect of 'Financial Resources,' BN unit considers that it can only meet 5% of the required capacity leading to a 'Very High' capacity need in this respect.

9.2.6 **46 Independent Infantry Brigade**

The 46 Independent Infantry Brigade of Bangladesh Army is made responsible by AFD for earthquake response in Sector-6, which is comprised of areas under Badda, Khilgaon, Rampura, Tejgaon, Kalabagan, New Market, Dhanmondi, Shahbag and Ramna of Dhaka City. The Brigade has delegated its operational responsibility among 4 units with clearly defined AOR. The Brigade is a specialized infantry Brigade as it has an additional but integral artillery regiment. It enjoys unity of command with its Headquarter located within Dhaka Cantonment (Near BNS Haji Mohsin). In respect of manpower, the Brigade would not suffer from any capacity gap since its integral manpower is already more than that of a normal infantry Brigade. Additionally, it would get reinforcement of a Brigade size force (1200-1500 personnel) from another Cantonment of Bangladesh Army.

The Brigade has limited exposure to DREE, the annual event on earthquake response training. The 'Training' capacity gap of this Brigade is perceived to be 'High'. In terms of 'SAR Resources,' the Brigade would largely depend on 14 Independent Engineering Brigade. However, its SOP says that each subsector of 46 IIB will have 6 rescue teams and each rescue team will have 20 personnel. On the other hand, each subsector will also have six 20-member debris clearance teams. The Brigade is self sufficient in terms of communication equipment and has a total of 117 vehicles of different kinds that would be of good use in SAR operation though the Brigade opined that it has 'High Gap' in terms of 'SAR Resources.' The Brigade does not maintain any relief good (food, water etc), shelter and medical resources for distribution to the earthquake victims but it is nearly self-sufficient in terms of 'Other Material Resources' for its own deployment

and operation and has 'Moderate' gap only. In case of 'Regulatory Frameworks' also, it has 'Moderate' capacity need. Importantly, the Brigade maintains sufficient contingency money from which it can meet up own deployment and operation at least for 15 days of response operation.

9.2.7 **14 Independent Engineering Brigade**

The 14 Independent Engineers Brigade of Bangladesh Army is responsible for Sector-7 for earthquake response operation in Dhaka City, which is comprised of areas under eight police stations namely "Paltan", "Motijheel", "Sobujbag", "Jatrabari", "Sutrapur", "Gendaria", "Demra" and "Shyampur". It has divided the AOR into three subsectors and delegated operational responsibility to different battalions under its command. The battalions have wide experience in construction and demolition of concrete buildings/structures.

The 14 Independent Engineers Brigade has the establishment of 3,241 personnel. Of them, about 1,000 personnel would be dedicated for earthquake response operation. In addition, its strength would be reinforced by another Brigade from Army. As such, the Brigade will be self sufficient in respect of manpower with 'No' capacity need. In terms of training, the Brigade is in better position primarily due to hands on working exposure of its personnel in various government construction projects. The rare experience of arranging FTX for DREE-2019 has added great value to its training capacity and accordingly its capacity need is only 'Low' now.

Being an Engineering Brigade, the 14 IEB maintains a good stock of SAR resources especially the heavy-duty construction equipment. In addition, a large portion of the government-procured SAR resources is also handed over by DDM to 14 Independent Engineering Brigade for use by Armed Forces. As such, there remains 'No' capacity gap against SAR resources rather; it has 30% additional capacity that can be used by other main operational units in some other sector. In case of 'Other Material Resources', the Brigade enjoys 90% required capacity with only 'Low' capacity need. With respect to 'Regulatory Frameworks' it has again 'Low' capacity need and for 'Financial Resources', the Brigade appears to have 'No' capacity gap.

9.2.8 **Border Guards Bangladesh**

Border Guards Bangladesh (BGB) is responsible for Sector-8 of Dhaka City for the earthquake response operation, which is comprised of 4 police stations of Old Dhaka. Accordingly, it has delegated the responsibility to 4 of its integral units. From exiting manpower, BGB HQ would be able to spare about 750 personnel against a requirement of 1500 personnel. So, there would remain a 50% capacity need, which would be filled up by reinforcement coming from Cumilla Sector of BGB. As such, finally there would remain 'No' capacity gap. In respect of training, the capacity gap as perceived by BGB is 'High' while in case of SAR resources, it has only 10% of its required equipment making the capacity gap 'Very High.'

The BGB has a well established hospital, which would be able to extend considerable medical facilities to the earthquake victims. For own operational deployment in the field (under open sky), the BGB has sufficient shelter materials. So, the capacity gap in respect of 'Other Material Resources' would be 'Low'. On the other hand, 'Moderate Gap' exists in respect of 'Regulatory Frameworks' since BGB has to update its own operational plan, prepared long back. For earthquake response operation, the BGB would not require any financial support for initial response phase and hence the capacity need in terms of 'Financial Resources' is graded as 'No'.

9.2.9 **Summary of Capacity Need of Operational Units**

The perceived needs of different operational units, responsible for different sectors, are summarized in the table below (Table 60). It is revealed that in terms of Manpower, there is no capacity need for 6 operational units. In Sector 3, where the operational unit is 6 IAB, the capacity need is 'Moderate' while in Sector 5, where operational responsibility lies with BN Administrative Authority Dhaka, the capacity need is 'High'. In case of 'Training,' the capacity need ranges from 'High' to 'Very High' except in Sector 7, where operational units responsible is 14 IEB, it is found to be 'Low' primarily because the Brigade is always engaged in similar kind of operations – constructions, demolition etc. Similarly, all the Main Operations Units except 14 IEB have 'Very High' or 'High' capacity need in respect of 'SAR Resources'. Here, 14 IEB is self sufficient with SAR resources primarily because it has integral engineering resources and secondly, DDM handed over 14 IEB all SAR resources meant for Armed Forces. In terms of 'Other

Material Resources' and 'Regulatory Frameworks', the capacity need generally is 'Low' to 'Moderate'. In respect of 'Financial Resources' for own operation, all units, except two, perceive that they do not have any capacity need.

Table 60: Summary of Capacity Need in Different Sectors

Category	86 ISB	BAF BBD	6 IAB	BAF BSR	BN AAD	46 IIB	14 IEB	BGB
Manpower	No	No	Mode-rate	No	High	No	No	No
Training	High	Very High	High	High	High	High	Low	High
SAR Resources	Very High	Very High	Very High	Very High	Very High	High	No	Very High
Other Material Resources	Low	Mode-rate	Very High	Mode-rate	Very High	Mode-rate	Low	Low
Regulatory Frameworks	Mode-rate	Mode-rate	Mode-rate	Low	High	Mode-rate	Low	Mode-rate
Financial Resource	'No	No	Very High	No	Very High	No	No	No

Note: Gap 1%-25% (Low Gap), 26% to 50% (Moderate Gap), 51% to 75% (High Gap) and 76% to 100% (Very High Gap).

9.3 **Baseline Capacity of other Important Stakeholders**

9.3.1 **BMD**

Bangladesh Meteorological Department (BMD) is the only government meteorological organization, which has the mandate to issue early warning for any disaster. The BMD has a total of 10 seismometers installed at different locations across the country through which it can only measure the intensity of the earthquake but it does not have any capacity to issue early warning for earthquake. The BMD informed, in the global context also, there is hardly any effective early warning system for earthquake. Nonetheless, BMD needs to keep abreast with the latest development in this field.

9.2.2 **SPARRSO**

The SPARRSO does not have any capability to directly receive high resolution satellite images that can be used for damage assessment in earthquake. Once there is requirement of high resolution images for damage assessment, the SPARRSO has to place the

demand to vendors, who would supply the picture with a time gap of 2-3 days. This time-consuming process would only delay the proper damage assessment and subsequent response operation. However, SPARRSO has the option to seek assistance from the international community especially from the USGS and other sources. But the use of drones by agencies like DDM can secure images for damage assessment after any major earthquake, SPARRSO official opined.

9.3.3 **AFD**

In case of major earthquake in Dhaka City, the Armed Forces Division (AFD) would play the most pivotal role as the coordinating body of three services (Army, Navy and Air Force) with Ministry of Defence and Prime Minister's Office. As per the 'Comprehensive Guideline for Armed Forces in Disaster Management', to facilitate the deployment and operation of Armed Forces in Disaster Management, AFD would establish a monitoring cell primarily to coordinate with all concerned ministries and with friendly Armed Forces. It has also published a 'Standing Operating Procedure of Bangladesh Multinational Coordination Centre' that provides a basic understanding of the Bangladesh MNCC concept during any disaster-related situation. AFD has been playing a great role since 2010 by jointly organizing the yearly DREE that has immense training value. The DREE is also a platform that helps the stakeholders in identifying their respective capacity gaps. However, AFD needs to give a final shape to its Draft Contingency Plan for Earthquake Response, meant for Dhaka City.

9.3.4 **DSCC and DNCC**

The Earthquake Emergency Plan of Dhaka City Corporation is a 10-year old document, which needs to be updated. Meantime, Dhaka City Corporation has been bi-furcated into DSCC and DNCC but none of them published any complete updated plan on earthquake emergency. Importantly, eighteen unions (9 in each City Corporations) have recently been included in the city corporations but both DSCC and DNCC are yet to incorporate them in their Disaster Management Plan. Unless this issue is rightly addressed, the population of these unions might not get due attention since their inclusion is also not incorporated in the Draft Earthquake Contingency Plan of AFD, which is a major stakeholder of coordinating earthquake response operation.

There is no separate set up of manpower in the DSCC and DNCC for earthquake management. However, both the city corporations have their Disaster Incident Management Team (DIMT), headed by respective Mayors to look after earthquake management. Similarly, with respect to SAR equipment, none of the City Corporations is in a good shape. Other than the equipment being procured through Urban Resilience Project, there is no noteworthy heavy duty equipment dedicatedly preserved for earthquake response operation. However, in both DSCC and DNCC, there are a good number of excavators, bull dozers and trucks, which are generally used for day to day waste management. These trucks and other vehicles provisioned from civil contractors would be used for debris removal as opined by the senior officials of both the city corporations.

The Urban Resilience Project is a good start in capacity building for earthquake response operation for the city corporations. However, the equipment procured so far is mostly light in nature and sufficient heavy equipment is yet to be procured. The number of warehouses are also very less to cover the mega-city of Dhaka. Nonetheless, expansion of this capacity building project would prepare both the city corporations to better face any earthquake eventuality.

The present earthquake response structure involves the Ward Commissioners of DSCC and DNCC. However, as Bangladesh Armed Forces and BGB would be the key players on the ground for SAR and other response activities, the ward commissioners' operational modalities need to be incorporated in the overall operational plan. There must be some mechanism to synchronize the efforts of Main Operational Units, City Corporations, FSCD and rescue & relief workers from abroad.

9.3.5 **DGHS**

Directorate General Health Services is the main body to ensure healthcare for the citizens of Bangladesh and it has the mandate, "To ensure instantaneous emergency health care services in case of natural disaster". Accordingly, it has regular training programme on 'Emergency Preparedness and Response (ERP)' for its personnel. However, the training on 'Search, rescue and evacuation for community level health workers' appears to be inadequate as only 105 community health workers have been trained over a period of more than 4 years. Importantly, the DGHS is being run with more than 27% vacant posts. Nonetheless, it is

appreciable that DGHS, with technical assistance of WHO, prepared the "Health Sector Contingency Plan for Earthquake Preparedness and Response" in 2011. The DGHS would open some 30-man remote centers across the city to render medical services and each shift of such centers would be manned by medical specialist from different streams including Medical Officer, Orthopedic Surgeon, and Anesthetist etc. However, it is yet to define a dedicated & complete mechanism or structural arrangement following which it would coordinate with the Main Operational Units and unfold the earthquake response operation in different sectors of Dhaka City.

9.3.6 **Customs and Immigration**

The Dhaka Customs House is entrusted with the responsibility of looking after the customs procedure at HSIA. However, they do not have a dedicated policy on 'Disaster Customs.' The NBR issues SRO on case by case to simplify the customs procedure as required. The existing procedure might emerge as an obstacle in clearing emergency relief goods and other SAR resources with required pace. A standing policy on disaster customs, if made available, would better facilitate handling of emergency cargo during emergency. An important point to note is its manpower crisis, where it was observed that the Dhaka Customs House was running with only 46% of its approved manpower. Similarly, it needs to have more communication equipment and scanners. On the other hand, the immigration procedure for earthquake response operation needs also to be relaxed as far as possible to facilitate timely reach of rescue personnel, medical experts, media men and others concerned to the earthquake-hit areas. Relaxation of immigration formalities on case to case basis would only emerge as a bottleneck in the operational activities.

9.3.7 **Biman Bangladesh Airlines**

BIMAN Bangladesh Airlines, the sole agency responsible for ground handling services at the HSIA, suffers from shortage of manpower and equipment. To meet emergency ground and cargo handling requirement on account of earthquake, it needs to augment its work force along with procurement of modern heavy-duty equipment. Nonetheless, Biman has made remarkable progress in terms of procurement of ground and cargo handling equipment in three years time (2016-2019). Importantly, a good number of

such equipment is in the pipeline for procurement. It also hired good number of people to operate this equipment. Other Biman stations, outside Dhaka, have some ground and cargo handling personnel but in case of earthquake emergency, it would not be possible to pull significant number of work force from those stations because, all other airports are likely to get busy on account of major earthquake. However, the retired personnel with cargo handling background might be called on emergency. Many of them are presently serving local private airlines and some are remaining idle. On the other hand, BAF has always some personnel doing the similar job for its operational requirement. These people can also be called to meet the emergency at HSIA. As such there is a requirement of maintaining database of such technical hands.

9.3.8 **CAAB**

The Civil Aviation Authority of Bangladesh (CAAB) would facilitate air operation from and to the airports of Bangladesh especially in Dhaka on account of major earthquake emergency with special emphasis on required relief operation. It appears that the number of Air Traffic Controllers is inadequate to maintain the control tower for sustained relief operations at HSIA under stress. However, reinforcement to some extent would be possible from Bangladesh Air Force in this regard. Otherwise, as the third terminal comes up, the capacity of the airport would get a boost by 150%. With this expansion, there would be enough space to park cargo/relief aircraft during sustained relief operation but the lack of any dedicated Humanitarian Staging Area might appear as a bottleneck in the overall supply chain network of relief goods. Besides, the CAAB is yet to upgrade the ILS category and consequently, many flights need to divert to alternate airfield in neighbouring countries. This might delay the supply chain process of relief goods from abroad in winter months.

9.3.9 **FSCD**

Bangladesh FSCD is perhaps the most organized and prepared agency to operate during the earthquake emergency in Dhaka City. There are 40,000 trained urban community volunteers, trained by FSCD, who would report to different fire stations in the event of a major disaster. At present, there are 18,200 volunteers earmarked for 91 wards of two city corporations (DSCC and DNCC). However, whether and how they would be engaged with ‘Main Operational Units’ of Armed Forces is not well defined. The SAR

operational concept of FSCD is unique to accommodate the trained volunteers in boosting their workforce. Training of volunteers needs to be continued so that there are more volunteers to cover the newly raised wards of both DSCC and DNCC. Besides, the fire stations of Dhaka City need to be modernized with sophisticated SAR resources and allocated with sufficient liquid fund so that unhindered operation can be continued in earthquake emergency.

9.3.10 **DDM**

The DDM functions with the mandate to address DRR and emergency response operation for any disaster including earthquake. It is bringing out required policy documents/guidelines to coordinate the earthquake management actions of various stakeholders. It is also procuring various types of earthquake response equipment for different stakeholders. However, DDM needs to procure equipment as per the requirement of eight main operational units that are vested with the responsibilities of operating in eight sectors of Dhaka City Corporations instead of handing over all equipment to 14 Engineers Brigade. Accordingly, the operational units of BA, BN, BAF and BGB needs to maintain their individual warehouses to stockpile various equipment but ensuring highest level of serviceability to meet operational requirement. The DDM also needs to strengthen its distribution mechanism of various policy documents/guidelines etc so that they reach the right person in the right office.

9.4 **Capacity of Private Civil Engineering Firms**

No database is readily available, in any single platform, with regards to SAR assets owned by and available with various private engineering firms operating at Dhaka though they are found to be very resourceful. Besides, there is no list available with any single agency about such firms operating at Dhaka and its neighborhood. Most of the SAR assets of firms under study are deployed in the field and they have sufficient number of operators. However, they often change their operating area as per the commitment of their firms.

There are many engineering resources available with private engineering firms operating at Dhaka and their assistance can augment the SAR efforts of the government. It is found from this study that 20 engineering firms collectively held among others 219

excavators, 70 bull dozers, 127 loaders, 295 dump trucks, 87 conventional trucks, 310 generators and 31 forklifts. In case of major earthquake, emergency response operation would be the highest priority where these resources would be an added capacity. However, an effective mechanism to incorporate these assets during earthquake emergency is yet to be devised.

Some of the firms have the experience of participating in SAR efforts after the 'RANA PLAZA' collapse in 2013 under the command of Bangladesh Army. Their experience can be of immense value in training others and while carrying out similar operations in the aftermath of earthquake in Dhaka city. The assets of 20 private engineering firms under study can remove about 494,900 tons of debris at a distance of 7 km in seven days time. The removal of this amount of debris would certainly make some difference in the overall state of earthquake response operation. Importantly, there are many small firms, which remained beyond the scope of this study but their resources might bring some respite to a resource-scarce operation.

9.5 **Awareness and Preparedness of City Dwellers**

9.5.1 **Awareness**

In general, Dhaka City dwellers are well aware (96.6% aware) of the likelihood of earthquake in their city. The study reveals that there exists significant association between the categories of respondents and earthquake awareness where people of Modern Dhaka were found to be more aware followed by people of Semi-Modern Dhaka. Importantly, 58% people of Dhaka City Corporation were not told by any source about their actions in earthquake. Here, people of Old Dhaka were found to be mostly (67%) ignorant about their actions in earthquake followed by people of Semi Modern Dhaka (38.4%) and Modern Dhaka (20.7%). It is also observed that there exists significant association between the categories of respondents and their knowing about the actions in case of earthquake. It is revealed from another question that the people (93.5%) of Old Dhaka are more willing to render voluntary service followed by people (91.4%) of Semi Modern Dhaka and Modern Dhaka (86%) in case of earthquake response. There also exists significant association between the categories of respondents and their willingness to render voluntary services.

9.5.2 **Preparation**

City dwellers' preparation for earthquake was judged by their general preparation for earthquake, maintaining stock of dry food and drinking water at least for three days, participation in some training/drill and also by their ability to cut off power and gas supply. It is alarming to note that more than 67% of the city dwellers are not prepared for any earthquake eventuality. In case of people of Old Dhaka, it is even higher (74%). However, it is revealed that there is no association between categories of respondents and their preparation for earthquake. In case of maintaining emergency stock of dry food for at least 3 days, the people of Old Dhaka (74.5%) was ahead of people of Modern Dhaka (73.7%) and Semi Modern Dhaka (69.9%). In case of maintaining drinking water, again the people of Old Dhaka has recorded the highest percentage (87%) followed by people of Semi Modern Dhaka (85.7%) and Modern Dhaka (84.4%). In both the cases of dry food and drinking water, no association was found between the categories of respondents and their storing behavior of food and water.

Exposure to training/drill on earthquake response was found to be a very weak area in this study. In general, only 13.1% people of Dhaka City was exposed to some kind of training/drill on earthquake leaving nearly 87% of them without such exposure. The people of Modern Dhaka had the highest percentage (16.2) in this respect. Statistical analysis reveals that there is no association between the categories of respondents and their exposure to training/drill. City dwellers were also asked to express their ability to cut off power supply and gas supply from the main line of their respective buildings. In case of power supply, the people of Old Dhaka were found to be more cautious and 60% of them knew how to cut off power for the whole building. The people of Modern Dhaka and Semi Modern Dhaka were found to be little reluctant in this respect with only 45.3% and 53% of them knowing this critical operation respectively. Interestingly, there exist significant association between the categories of respondents and their knowing to cut off power supply. On the other hand, in case of knowing how to cut off gas supply from the main line of the building, the performance of city dwellers was again discouraging. Only 24.1% of them knew this operation, in general. However, there exists no association between the categories of respondents and their familiarity with cutting off the gas supply.

9.5.3 **Perception of City Dwellers' about Awareness and Preparation**

Almost every city dweller (99.7%) either 'Strongly Agreed' or 'Agreed' that there is need for strengthening awareness program for earthquake response in Dhaka City. It is to be noted that only 0.3% of them remained 'Indifferent' with regards to need for awareness strengthening programme but none expressed his 'Disagreement' for that. On the other hand, it is observed that there exists significant association between the categories of respondents and need for awareness strengthening in Dhaka City. With regards to the second statement "The mass media needs to play more active role for awareness building", again, a noteworthy 95.8% of the city dwellers either 'Strongly Agreed' or 'Agreed' with it. However, 3.4% of them remained 'Indifferent' and only 0.9% expressed their 'Disagreement'. It is also revealed that there exists significant association between the categories of respondents and the need for more active role of mass media for awareness building. "City dwellers do not have adequate preparation for earthquake" was the third statement for which a very encouraging 97.6% of the respondents either strongly 'Strongly Agreed' or 'Agreed' to the query and 1.4% of them remained 'Indifferent' while only 1% people expressed their 'Disagreement'. Statistical interpretations revealed that there exists significant association between the categories of respondents and their perception about city dwellers' preparation for earthquake. While recruiting volunteers, there should be right representation from different wards of City Corporation as considered by 97.7% respondents from city dwellers. The responses of three categories of people were nearly similar and there was no association between the categories of respondents and their attitude towards volunteer recruitment.

While studying the need for arranging regular earthquake drill in Wards of City Corporation, the response of city dwellers was very appreciable with 94% of them either 'Strongly Agreed' or 'Agreed' and concluded that there was such requirement. Though 5.2% of them remained 'Indifferent', only 0.8% expressed their 'Disagreement'. Importantly, study also revealed no association between the categories of respondents and their attitude towards the statement. On the other hand, for the statement "There is need for pre-designation of open space as immediate shelter" for the earthquake victims, a notable 95% of the total respondents either 'Strongly Agreed' or 'Agreed' appreciating that it would be prudent to pre-designate the limited open space so that chaos and

confusions are very less during earthquake emergency. Respondents of different categories of people reveal that there is no association between the categories of respondents and their attitude towards the statement "There is need for Pre-designation of Open Space as Immediate Shelter".

A very interesting finding came out when the respondents were asked to opine on the statement "Pharmacy Workers, if given First Aid training and put into work, would ease the First Aid during Search and Rescue". More than 81% of them either 'Agreed' or 'Strongly Agreed' highlighting the need for putting the pharmacy workers in the first aid business after an earthquake. Nonetheless, they would also require some training to undergo. It is well understood that they would be working better since many of them have already some exposure in delivering first aid. On the other hand, against the statement, "Trained Construction Workers may effectively be used in SAR Operation", a noteworthy 77.2% of the total respondents either 'Strongly Agreed' or 'Agreed'. An insignificant 9.2% of them remained 'Indifferent' while 13.6% people expressed their 'Disagreement' with the statement. From statistical analysis, it was observed that there exist significant association between the categories of respondents and their attitude towards this statement.

9.6 **Other Findings**

Unclear AOR. 46 Independent Infantry Brigade in their AOR delegated New Market and Hazaribag Thana to one artillery regiment. However, these two areas (Thanas) are also included in the AOR of Border Guards Bangladesh (BGB). Again, another East Bengal Regiment of the 46 IIB is made responsible for Banani and Gulshan area, whereas, Bangladesh Navy (Admin Area-Dhaka) has also mentioned Banani, Gulshan as their AOR. Again, one Bangladesh Infantry Regiment of 46 IIB is made responsible for Lalbagh, Kamrangirchar, Chawkbazar, Kotwali and Bongshal thana. The operational plan of Border Guards Bangladesh (BGB) also says that these areas are under their AOR. Again, the 46 IIB (Sector-6) says that the Tejgaon Old Airport and Public Service Commission area falls under their AOR. On the other hand, BAF Base Bashar, which is responsible for Sector – 4, also says that Old Airport at Tejgaon is its AOR.

Assignment of New Wards. The Dhaka City Corporation has been divided into two – DNCC and DSCC. Many new unions are also brought under these city corporations and

accordingly, many new wards are created for both DSCC and DNCC. These areas are not incorporated in the Draft Earthquake Contingency plan of AFD. Accordingly, the operational responsibilities of these areas are also not given to any unit of the Armed Forces. There is requirement of making new sectors for these areas or present sector areas may be revised. Otherwise, the critical response is unlikely to be unfolded for them, as desired.

Identification of Potential Shelters. Locations of all potential emergency shelters (school buildings, convention centers etc), which are found to be robust in construction and easily accessible, may be identified and mapped for each sector. Such information may be shared among the sectors and other important stakeholders to bring harmony in overall response effort. This mapping may be reflected in the unit operation plan/contingency plan.

Compatibility of Communication Equipment. The communication equipment and devices that would be procured in future should have compatibility with the existing one. Besides, there may be a compatibility check among the users of communication resources under different Main Operational Units.

CHAPTER X: CONCLUSIONS AND RECOMMENDATIONS

10.1 General

The broad objective of this study was to assess the capacity need for earthquake response in Dhaka City. As such, efforts were made to identify the determinants of capacity for this study to develop the conceptual framework. Thereafter, various stakeholders of earthquake response in Dhaka City were identified and the capacity needs of eight main operational units of Bangladesh Armed Forces and BGB were assessed through a participatory approach. On the other hand, the baseline capacities of other important stakeholders were also studied. The awareness and preparation of Dhaka City Dwellers regarding earthquake was also within the purview of this study. The major findings of this study are amply highlighted in Chapter IX. In brief, the main operational units need to augment their SAR capabilities through procurement of SAR equipment and training. They also need to update their respective SOPs and carryout compatibility test of their communication equipment to secure a seamless communication during emergency response operation. Other important stakeholders of earthquake response also need to enhance their capacity especially in terms of provisioning of manpower, SAR resources and Legal and regulatory framework. Nonetheless, based on the major findings of this study, following recommendations are made:

10.2 Main Operational Units

The SOPs/Standing Orders developed by the operational units may be updated immediately with all essential information like available open areas, water bodies, hospitals, clinics, schools & colleges, pharmacies, name & contact numbers of local leaders, names of different utility service providers, location of generators including portable ones, and location of rescue assets of civil organizations so that emergency response can be unfolded with all available resources from the very beginning.

The Main Operational Units, through internal coordination meeting, may clearly define their AORs and delineate respective areas with sufficient landmarks (buildings and roads etc) to avoid duplication of effort and not to keep any area unaddressed because of ambiguity. Similarly, the subsectors may also be demarcated with such landmarks.

The Main Operational Units (Except 14 IEB) may endeavour to procure both light and heavy duty SAR resources to meet their own operational requirement. They may place demand for allocation of special budget to the government through DDM for such allocation and side by side, they may also raise a special DM unit to maintain such costly resources.

The Main Operational Units, which have no noteworthy medical facilities of its own, like 14 IEB, 86 ISB, 6 IAB and 46 IIB may gradually develop their own medical facilities integral to the unit or they might have some dedicated field hospital to facilitate their earthquake response operation. Besides, other Main Operational Units like BAF Bangabandhu, BAF Bashar, BN Admin Area Dhaka and BGB, which have already some hospital facilities, may take up steps to extend their facilities so that they can extend considerable medical treatment to the earthquake victims.

10.3 **BMD and SPARRSO**

Both BMD and SPARRSO might take up steps for their respective capacity building. Here, emphasis may be given for Bangladesh Meteorological Department to have latest early warning system and SPARRSO might aim to have capability for obtaining real-time or near real-time images of the affected ground area so that damage assessment is an effective one. Besides, both the organizations may collaborate with other reputed world agencies to get their expertise in their respective fields. The SPARRSO may have some understanding with some Geo-Stationary satellite sources, which has good resolution in assessing the damage.

10.4 **AFD**

The AFD may be continue to arrange the DREE every year but the participation to such exercise may be extended to some selected field-level non-commissioned personnel of the Armed Forces and BGB. Importantly, right after the DREE, there may be a train the trainer exercise at different units so that more number of people are given training. All the main operational units may be given the responsibility, in rotation, of organizing the field exercise (FTX) during the DREE so that all units can capitalize from this invaluable training exercise. In future, such awarding of responsibility to Main Operation Units may also be repeated.

Training exercise may also be arranged among the eight operational units of Bangladesh Armed Forces and BGB to see the compatibility of their communication equipment in an inter-sector environment in a setting of normal telecommunication failure. Gradually other stakeholders like FSCD, City Corporations and others utility service providers may also be included in such communication drill.

The AFD may arrange for allocation of handsome amount of money to each Main Operational Unit of Bangladesh Armed Forces and BGB so that these units can keep same readily available to meet any emergency operational requirement in the aftermath of earthquake. Otherwise, there may be some arrangement following which these units would be able to draw money on priority basis from the scheduled banks of the country.

Armed Forces Division may maintain a database of the personnel of Bangladesh Armed forces including the retired personnel, who received some kind of training on earthquake response at home and abroad. In case of emergency, they may be called to report to Dhaka area in case of emergency.

The draft contingency plan of the Armed Forces Division may be finalized with latest updates in all respect especially with regards to layout of underground utility services for all sectors. There may be a standardized format for the eight operational units (responsible for eight sectors) to follow while finalizing individual contingency plan or SOP so that all relevant information is available for all the sectors of Dhaka City.

The AFD might develop a ‘Drone Unit” through BAF Base Bangabandhu or BAF Base Bashar that would be dedicated for real time damage assessment after the earthquake and disseminating the same information to all other concerned stakeholders.

10.5 **DSCC and DNCC**

The heavy equipment and other machineries being procured, through URP, for City Corporations may be stored in strategically important and dispersed locations and such warehouses may be more in number so that the assets are less vulnerable to earthquake. Importantly, alongside the city corporation personnel, the members of armed forces and BGB may also be trained to operate the equipment during peacetime so that they can operate them in the field during emergency if the situation demands so.

The DNCC may take up a step so that the WB-financed Bangladesh Urban Resilience Project (URP) of the government is extended and strengthened further to procure more heavy-duty SAR equipment, manpower and training for the major stakeholders of earthquake response. Importantly, there may be a judicious distribution of such invaluable assets among the stakeholders so that they are properly maintained, operated and kept in operational readiness.

The areas under various union councils, included in City Corporations recently, may be incorporated in different sectors based on the proximity of the areas with neighbouring sectors and operational capability of the unit concerned. If ground reality suggests, new sectors may also be created. Accordingly, demarcation of the sector boundaries may be amended. DSCC and DNCC may coordinate with AFD for such inclusion of new Wards.

The City Corporations may earmark the open spaces of the city to city dwellers of different area so that they serve as potential shelters for earthquake victims. Considering the sanitation requirement, city corporations may construct public toilets in Dhaka City preferably adjacent to those open spaces and across the city.

The city-dwellers may be trained, through community based training programme on "know how to switch off the power for the whole building and cut off gas supply for the same." They may also be made aware about their predetermined assembly places for taking immediate shelter and may be prepared, through awareness programme in the mass media, for regularly storing dry food and water for at least for 3 days.

The DSCC and DNCC may bring out their own 'Earthquake Contingency Plan' with clearly defined AOR and that must cater for the newly included wards. Since Main Operational Units will bring out their own SOP with information like open fields, water bodies, road networks, local leaders etc; DSCC and DNCC may jointly work with those units so that there is no duplication of effort.

10.6 **DGHS**

The DGHS may immediately take up steps to fill all the vacant posts in its organogram. Importantly, it may create new set up emergency satellite hospitals to meet the

contingency of earthquake. It may update its Emergency Response Plan and may maintain a buffer stock of emergency medical stores across the city.

The provisioning of medical store would be a big challenge for the government in post-earthquake scenario. A peacetime well-thought of and redundant distribution mechanism for medical stores may be devised to reach the victim dressing centers and field hospitals. Integration of privately-run pharmacies and medical stores would be very effective since hundreds of such outlets are scattered across the city. As such, these outlets may be enlisted and a complete database may be maintained to call them on emergency.

The DGHS may gradually bring the employees of the Pharmacies of Dhaka city under the earthquake response programme. There may be a representation from them, through DGHS, in the annual DREE, organized in Bangladesh. Besides, they may also be told, in peacetime, to report to some designated place in case of a major earthquake. They may be engaged in dispensing medicine and offering first aid to the injured city dwellers. DGHS may shoulder the responsibilities of imparting advance training to them.

10.7 **Customs and Immigration**

The customs and immigration policies may be updated with provision for facilitating emergency clearance of relief goods and arrival of rescue workers, medical teams and media personnel by air, rail and road. Customs department, in coordination with DDM and AFD may prepare a list of items that might be required during the earthquake response, and accordingly, formulate necessary policies to facilitate fastest entry of the same. The Nepal experience 2015 may act as ready reference while formulating such policies.

10.8 **Biman**

Biman Bangladesh Airlines may enhance its ground handling and cargo handling capability at the HSIA so that relief goods from the cargo aircraft are offloaded without undue delay. This capacity is required not only to facilitate faster offloading of cargo from aircraft, it also facilitate more number of cargo aircraft landing in an airport. As such, Biman may go for procurement of required equipment and hiring people catering

for such emergency. Besides, Biman may also maintain a database of its retired personnel with such background so that they can be called for emergency response duty. Biman may also take part in the annual exercise DREE as organized by AFD and DDM.

10.9 **CAAB**

The CAAB may have a disaster response support plan that would cater for emergency allocation of space to be used Humanitarian Staging Area. It might have an augmented establishment to meet any earthquake emergency especially keeping provision of round the clock maintenance of ATC tower under stress condition. In the upcoming 3rd Terminal, it might have some space for emergency customs, on arrival visa, quarantine and space for incoming dog squad etc to facilitate faster entry of emergency aid and emergency rescue workers.

10.10 **FSCD**

The volunteer training programme, as targeted by FSCD of Bangladesh, may be materialized at the earliest. The database of the trained volunteers may be shared with all Main Operational Units of the Armed Forces and BGB. Importantly, provision may be made to direct some of these volunteers to the concerned sector headquarter to immediately join the rescue effort undertaken by the Main Operational Units. Otherwise, FSCD may conduct a separate volunteer training programme dedicatedly for all the eight sectors of Dhaka City to keep at least 1000 volunteers standby for each sector. While recruiting volunteers for such training, there may be a judicious representation from local community.

10.11 **DDM**

The SAR equipment to be procured for different agencies for earthquake response should be compatible as much as possible. This would promote interoperability and ensure efficient use of equipment. As such the government may make some standardization for purchasing such equipment. The DDM may take up a case for such standardization.

The DDM may maintain a database of the construction workers having experience of cutting steel structures and demolishing buildings. These semi-skilled people may be trained to operate different types of heavy-duty concrete cutters under the auspices of

DDM or City Corporations or Bangladesh FSCD. The trained people may be enlisted as volunteers to work in case of any earthquake eventuality.

DDM, in coordination with AFD, may bring out a clear cut policy guideline to incorporate the foreign rescue workers, medicos and volunteers that would arrive from abroad during the response phase of earthquake. Some focal points may be earmarked with necessary phone number and e-mail so that such interested volunteers and specialized workers can communicate well before landing to Bangladesh. The MNCC may get a permanent organizational structure with staffs having fluency in major languages of the world.

DDM may arrange at least one drill for each sector in every four years involving the city dwellers of concerned sector. Participation of major stakeholders like AFD, FSCD, DGHS, City Corporations, utility service providers and the volunteers trained by FSCD may be ensured. Such drill may also include mock up evacuation drills leading to designated open spaces by the selected city dwellers. In such case only the nominated (30-50) city dwellers may know, well in advance, the designated open space for them to avoid undue chaotic rush for shelters in real emergency.

All the eight Main Operational Units of the Armed Forces and BGB may be allotted with some heavy SAR equipment by the DDM to keep them acquainted with their operational procedure. This would also allow them to commence the SAR operation immediately after the occurrence of earthquake. Besides, the operational units may be also given sufficient budget to facilitate direct procurement of SAR equipment and provisioning of operators.

DDM may prepare a database for the heavy equipment like excavator, pay-loader, dump truck etc that are owned by various civil construction firms at or near Dhaka city. Knowing the latest position of such equipment and contact numbers of their operators will considerably enhance the country's earthquake response capability. Accordingly, there may be a peacetime agreement with such firms so that employment of such equipment is facilitated and they can be paid from the government in due course of time. Besides, there may also be database prepared by DDM for off-the-shelf sources of such equipment at home and abroad.

CHAPTER XI: DIRECTIONS FOR FURTHER RESEARCH

This research, primarily, was aimed at assessing the capacity need for earthquake response in Dhaka City. Accordingly, attempts were made to assess the capacity gap/need of all eight Main Operational Units; those are responsible for eight sectors of Dhaka City. Nonetheless, baseline capacity of all other important stakeholders for earthquake response was also studied. In any future research, the capacity gap/need of these stakeholders (other than main operational units) may also be studied. Besides, there may be similar study with regular intervals to assess the pace of capacity development among the important stakeholders. Such a study may aim to see whether the gap between existing capacity and desired capacity is narrowing or widening.

While sampling the city dwellers, slum dwellers and floating people were not included just to keep the study manageable. Any future research may take these vulnerable populations into consideration. Again, while determining the sample size, it was revealed that a sample size of 384 was acceptable for this research though the population of Dhaka City was little more than 8.84 million in 2011. Accordingly, a larger sample size (715) was considered to have better representations from different areas. Meantime, population of Dhaka City has gone up and accordingly, any further study may be conducted with larger sample size including people from all walks of life. Besides, the preparation of educational institutes like schools, colleges and madrasas etc may also be studied.

Organizational capacity need assessment is always a very sensitive issue and the organizations are not really bound to dish out information, which are classified or bears some kind of sensitivity. As such, any further study that would involve the units of Armed Forces or law enforcing agencies may be some kind of participatory assessment where there may be active contribution of the Unit concerned.

In any disaster situation especially in earthquake mega disaster, assistance from international community bears special importance. Historically, hardly any country alone could manage a mega disaster. As such, in any future research, modalities of calling for international assistance and various coordination aspects at different levels including media management may also be studied.

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