National Resilience Programme

Report on

Gap Analysis on Existing DRM and Disaster Response and Recommendations for Earthquake Safe and Resilient Bangladesh

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National Resilience Program

Gap Analysis on Existing DRM and Disaster Response and Recommendations for Earthquake Safe and Resilient Bangladesh

Final Report

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Dhaka, Bangladesh

National Resilience Program (NRP)

Gap Analysis on Existing DRM and Disaster Response for Mega Disaster

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Acronyms

AFD	Armed Forces Division
BBS	Bangladesh Bureau of Statistical
BDRCS	Bangladesh Red Crescent Societies
BNBC	Bangladesh National Building Code
B-PDNA	Bangladesh model of Post Disaster Need Assessment
BRRM	Bangladesh Risk and Resilience Model
BWDB	Bangladesh Water Development Board

CCDMC	City Corporation Disaster Management Committee
CDMP	Comprehensive Disaster Management Programme
CDA	City Development Authority
DC	Deputy Commissioner
DDM	Department of Disaster Management
DDMC	District Disaster Management Committee
DESCO	Dhaka Electric Supply Company Limited
DGHS	Directorate General of Health Services, Ministry of Health and Family Welfare
DM	Disaster Management
DPDC	Dhaka Power Distribution Company Limited
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DRSC	Disaster Resilience Score-Board for Cities
DWA	Department of Women Affairs
EDRM	Earthquake Disaster Risk Management/Reduction
EPAC	Earthquake Preparedness and Awareness Committee
FPOCG	Focal Point Operation Coordination Group of Disaster Management
FSCD	Fire Service Civil Defence
GAR	Global Assessment Report
GEM	Global Earthquake Model
GoB	Government of the People's Republic of Bangladesh
HAZUS	Hazard Assessment USA, Tooldbox for hazard and risk analysis based on US model
HBRI	Housing and Building Research Institute
IMDMCC	Inter-Ministerial Disaster Management Coordination Committee
JICA	Japan International Cooperation Agency
LGD	Ministry of Local Government, Rural Development and Co-operatives
MoDMR	Ministry of Disaster Management and Relief
MoHPW	Ministry of Housing and Public Works
MoP	Ministry of Planning
MoWCA	Ministry of Woman and Children Affairs
NDMAC	National Disaster Management Advisory Committee
NDMC	National Disaster Management Council
NEOC	National Emergency Operation Center
NOC	No Objection Certificates
NPDM	National Plan of Disaster Management
NPDRR	National Platform for Disaster Risk Reduction
NRP	National Resilient Program
PDNA	Post-Disaster Needs Assessment
RAJUK	RAJUK under Ministry of Public Work
SDG	Sustainable Development Goals
SFA	SAARC Framework for Action
SFDRR	Sendai Framework for Disaster Risk Reduction
SOD	Standing Orders on Disaster
UDD	Urban Development Directorate

UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UZDMC	Upazila Disaster Management Committee
URP	Urban Resilience Program
WB	World Bank
WDMC	Ward Disaster Management Committee
WEOC	Ward-level Emergency Operation Center

Executive Summary

Based on the 2019 various World Disaster Report, undoubtedly, Bangladesh is among most disaster-prone countries in the world facing a high risk of earthquakes, floods, and cyclones; with a low level of adaptive capacity to face disaster. Moreover, Bangladesh is one of the fastest urbanizing countries in the world, with an average annual rate of urbanization of 5.34 since 1974. It is anticipated that by 2050 the country's share of urban population will reach 56%, which was 35.8% in 2017. In the face rapid urbanization, the country's number of cities has increased by about 4.7 times in the last 40 years. At the same time, Bangladesh with 7-8% national growth is on a strong track to becoming a Middle-Income country. All of this means risk to human lives and resources. This objective can only be achieved if Bangladesh would become safe and resilient for natural disasters, especially earthquakes. The overall situation analysis shows that an enormous amount of work and research related to natural disasters and risks have been done by national and international organizations and many policies and strategies and organizational arrangements are in place, and what is remained as the main gap and challenge is their implementations. This is the FACT that "Government" and "People" should accept.

To deal with this high level of risk, the Government of Bangladesh (GoB) has instituted many disaster risk reduction strategies and policies and is investing a lot to mitigate the risks of natural hazards, especially floods and cyclones since 1990. It is noted that during the last decade, the country has been successfully managed the hydro-meteorological disaster resulting in reducing the loss of lives from cyclones compared to similar events in the '70s and '90s. The good and positive sign is that the effect of the ongoing activities by GoB has reduced the risk level since 2013 to present from 20.22% to 18.78%; which indicates the risk reduction activities provide a positive response.

Despite the strong will of the GoB for safe and sustainable development and be prepared for disasters, the existence of young motivated generation, availability of international funds and good achievements; like many other developed or developing countries, there are still gaps in the DRM programs in particular to seismic hazards that need to be addressed. Doing a situation analysis on the existing DRM system of Bangladesh, and reviewing all of the studies that have been done (or ongoing) with respect to earthquake hazard, vulnerability, and risk analysis, the major challenges toward safe and resilient Bangladesh has been identified as Lack of fully integrated-Nexus disaster risk management and emergency response system; lack of integrated hazard, vulnerability, risk and resilience model; Insufficient technical capacity and resources; Low public awareness; and Accepting the fact of high earthquake risk in main urban development.

Based on the international practice and UN strategies and guidelines such as SFDRR and SDG (2015-2030); lessons learned from the countries with similar condition and their successful achievements; and with the socio-economic and cultural consideration of great nation of Bangladesh; 10 key recommendations with the main objectives of saving human lives and resources are proposed, which are all aligned with the SFDRR and scientific and technical principal of earthquake risk reduction. The full implementation of these recommendations, which has minimum cost implication on the GoB, ensures the safety, security, and sustainable development and growth of Bangladesh.

The proposed recommendations which are completely integrated and complementary with full interdependency, follow two main undeniable strategies for earthquake risk reduction:

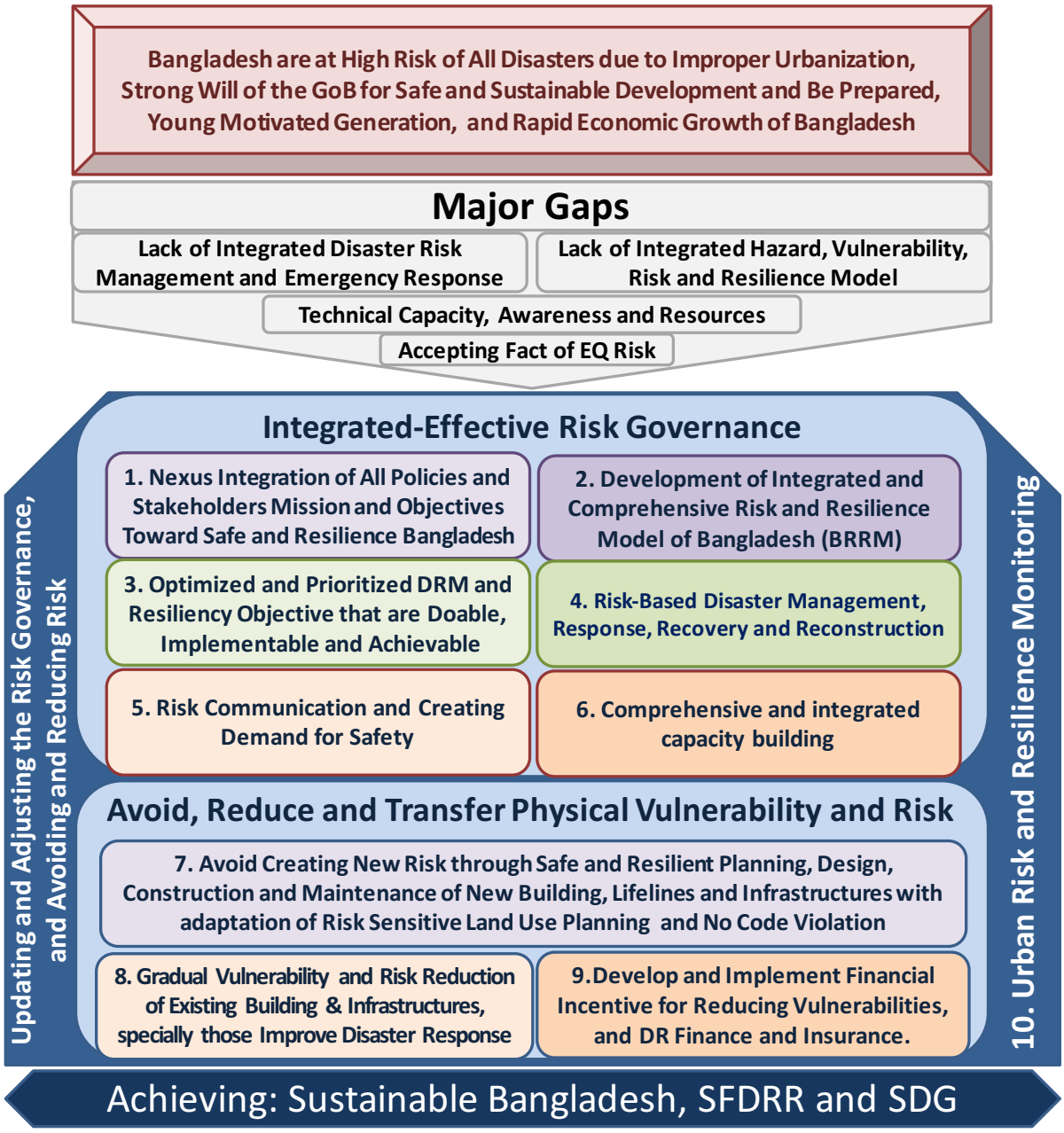
I. Integrated-Effective Nexus Risk Governance:

1. Integration of all programs, policies, regulations, institutions, and stakeholders by creating synergy through systematic and NEXUS approach.
2. Design and develop an integrated and compressive "Bangladesh Risk and Resilience Model" with the objectives of quantifying the actual risk (physical, human and economic loss). The
3. Optimized and prioritized DRM and resiliency objectives and actions that can be implementable, achievable, doable, and affordable to reduce risk effectively with a high level of implementation. For optimizing the activities, the acceptable level of risk, and the target resilience should be defined with emphasize on the main urban settlements.
4. Creating demand for safety through effective and reliable risk communication. Human safety against all disasters (natural or man-made) is part of the basic human right. An undeniable right that should be observed by the decision makers and governments of Bangladesh. The religious incentives should be used for creating demand and public participation.
5. Comprehensive and integrated capacity building. To build the specialized capacity that is required for effective risk avoidance and risk reduction and sustainable development; and being able to implement existing and available know-how toward safe urban development, building safety, human safety, and sustainable development of Bangladesh.
6. Implementation of Risk-Based Disaster Management, Response, Recovery and Reconstruction. Improving effective disaster response capacity through integrated and unified disaster response and Command System; and development of post disaster recovery and reconstruction program.

II. Avoiding, Reducing and Transferring Physical Vulnerability and Risk:

7. Avoid creating new risks through safe and resilient planning, design, construction and maintenance of buildings, lifelines and infrastructures. This recommendation can also be grouped in the above category since it is more management and governance oriented.
8. Gradual vulnerability and risk reduction of existing built-environment, especially important and vital ones with the objective of saving human loss and resources and improve disaster response.
9. Design, Develop and implement financial incentives for reducing vulnerabilities, and disaster risk finance and insurance.
10. Continuous Risk and Resilient monitoring of urban area through a safe and resilient index.

Recommendations 7 and 8 have the highest priority and can be started immediately. Construction of even one safe building or strengthening the safety of one structure is important and would have an immediate effect on risk reduction and reduces the post-disaster needs. Among the safety of the buildings, the school and hospital are vital. Thus it is highly recommended that safe school and safe hospital initiatives should be started immediately, which in turn requires the development of the special guidelines for "Safe and Resilient School" and "Safe and Resilient Hospital" as their basis.



Summary of the disaster risk facts and major gaps in Bangladesh DRM system, and the framework of the proposed 10 key recommendations for achieving sustainable development and growth of Bangladesh; as well as GoB contributions to SFDRR and SDG

1. INTRODUCTION

1.1. General Overview

Based on the 2019 World Disaster Report [65], Global Earthquake Model (GEM) [44], EU-Risk INFORM Index [61], and many national studies; undoubtedly, Bangladesh is among most disaster-prone countries in the world ranking 10 in 2019; facing a high risk of earthquake, floods, and cyclones. More important very low lack of adaptive capacity to face disaster. While we live with many unpredictable disasters in our world such as COVID-19, but unpredictability is often not the problem. The problem is that in general, even the governments that are facing clear risks, but they still fail to accept the fact of the existing risk. Thus as the first step, the "Government" and "People" of any nation should fully accept the fact that they are at risk. To deal with this high level of risk, the Government of Bangladesh (GoB) has instituted disaster risk reduction policies and invested in infrastructure along coastal areas to mitigate the risks from floods and cyclones. The good and positive sign is that, based on the World Disaster Report from 2013 to 2019, the effect of the ongoing activities by GoB has reduced the risk level since 2013 to present from 20.22% to 18.78%; which indicate the risk reduction activities provide positive response [65].

Bangladesh has not experienced a large-scale earthquake in the past century. However, the risk of earthquakes and other disasters remains. Many individuals and institutions are not aware of the steps they can take to reduce the impact of earthquake risks when they occur. In addition, despite the risks, buildings are often constructed in a way that cannot withstand an earthquake and the lack of public awareness has led to a low demand for buildings with these features. The lack of basic awareness about steps that can be taken to reduce fire risk too, is disconcerting and leaves the public vulnerable to potential dangers.

At the same time, Bangladesh with 7-8% national growth is on a strong track to becoming a Middle-Income country and demonstrates strong ownership to attain the Sustainable Development Goals by 2030 for resilience. Moreover, Bangladesh is one of the fastest urbanizing countries in the world, with an average annual rate of urbanization of 5.34 since 1974. It is anticipated that by 2050 the country's share of urban population will reach to 56%, which was 35.8% in 2017. In the face rapid urbanization, the country's number of cities have increased by about 4.7 times in the last 40 years. This objective can only be achieved if Bangladesh would become safe and resilient for natural disasters, especially earthquake. The overall situation analysis shows that enormous amount of work and research related to natural disaster and risk have been done by national and international organizations and many policies and strategy and organizational arrangement are in place; and what is remained as main gap and challenge is their implementations.

The National Resilience Programme (NRP) is designed with the goal of sustaining the resilience of human and economic development in Bangladesh through inclusive, gender responsive disaster management and risk informed development. Considering that most part of Bangladesh is exposed to high level of earthquake risk which can have a major effect on all planned development process; and lack of having a clear idea and experience on how the country is really prepared for a mega earthquake in large populated cities and towns as well.

This report describes a gap analysis of the earthquake disaster management of Bangladesh. UNDP in cooperation with the GoB undertook this effort to identify potential improvements

to the functional domains in Resilient that could be provided by the application of current or future technology. To perform this domain-based gap analysis, experts and officials will be interviewed subject matter related to the risk and resilient; to assure that the analyses reflected a representative view of the key stakeholders from different region and organization in Bangladesh.

This report will not intend to be an exhaustive list of gaps in earthquake disaster management of Bangladesh, but rather a framework for organizing and analyzing representative gaps uncovered by this effort. The purpose of this report is to present existing earthquake disaster management needs that will inform the development of appropriate technologies to meet these needs in the future. A thorough understanding of these gaps will allow for a more informed approach to applying technology and prioritizing research and development to allow the Disaster Risk Management (DRM) community consisting of many organizations (local, divisions, districts, sub-districts and unions and private) to improve their effectiveness and implementation of the policies.

This report provides evaluation of the existing DRM framework and organization and its achievements in order to identify the key challenges for Earthquake Resilient Bangladesh. The identified challenges are based on reviewing the existing documents and studies that has been done; and based on the interviews and discussions with the available key stakeholders listed in Appendix V.
The identified gaps could be categorized as:

- Stronger coordination, collaborations and linkages among the sectors
- Improvements for institutional capacity
- Effective implementation to realize inclusiveness of all multi stakeholders
- Lacks of required expertise in hazard- earthquake in particular, vulnerability and risk assessment
- Lacks of required expertise in post disaster needs and loss assessment for effective response.
- How GoB/MoDMR can improve structural/physical safety of the built environment (buildings, lifelines and infrastructures).
- Lack of incompatible design, construction and maintenance of the physical development with respect to potential hazards; i.e. low quality building and Infrastructure, improper engineering practice.

In order to have a better understanding of risk and resilience and what need to be done for gap analysis, a brief description of risk and resilience describing important contributing factors and their dimensions. When GoB or this project set their goal of Resilient Bangladesh, it should be exactly defined that what the target point is and what should be the acceptable level of risk with respect to the available technical, political, human and financial resources?

1.2. Earthquake Risk of Bangladesh

The general description of risk is defined as the probability of demand created by a disaster exceeding the capacity to cope with the disaster. Seismic risk represents the convolution (⊗) of hazard and exposure and the susceptibility or the vulnerability of the exposed elements to incur damage due to seismic action and in simple form or language is formulated as:

$$\text{RISK} = \frac{\text{Hazard} \otimes \text{Exposure Vulnerability} \otimes \text{Value}}{\text{Governance, Management, Capacity}}$$

The above relation shows that risk depends on four components:

- Intensity of hazards (Natural such as earthquakes, cyclones, floods, sea-level rise; and man-made such as fire, biological, cyber, etc,)
- Exposure vulnerability or susceptibility of the exposure to all type of hazards which depends on the safety and quality of the built environment (buildings, lifelines and infrastructures) and its socio-economic-cultural content.
- Value of the exposure. The human, economic and cultural value of the elements at exposure which highly depend on societal value and wellbeing affecting the risk level.
- Good and effective governance and integrated management have high effect on avoiding and reducing risk
- Adopting capacities depending on governance, disaster response system, preparedness, healthcare, social and material security, etc.

Considering this conceptual relation, and the following facts about Bangladesh:

- High seismic hazard, especially in Dhaka, north-eastern and north-west part of Bangladesh,
- High vulnerability of the built environment (based on the national and international studies such as CDMP, GEM, URP, etc.),
- Rapid growth of human, social, economical, cultural and security values with time and specially with the rate of 8% economic growth and development,
- Low level of awareness, preparedness and effective disaster (specially earthquake) response, and
- Lack of appropriate and integrated Risk Management system;

the earthquake risk in the Bangladesh should be high. See the overall quantitative and qualitative analysis of Bangladesh earthquake risk performed by Global Earthquake Model (GEM) as shown in Figure 1-1. This analysis shows that for a city or building located in a region of high seismic hazard may exhibit low risk if constructed specifically to resist the expected level of seismic action (i.e. if it has low vulnerability). Conversely, high risk levels are observed when the exposed urban area are highly vulnerable and therefore not prepared to cope with (even) low to moderate seismic hazard. Moreover, as Bangladesh grows rapidly socially, financially and having rich cultural value, high hazard and vulnerability increase the risk substantially. Finally, with integrated and effective risk governance, high capacity to cope and adopt with disaster as well as good response system, risk can be reduced and vice versa, poor governance and low technical, human and financial capacity and low level of preparedness risk become higher; as it is the case in most part of Bangladesh; which has made this country high in the world risk list. This is another fact that have to be accepted by all in order to take an effective can say and comprehensive action.

Moreover, based on the World Risk Index which ranks all countries based on their level of hazard, exposure, vulnerability and coping and adoptive capacity; Bangladesh Natural Disaster Risk has been ranked 10 in 2019 [Ref. 635]. Based on INFORM assessment (EU-Disaster Risk Management Knowledge Centre-INFORM report 2019), Bangladesh has the highest physical

exposure to flood score (10) and earthquake score (9.2) and with total score of 6, ranks 22 in all 191 countries against this risk which highlights the increased need for understanding of risk patterns and trends in the country. Figure 1-2 shows the trend and changes of risk and its main contributing factors: hazard, vulnerability, coping capacity from 2013 to 2020 in Bangladesh [Ref. 61, Risk INFORM].

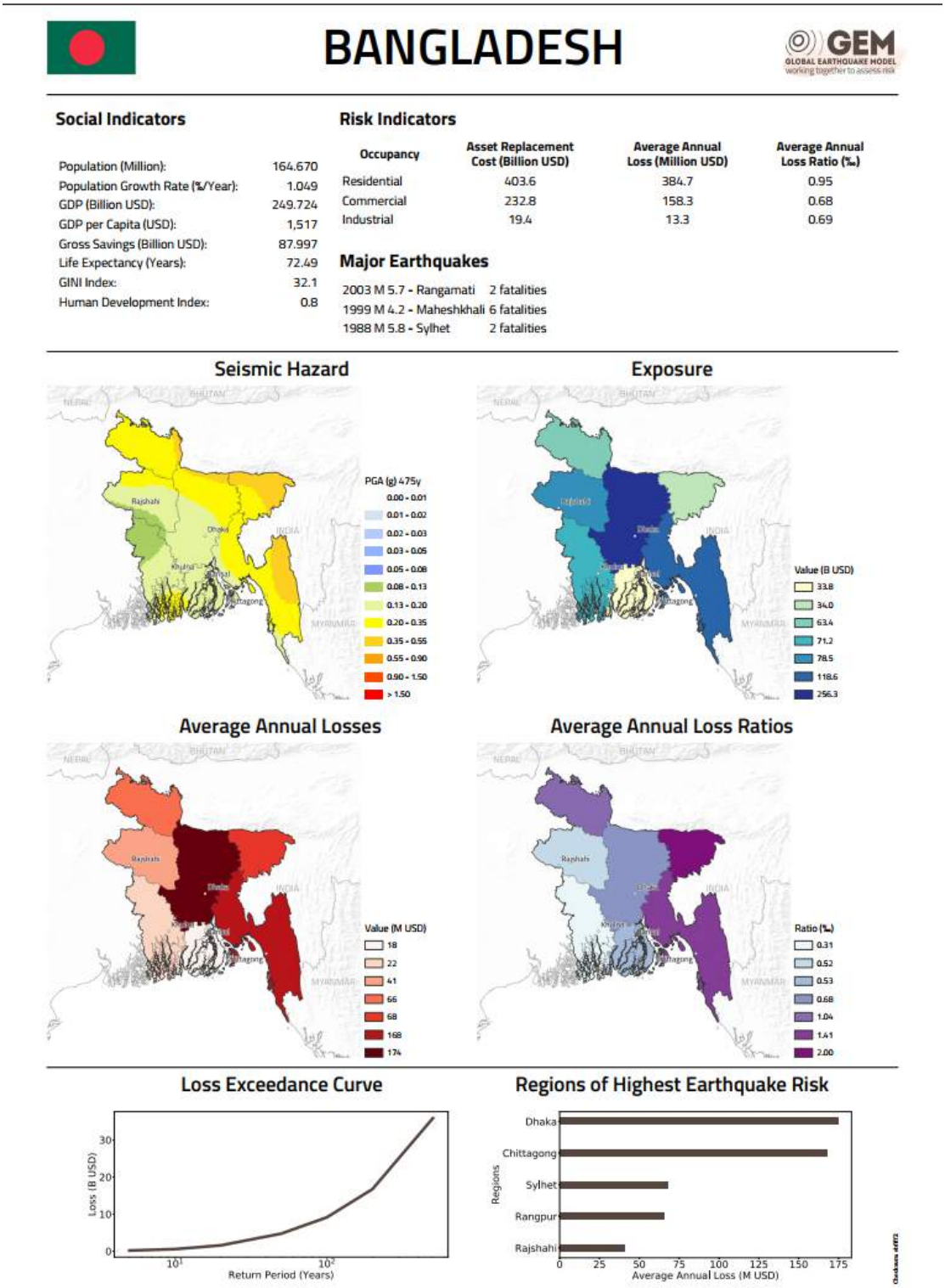


Figure 1-1: Bangladesh Seismic Hazard, Exposure, Vulnerability and Risk [Ref. 44, GEM 2018)

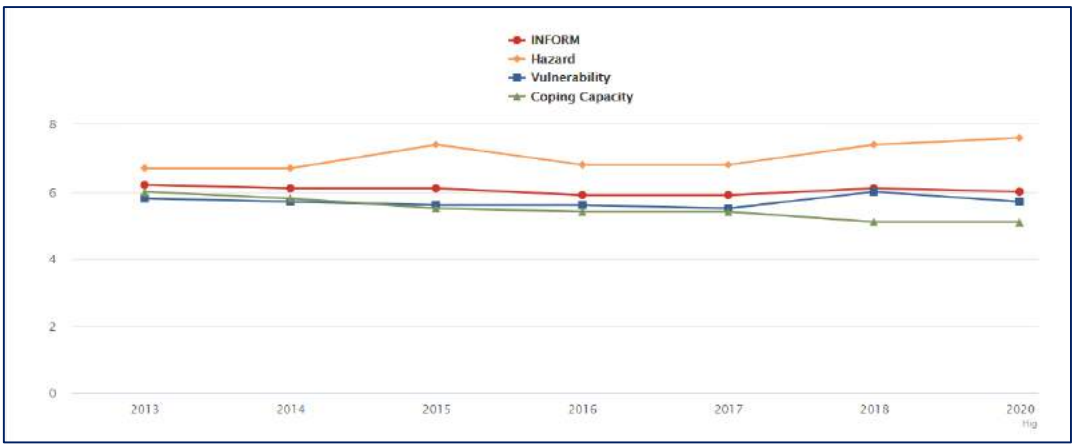


Figure 1-2 Trend and changes of risk and its main contributing factors: hazard, vulnerability, coping capacity from 2013 to 2020 [Ref.61, Risk INFORM]

1.3. Risk vs. Resilience

Disaster Resilience concept has been emerged as an evolution process from disaster response to disaster management to vulnerability reduction to risk reduction to risk management and now to resilience; all with one objectives of saving human lives and resources. The evolutionary concept from risk to resilience is shown in Figure 1-3. Based on UNDRR definition, Resilience is defined as the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. This concept can be simply defined as:

Resiliency = Exposure Resistance + Recovery and Coping Capacity

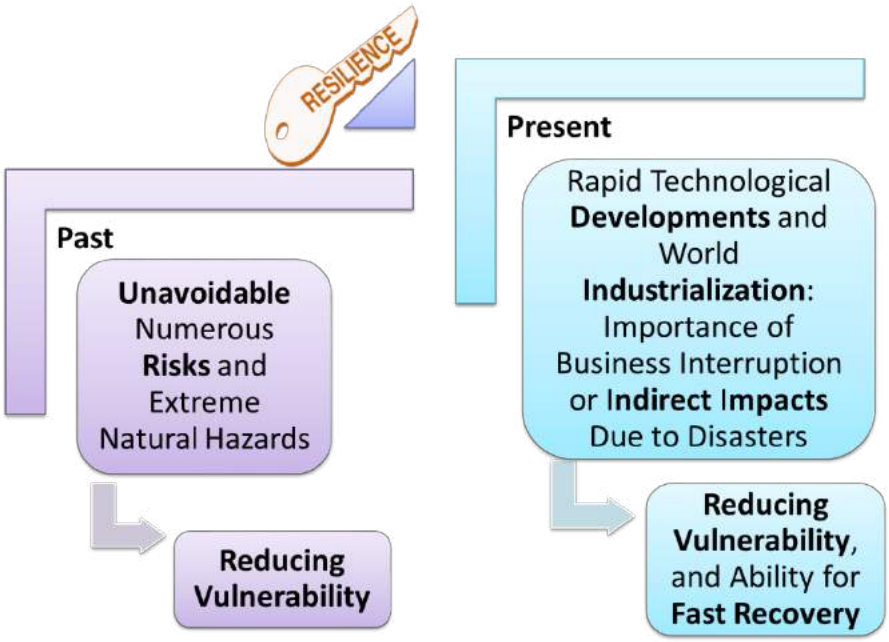


Figure 1-3 From Risk to Resilience

One of the best frameworks for defining and measuring disaster resilience at the community scale is the Multidisciplinary Center for Earthquake Engineering Research **R4** Resilience Framework. It consists of four domains of **R**obustness, **R**edundancy, **R**esourcefulness and **R**apidity. The **R4** Resilience framework also can be viewed within four dimensions of Technical, Organizational, Social, and Economic as shown in Table 1-1.

Table 1-1 Resilience Matrix: Domains and Dimensions

Domain Dimension	Robustness	Redundancy	Resourcefulness	Rapidity
Technical (Physical, Structural)	Structural and Nonstructural Safety for Natural Disaster	Technical, Facility and Human Capacity	Availability of Resources for Restoration and Repair	Restoration, Reconstruction and Recovery Time
Organizational (Legal and Institutional Structure)	Governance and Integrated Management and Planning with effective Implementation	Alternate Sites for Managing Disaster Operations	Capacity to Decide, Perform, Innovate, Expand and Answer to Demand Surge	Pre-Planned Reconstruction and Recovery Program with Experienced Management
Social System and Communities	Social Vulnerability/ Resilience Indicators	Availability of Housing Options for Disaster Victims	Capacity to Address Human Needs	Time to Restore Lifeline, Social Services (school,..)
Economic Direct & In-Direct	Extent of Economic Diversification	Ability to Substitute, Conserve Needed Inputs	Capacity to Improvise, Innovate and Absorb Financial Resources	Time to Regain Capacity, Lost Revenue and Business Recovery

The key factor in improving the resilience is the preparedness for post-disaster recovery to ensure continued operation (if desired) and live-able conditions immediately after the disaster. This process considers the performance of the government and threats posed by the post-disaster environment which could hinder the primary functions of the government. Thus a disaster resilient nation should have the following features:

1. Robustness through risk reduction: Ability to absorb the impact of occurrence of a disaster such as earthquake and continue to operate at the required level of performance. The robustness objectives should be provided by safe planning and design of the cities in order to reduce the damage at time of disaster or failure.
2. Redundancy and **r**esourcefulness are to reduce the time to recovery: To reduce the time of recovery, it is essential to provide systems that can ensure the continuity of the critical systems.
3. Recovery or Reconfigurability: To be truly resilient, the cities should be adaptable to cope with the effects of disaster, where practicable.

Finally, achieving resilience is a progressive and long-term process that goes beyond humanitarian relief and development investment by addressing a wider set of inherently connected challenges that together hold the most vulnerable communities back. It is expected based on the special emphasis on the Resilience in the **Sendai Framework for Disaster Risk Reduction, 2015-2030 and Sustainable Development Goals (Goal 11)**; to provide a new platform for a better understanding of the resilience concept and moving toward the resilient cities.

Earthquake Resilient Bangladesh should have the ability that its built environment (buildings, lifelines, infrastructures, etc.) resist and withstand against the impact of the earthquake or suffers minor damages without causing major disruption; being able respond effectively to the surging demand of rescue, relief, medical services and shelter of the affected people; restore the disruptions of emergency services; and to recover from the impact of earthquake disasters and reconstruct the damages area. From a resiliency, one expects that life and economy of the country continues after a disaster with any significant disruption; which is very important for sustainable development of Bangladesh.

To be resilient against all potential natural hazards in Bangladesh is an ambitious objective that is very hard to achieve with the existing high level of risk with next decades. It is recommended that GoB should at first achieve resiliency to low intensity and more probable earthquake; which is now the case for low intensity flood and cyclone. Thus, all of the risk reduction efforts should focus on gradual or step by step resiliency improvement which can be only with sustainable policy and effective implementation.

1.4. Structure of the Report

This report contains the following sections:

1. Review of the existing strategies, laws, policies, regulations, orders such as SOD 2019 and institutional arrangement for DRR in Bangladesh, Section 2.
2. Overall Review of the past studies done on earthquake hazard, vulnerability and risk; including the expected human losses, Section3.
3. Global disaster risk reduction frameworks, Section 4.
4. Earthquake disaster risk reduction experience of Iran and Nepal, Section 5.
5. Gap Analysis and identification the challenges by overall assessment of the existing key political and technical challenges and demand toward Resilient Bangladesh, Section 6.
6. Recommendation for effective risk reduction and increasing DRM capacity, section 7.

1.5. Target Users of the Report

All key stakeholders involving the disaster risk in Bangladesh listed in Appendix , especially Ministry of Disaster Management and Relief, Ministry of Housing and Public Work (MoHPW), LGD, academia, scientific and technical communities at national level; and UNDP, UNDRR and other UN, Development Partners, ADB and WB at international level.

2. OVERVIEW OF EXISTING STRATEGIES, LAWS, POLICIES, REGULATIONS AND INSTITUTIONAL FRAMEWORK FOR DRM

Risk and resilience planning and management is complex by its nature and involves legal, technical, and social dimensions. The legal and regulatory dimension includes laws, decrees, ordinance and other regulations adopted by national and local government. The technical and instrumental dimension includes planning tools and instruments which regulate uses of lands and strive for the best balance between private interests and the public good.

It is well understood that securing development gains through disaster risk management and risk-informed planning will require an all-of-society approach and broad engagement across government sectoral and ministerial lines.

The social and institutional dimension includes those mechanisms which include citizen participation in land use management practices, such as consultations, public hearings, open municipal sessions and plebiscites. The consultant will try to consider these entire dimensions during conducting situation analysis and diagnosis in this project.

In other words, it is planned that the present status (situation) of the disaster risk reduction and management to be analyzed in a way to find out what the shortcomings and constraints are, and also, what opportunities and capacities are and finally how it can eliminate shortcomings and constraints by using opportunities and capacities, so that Bangladesh can achieve more natural disaster resiliency and safety.

This Section of the report provides an overall situation of the disaster risk reduction and management in Bangladesh from the policy and government structure, based on the related documents that are outlines in the Reference section of this report. Section 2.1. provides an overview on the DRM structures of the GoB as the regulatory and responsible body for all of the disaster risk key stakeholders. Section 2.2 provide an overall situation analysis of the existing strategies, laws, policies and regulations for DRR such as Standing Orders on Disaster Management of the Government of the People's Republic of Bangladesh-GoB (SOD-2009 and SOD-2019).

2.1. GoB Vision, DRM Structure and Key Stakeholders

The disaster management vision of the Government of Bangladesh is to reduce the risk of people, especially the poor and the disadvantaged, from the effects of natural, environment and human induced hazards to a manageable and acceptable humanitarian level and to have in place an efficient emergency response management system.

Today, the GoB under the direct guidance of the Honorable Prime Minister of Bangladesh purses the implementation of this vision. In GoB, Ministry of Disaster Management and Relief (MoDMR) is the focal point for all DRM related activities. Other key ministries such as Ministry of planning (MoP) and Ministry of Housing and Public Work (MoHPW) have direct role in ensuring the safe and resilient planning and development of the Bangladesh built environments against natural disasters. The vision, objectives and functions of this ministries are explained in this section. Figure 2-1 shows the main key stakeholders and players that their policy, function, responsibility and performance have a major effect and impact on reducing the risk and improving resilience of Bangladesh against natural disasters.

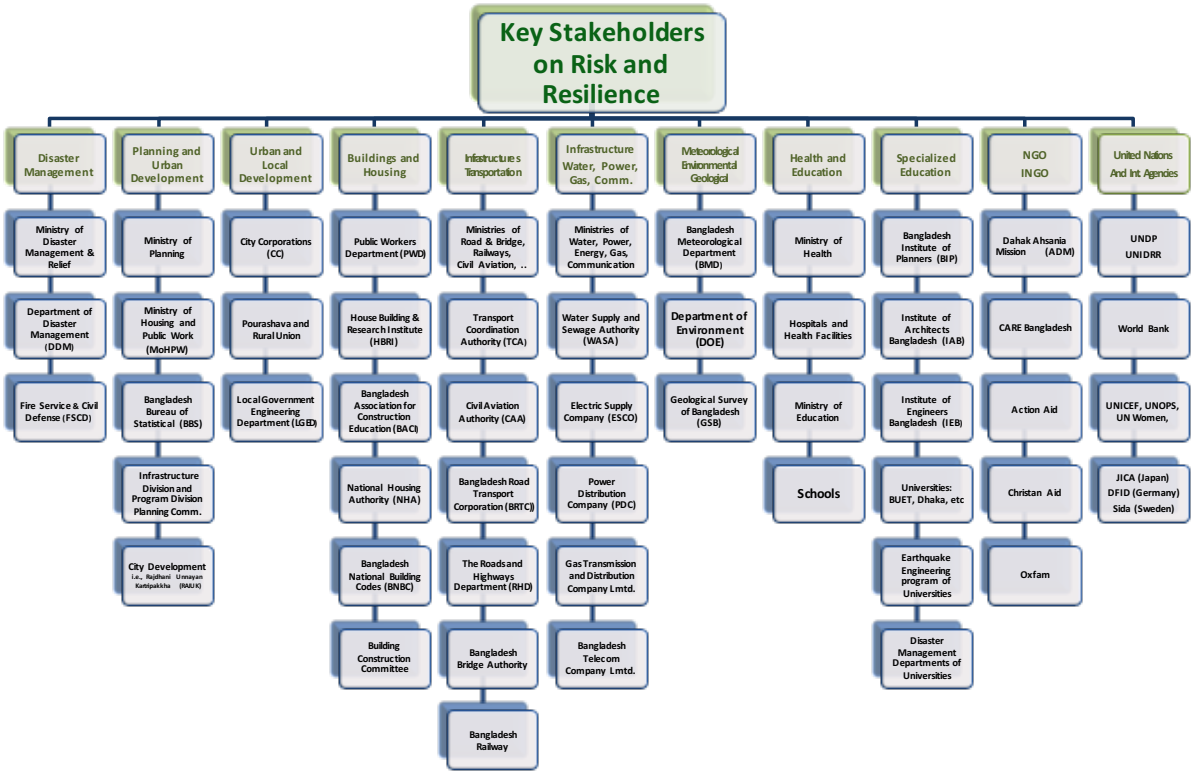


Figure 2-1 Key stakeholders and players related to disaster risk and resilience of Bangladesh

2.1.1. Ministry of Disaster Management and Relief (MoDMR)

The MoDMR is the main and key government responsible body for Disaster Risk Management (DRM). This Ministry will play key role in formulation of policy, laws and regulations and take necessary steps for planning, implementation and monitoring of DRM programmes. The MoDMR's vision, mission, objective and functions are as follows.

Vision:

To reduce the risk of people, especially the poor and the disadvantaged, from the effects of natural, environment and human induced hazards to a manageable and acceptable humanitarian level and to have in place an efficient emergency response management system.

Missions:

1. Achieving a paradigm shift in disaster management from conventional response and relief to a more comprehensive risk reduction culture.
2. Promoting food security as an important factor in ensuring resilience of communities to hazards.

Objective:

1. Professionalizing Disaster Management System
2. Strengthening Institutional Mechanism
3. Empowering a Risk Communities
4. Strengthening Emergency Response System
5. Developing and Strengthening Regional and Local Networks

Functions:

1. Relief and DRR programming, planning, research and monitoring.

2. Coordinating of all activities relating to DRM and relief incorporating disaster risk reduction and emergency response management.
3. Mainstreaming DRR across line ministries and agencies at all levels.
4. Approval, administration and monitoring of safety net programs.
5. Constructing small scale infrastructures in order to eliminate disaster risk.
6. Assessment of disaster situation and recommendation to declares state of disaster emergency, evacuation, and monitor disaster early warning dissemination.
7. Establishing, strengthening and improving the national disaster response mechanism.
8. Implementation of the refugee related programs.

Based on the 2019 Standing Orders on Disaster (SOD), MoDMR also has the responsibility for coordinating national DM efforts and NDMC is the supreme body for providing overall direction. Figure 2-2 shows the Government of Bangladesh DRM structure at national and local level.

The Department of Disaster Management (DDM) and other cooperating agencies under the MoDMR will assist different ministries, divisions departments, directorates and authorities to implement disaster risk reduction, humanitarian assistance, and recovery activities ensuring synergies and coordination. The MoDMR will provide necessary information to the National Disaster Management Council, Inter-Ministerial Disaster Management Coordination Committee, National Disaster Response Coordination Group and other national and local level disaster management committees and will assist them in making decision for DRM. Beside this, the ministry will coordinate all the activities of the government and non-governmental agencies and development partners directly and indirectly involved in DRM activities.

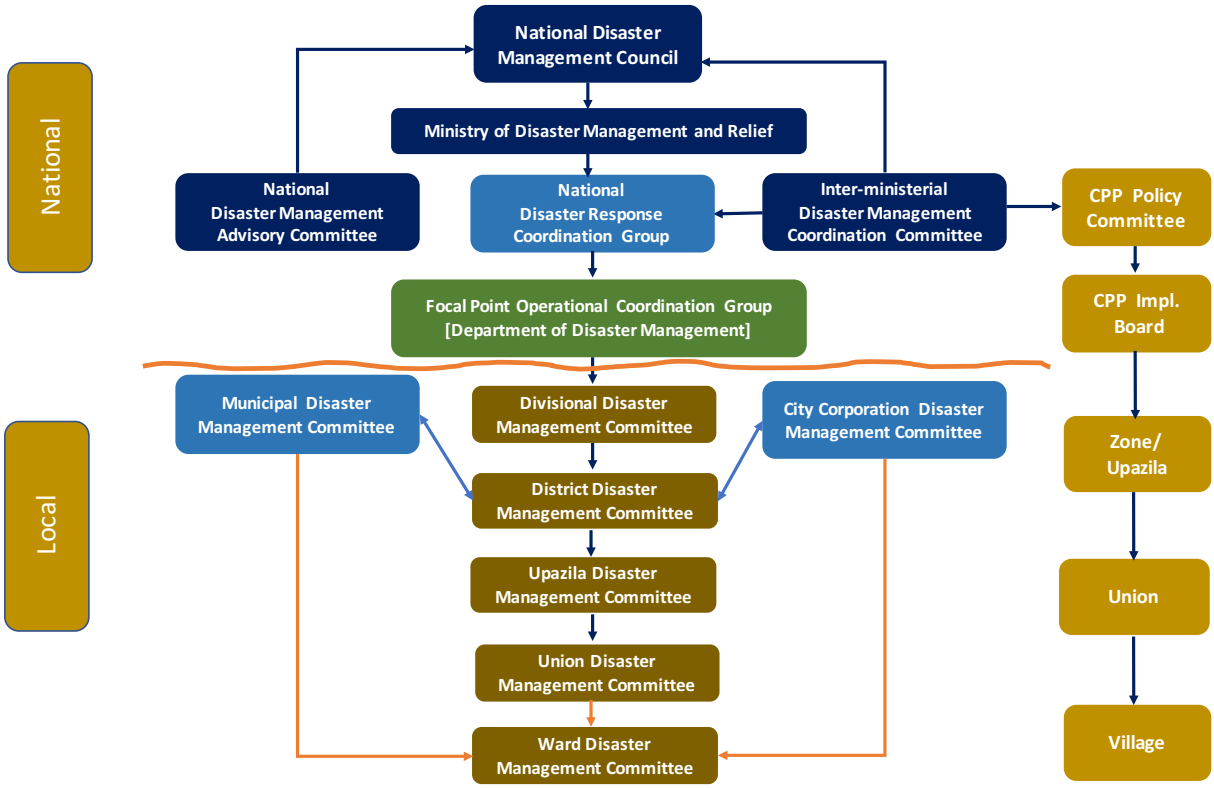


Figure 2-2 Structure of MoDMR and national and local disaster management organization based on the SOD 2019.

Department of Disaster Management (DDM), established in 2012 after the enactment of DM Act 2012 (in succession of Disaster Management Bureau (DMB) which was established in 1993) is responsible to promote disaster prevention, mitigation and preparedness, provide guidelines and to organize training and awareness for the concerned people and stakeholders to mitigate the impacts of disasters. Currently, the DDM focuses on risk reduction through community mobilization, capacity-building and linking risk reduction with the socio-economic development of the poor and vulnerable groups and with developing the DDM's partnership with other government agencies, NGOs and international organizations.

Observation: Considering the important MoDMR mission of "Achieving a paradigm shift in DRM from conventional response and relief to a more comprehensive risk reduction culture"; the program and function, and as well as the structure and human capacity of the Ministry should also be tuned more toward the action-oriented mitigation, prevention and risk avoidance program. The system and activities of MoDMR are still more response oriented that risk avoidance and prevention oriented.

2.1.2. Ministry of Planning (MoP)

The Ministry of Planning (MoP) is one the key government responsible body for the development and planning of a country. They have an important role in making sure that all public buildings and infrastructures are built safe against earthquake; as well as to monitor the sustainable development of Bangladesh. Vision, mission, objective and functions of MoP are as follows.

Vision:

1. Sustainable, time bound and effective socio-economic development plan
2. Planning Commission, Infrastructure and Programming Division

Mission:

Sustainable development through participatory national development plans, policies, strategies and efficient resource management.

Infrastructure and Programming Division under the Planning Commission of this ministry, is responsible for the infrastructure development of the Bangladesh. They have a vital role for safe and resilience planning, design, construction and maintenance of all urban and rural infrastructure. As it can be visibly seen in the objective and function of this division, there no foot-print of DRM policy and concern. In other word, safety and sustainability does not have high priority in the infrastructural development of Bangladesh.

Objectives:

1. Development of the necessary infrastructure, utilities and other services needed to promote growth.
2. Strengthening of the country's scientific and technological capability.
3. Protection and preservation of environment by putting in place adequate regulatory regimes and effective institutions
4. Development, improvement and maintenance of rural infrastructure.
5. Improving utilization of health and education services and facilitates

6. Improvement in the quality of life of the rural population through mobilization of the rural masses and resources by creating direct employment opportunity for the rural poor through improvement and maintenance rural infrastructure
7. Attainment of food production beyond the self- sufficiency level in the shortest possible time
8. Development of industries essentially based on comparative advantage of the country
9. Achievement of a lower population growth.
10. Creating indirect employment opportunity in road transport, trading and other sectors

Functions:

1. Policy planning
2. Program and project planning
3. Sectoral planning
4. Determination of objectives, priorities and policy measures for development plans
5. Identification role of various economic sectors required to reach plan objectives and goals.
6. Formulation of detailed resource allocation to realize the plan objectives
7. Appraisal of projects embodying investment decisions for implementation of the sectoral plans
8. Evaluation of the impacts of projects on the people's living standard
9. Formulation of Reduction Strategy Paper (PRSP).
10. Evaluation of Plans and their impact on the economic development

2.1.3. Ministry of Housing and Public Work (MoHPW)

The MoHPW is responsible to ensure the best use of the land through proper planning and research, to create sustainable, safe and affordable housing for the low and medium income people of the country and planned urbanization; as well as providing modern facilities for various government ministries, departments, offices and agencies. Based on the above mentioned responsibilities; the objectives of MoHPW are:

1. Planning urbanization.
2. Providing official and residential accommodation.
3. Plan and Promote safe and affordable housing.
4. Management of government owned properties; and
5. Management of public buildings and other infrastructures.

The functions of the Ministry are:

1. Formulation and amendment of housing policies, laws, codes and rules. Planning and undertaking of activities to solve housing problem.
2. Preparation of laws and policies to promote housing sectors.
3. Research and technological innovation on housing, building construction and urban development.
4. Preparation of architectural and structural design of public buildings and infrastructures.
5. Conducting research and innovate technology on urbanization, housing, construction of buildings.
6. Creation of opportunities for involvement of the private sector in solving urbanization and housing problems.

From the objective and functions of this Ministry, it can be seen that the following main department/division have important responsibility and role toward earthquake risk avoidance and risk reduction and making sure that all development is being done seismically safe. These departments are:

1. **Urban Development Division (UDD)**: The UDD is promoting risk-integrated land-use planning and updating the existing policy for planned urbanization. UDD is also responsible for urban planning which should be risk-sensitive.
2. **Public Work Department:** PWD is responsible for preparation of architectural and structural design of public buildings and infrastructures.
3. **City Development Authorities:** These administrative and operational authorities are responsible for the issuing the permits for any construction in the main cities of Bangladesh. They are: RAJUK for Dhaka and greater Dhaka (DMDP), Chottogram Development Authority (CDA.), Rajshahi Development Authority (RDA) Sylhet Development Authority (SDA), and Khulna Development Authority (KDA). In smaller cities, the Building Construction Committee (BCC) have the authority and responsibility.
4. **Pourashava and City Corporation:** In the urban areas, municipal bodies are called 'Pourashavas' and City Corporations. Although City Corporations are governed by specific statutes, the Pourashava Ordinance 1977, which governs the municipal bodies, defines the basic character of all municipal areas. While both Pourashavas and City Corporations are autonomous body corporates, the autonomy is limited by the fact that the government acts as the prescribed authority of the Pourashavas and has the authority to intervene in the affairs of the City Corporations. In the urban areas, the main functions of the Pourashavas/City Corporations include providing civic amenities to the citizen and performing a variety of socio-economic functions. However, in their existing role of providing civic amenities to the citizen, these bodies mostly depend on other agencies for building up infrastructural facilities and the generation of utilities and other services. There are discussions that this local govt. bodies are constrained to perform all stipulated functions due to a shortage of funds.

Observation: Risk-sensitive landuse planning and structural safety and making sure that buildings are built safe with good quality has been mentioned as a priority of this Ministry.

2.1.4. Armed Force Division

The Bangladesh Armed Force Division (AFD) in addition to their normal responsibilities have the following responsibilities for risk reduction, preparedness, disaster response and post disaster rehabilitation and reconstruction. These responsibilities are carried out by the Bangladesh Army, Navy, and Air- force with respect to their nature of responsibilities.

Risk Reduction:

- Develop risk reduction and preparedness strategies through conducting detailed sectoral risk assessments;
- Prepare Contingency Plans on earthquake and landslides for AFD;
- Arrange training and workshops on earthquake and other natural hazards;
- Arrange desktop simulations and scenario-based demonstrations for people on earthquake preparedness and emergency response;

- Arrange Disaster Response Exercise and Exchange (DREE) in coordination with Disaster Management and Relief
- Divide the city into zones based on earthquake exposure and vulnerabilities; and assess the possible damage and loss and response planning with implementation strategy;
- Establish an emergency communication system to exchange information on Disaster Risk Management;
- Mobilize, store and maintain all equipment and tools that required for conducting Search and Rescue;
- Mobilize required resources for the implementation of the Disaster Reduction Action Plan.

Preparedness for Response:

- Keeping effective communication and coordination with MoDMR and National Disaster Response Council coordination group;
- Ensuring preparedness of Armed Forces with necessary equipment for helping in safety, evacuation and rescue programme considering the risk and hazard of disaster prone area;
- Arrange training for the Disaster Management Task Forces formed by Armed Forces Division;
- Creating groups for Armed Forces Division for emergency search, rescue, evacuation and humanitarian assistance programme;
- Undertake programmes with assistance from MoDMR to engage Armed Forces to help the civil authority as it become necessary;
- Arrangements training for rescue and humanitarian response related issues;
- Ensuring safety of buildings, materials, public and assets; and
- Preparation of Contingency Plan.

Disaster Response:

- Operate the control room along with Prime Minister's Monitoring and Coordination Cell keeping active for 24/7;
- Maintain communication with National Emergency-Disaster Operation Center (NEOC), coordinated with MoDMR;
- Ensure preparedness of army, air Forces, navy coordinated units for rescue, evacuation and humanitarian assistance programme management on the basis of need;
- Help the civilian authority, engage armed Forces in response, humanitarian assistance and rehabilitation activities; upon the requisition of the government;
- Collecting data on rescue, humanitarian assistance related programme and dispatch it to Prime Ministers Office's Coordination Cell, NEOC, Inter- Ministerial Disaster Management Coordination Committee and NDRCC of MoDMR;
- Implementation of rescue and humanitarian assistance programme taken by civilian authority on the basis of need;
- Maintaining coordination with civilian administration and authority under Incident Management System; and
- Create report on humanitarian assistance and rehabilitation related programme managed by civilian authority and dispatch it to National Disaster Management Council and MoDMR.

Post Disaster Rehabilitation and Reconstruction:

- Assist to formulate survey and rehabilitation need in disaster affected area;
- If needed, then with the coordination of Ministry of Disaster Management and Relief assist to implement rehabilitation and recovery programme;
- Assist local administrative to improve the environment and collapsed area;
- Assist local administrative to ensure the supply system of safe drinking water and recovery and improvement of communication system;
- Set up field hospital if needed;
- Assist local administrative to build temporary shelters.

The above mentioned responsibilities would be performed by each division of the AFD. It can be seen that AFD has an important role in all aspect of the disaster risk reduction.

2.1.5. Bangladesh Fire Service and Civil Defense (BFSCD)

The Bangladesh FSCD which should be operate in a very close relation with MoDMR is responsible for acquiring competency to lead the firefighting and disaster management in GoB with the mission of:

1. Protecting and saving lives and property for a safe and secured Bangladesh.
2. Improving fire and general building safety.
3. Efficient and timely inspections of relevant organizations and important building and infrastructures.
4. Making a building and fire safety data tracking system.
5. Harmonized standards and procedures upon which the future buildings are designed and constructed to be safe for fire.

Observation: The existing structural system of the FSCD in all cities need to be strengthened from station building structural safety, manpower and equipment in order to fulfil the defined mission. 24 FSCD stations in Dhaka, 1 in Rangpur, etc. with very limited specialized manpower (especially for earthquake disaster response, which is totally different from flood and fire) cannot by any mean to answer to the surge demand for rescue which would be created even after a small earthquake. For effective rescue operation after an earthquake, you need specialized train structural engineering for search and rescue operation after an earthquake. Thus FSCD should enhance its capacity in all dimension.

2.2. DRM Policy Structure in Bangladesh:

The study clearly shows that GoB has tried to focus on mainstreaming the DRR into its development process. The Disaster Management Act (2012), the National Plan for Disaster Management (2016-2020), Government of Bangladesh Disaster Management Vision, Standing Orders on Disaster, 7th and 8th Five Year Plan, National Women's Advancement Policy (2011), National Child Policy (2011), Children Act (2013), National Education Policy (2010), Debris Management Guideline (2015 draft), Policy Guideline of Dead Body Management after Disaster (2016) and Comprehensive Disaster Management Programme (CDMP) which provides earthquake vulnerability assessment and earthquake contingency plan for 6 main cities; are some examples. The 33 main policy and planning related documents that are listed in the References have been collected to be reviewed for the gap analysis.

2.2.1. Disaster Management Act 2012

The Disaster Management Act 2012 is the legal framework for DM in the country. The National Disaster Management Council (NDMC), headed by the Prime Minister, is the supreme body for providing overall direction for DM, with the MoDMR having the role of "Secretariat" to NDMC. Figure 2-3 shows the relation between regulatory frameworks related to DRM.

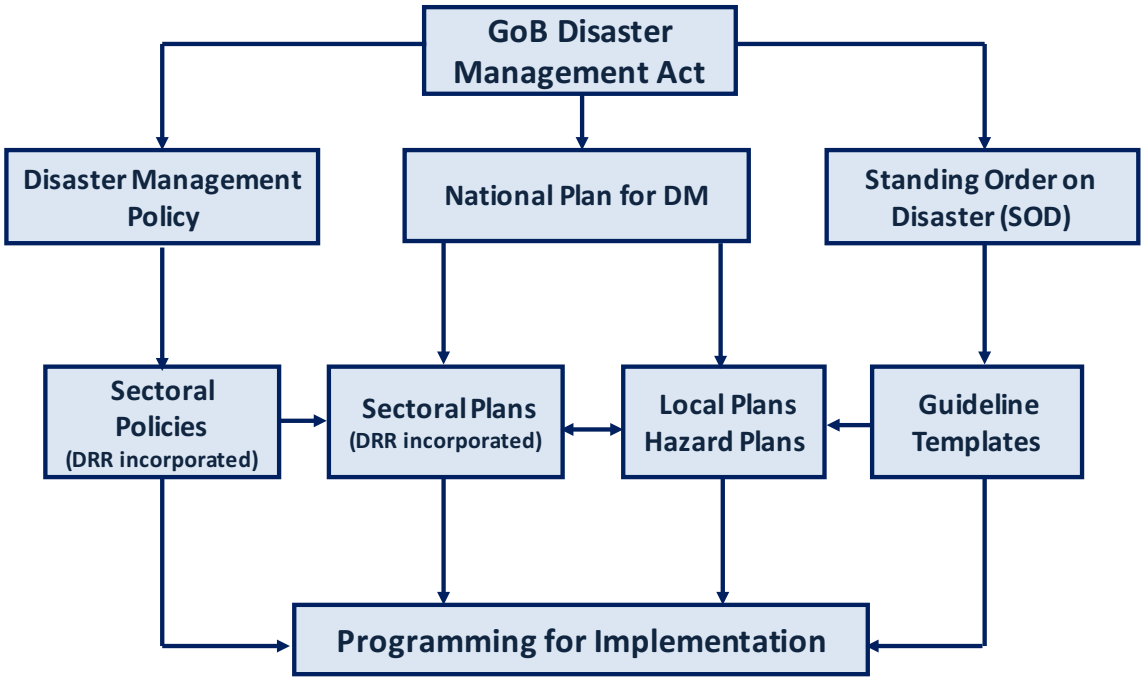


Figure 2-3 Disaster Management Regulatory Framework

2.2.2. Bangladesh 8th Five-Year Plan 2021-2025

The overall goal of DRM in the Bangladesh context is to build resilience of the poor and reduce their exposure and vulnerability to geo-hydro-meteorological hazards, environmental shocks, human induced disasters, emerging hazards and climate-related extreme events to make cities, human settlements and resources safe, resilient and sustainable. Under the 8th FYP, the Disaster Management Act of 2012 will be institutionalized and implemented to achieve adequate decentralization throughout the Government and accountability for delivery. Adequate national resources will be identified to finance risk reduction and enable appropriate allocation of resources for disaster resilience through local and national level mechanisms. Regional cooperation will be further strengthened for DRM and resilience.

2.2.3. National Plan for Disaster Management (2021-2025)

This documents provides National Plan for Disaster Management (NPDM) for years 2021-2020, as an integrated part of the disaster management (DM) policies of the Government of Bangladesh (GoB), which is exemplified in its vision and the mission of the Ministry of Disaster Management and Relief (MoDMR). The plan has three core goals of saving lives, protecting investments and effective recovery. It builds on GoB's past success in disaster management and international DRR frameworks, and adopts a phase-wise approach with 34 core targets to be implemented in partnership with relevant stakeholders in the context of rapid change in Bangladesh.

NPDM 2021-2025 is upgraded from the two previous NPDMs (2010-2020), which were the first policy document of its kind. NPDM 2016-2020 reflected a paradigm shift from relief-based disaster response to proactive disaster risk reduction, with emphasis on capacity strengthening. NPDM 2016-2020 was drawn from regional and global frameworks including the Sendai Framework for Disaster Risk Reduction (SFDRR) and Asia Regional Plan for Implementation of Sendai Framework for Disaster Risk Reduction 2015-2030. It was recognized the national strategy for addressing global and regional targets. The plan reflects the basic principles of the SAARC Framework on Disaster Management.

A review of NPDM 2016-2020 indicated the achievement of reducing the disaster victims, ensuring early warning and response mechanism, mainstreaming disability and gender inclusive disaster risk management, strengthening civil-military coordination for humanitarian response and starting Implementation of SFDRR, etc. However, still piecemeal works or patchwork-based pilot interventions are dominant in DRR sector. It is necessary for enhancing the capacity for whole disaster cycle management including increasing no regret investment, tackling urban disasters, enhancing information management mechanism etc. Moreover, the lessons from the implementation of NPDM 2016-2020 indicated the need to address the following issues: urban disasters; capacity strengthening at district and Upazila administrations; information management; synergy between DRR and climate change adaptation plans; monitoring; coordination and command system; user-friendly planning; and proactive dissemination.

Another feature of this version of the NPDM is its alignment with national, regional and international frameworks including the GoB's 7th and 8th Five-Year Plan, Asia Regional Plan for SFDRR, and Dhaka Declaration 2015 Plus for Disability Inclusive Disaster Risk Management. The plan places importance for disaster risk management linking with rapid urbanization and climate change, and the necessity of DRR for sustainable development, and is flexible and adaptive in cognizance of the changing nature of risks in Bangladesh. NPDM 2021-2025 produced through a participatory and inclusive approach through extensive stakeholder and expert consultations. Moreover, the purpose of NPDM is to guide implementation of the Disaster Management Act 2012, allowing GoB ministries and other agencies to use it to produce their Annual Work Plans. The plan takes a 'whole-of-Government' approach, and it also attaches importance to engagement of the private sector.

2.2.3.1. Vision, Goals; Strategics, Objectives and Priorities of NPDM:

The strategic aim is to provide the guidance to relevant stakeholders, recognition of emerging risks and phased implementation of prioritized actions. A set of objectives allow operationalizing the aims through identifying priority actions, providing a roadmap for implementation of at least 20 core investments, incorporating DM aspects in sectoral plans, exploring public-private investments, ensuring inclusivity, addressing emerging risks, promoting risk governance and illustrating how the work of various stakeholders can contribute to GoB's DM vision.

Vision: Building on past achievements and tackling new risks, NPDM is based on SFDRR and follows the national targets indicated in SFDRR and is aligned with its four priorities. Bangladesh has invested strongly on DRR, and despite frequent disasters, disaster mortality has reduced significantly, 7% GDP growth is maintained, food security is improved and almost

all the MDGs were achieved. However, a changing risk context means new challenges, but also opportunities for building resilience. Thus, building on past achievements and tackling new risks, the vision of NPDM 2021-2025 is: "Winning resilience against all odds".

Goals: The three core goals of NPDM are saving lives, protecting investments, and effective recovery and rebuilding.

Observations: *These goals need to be quantified with respect to expected level of hazard. Otherwise it can be achieved and the success to be measured.*

Strategy Directions: The NPDM eight key strategic directions for achieving resilience are:

1. Upgrading existing DRM programs and policies, for example activation of urban DMCs, capacity raising of CPP;
2. DM governance as a specific area led by MoDMR with inter-ministerial mainstreaming linkages to relevant ministries;
3. Intensive investments for building resilience against chronic disasters such as floods and drought;
4. Social protection policies and programs to address poverty and vulnerability and contribute to resilience;
5. Inclusive development incorporating disaster risk reduction with sensitivity to gender, disability, age and other vulnerabilities;
6. Risk-informed private sector engagement to risk-proof economic and physical investments and for business continuity;
7. Resilient post-disaster response and recovery following a strengthening 'whole of society' approach; Emerging risks; and
8. Planning for emerging risks with specific focus on potentially catastrophic urban disasters such as earthquakes.

2.2.3.2. NPDM Focus Areas:

Bangladesh aligns its DM strategies and plans with SFDRR and the following focus areas will enable implementing them: Promoting policy coherence among DM and development in-country; Making disaster risk reduction a development practice to achieve resilient public investment and the SDGs; Encouraging private sector engagement towards risk sensitive investments; Building capacity and leadership to implement NPDM 2021-2025 at the national and local level. These focus areas will need to be supported by adequate capacity and resources at the local level; knowledge and information from the scientific and academic community; and practical guidance and tools, following an inclusive approach. NPDM 2021-2025 thus provides two main implementation guides:

1. Broad policy direction in terms of national level action plans to guide DM in Bangladesh in alignment with SFDRR in the national context of the SDGs;
2. Action plans with indicative timeframes over the next 5 years and 34 core targets to be continued until 2030.

2.2.3.3. Social Underlying Strategy:

Social inclusion is an underlying and cross-cutting strategy in all the action plans of NPDM, and were informed by the outputs of stakeholder consultations. Two main inclusivity areas should inform all DM initiatives, policies, programs and planning:

1. To ensure incorporation of gender issues in decision making and participation of women and men in all NPDM priority actions; and
2. To ensure adequate considerations for people with vulnerabilities (e.g. single marital status, age, disability) in DRM policies and programs and across implementation of NPDM.

2.2.3.4. Accountability Framework:

Implementation of NPDM is linked to the framework of national policy, legislation and business rules, involving various strategies, including: Ministry, department and agency focal point; Links between policy and operations; Expanding the scope of planning; Political consensus and allocation of resources; Contingency/Preparedness plan; Periodic review of the implementation of the plan; Funding requirement and resource mobilization; and Coordination, Communication and Cooperation.

2.2.3.5. Priority Level Action Plans:

The NPDM priorities were derived following an 'all-hazards' approach with hazard-specific activities linked to broader priority level action plans of the SDFRR:

1. Priority 1: Understanding disaster risk – Action plans under this priority focus on raising awareness, research and development activities, networking, and information/knowledge management.
2. Priority 2: Strengthening disaster risk governance to manage disaster risk – This priority area is concerned with inclusion of Disaster Impact Assessment (DIA) into policy, inter-ministerial coordination, institutional capacity strengthening, public private engagement, and international and regional cooperation.
3. Priority 3: Investing in disaster risk reduction for resilience – Under this priority, actions plans include nationwide capacity building, physical works for resilience, DM financing, institution building, addressing the key hazards of floods and cyclones, but also following an 'all-hazards' approach.
4. Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction – Concerned action plans include strengthening forecasting and early warning systems, emergency response capacity building, sector-wise preparedness, inclusive recovery and rehabilitation, business continuity, and multi-hazard response and recovery measures.

2.2.3.6. Timelies, Actions and Targets

The timeline for the period of 2016-2020 for NPDM was structured into three program periods of 1) 2021 - preparatory year with continuation of existing programs; 2) 2021-2022 - initiation of new actions plus actions continuing from the previous period; and 3) 2023-2025 - more initiatives and an activity peak relating to expected growth in institutional capacity. Many of the core targets will continue to be implemented over the long term until 2030. After each period, review and updating processes will be undertaken with stakeholders' feedback, making NPDM 2021-2025 an adaptive document. Table 2-1 shows the proposed key target of NPDM action plan for the earthquake 2019-2020 and beyond, which are subject to official approval.

Table 2-1 NPDM Proposed Action Plan for the 2019-2020 and beyond

Activities	Targets	Lead Ministry
Reviewing and sharing result of existing multi-hazard Risk Assessment and Plans for Earthquake Preparedness and Response Programme	Earthquake preparedness and response programme reviewed	MoDMR
Conducting and Reviewing Community based Risk Assessment (CRA/URA)	1,000 Union Parishad and 500 city wards conducted CRA/URA	MoDMR
Capacity building programme for professionals, responders and DMCs	500 DMCs, 500 professionals and 5000 responders are trained	MoDMR
Updating and developing DRM training curriculum	5 training institutes reviewed curricula and conducting training	MoDMR/DDM
Implementing of SOD 2019 planned activities including coordination and monitoring	Socialization and implementation continued	MoDMR
Expanding earthquake program including review & update and developing national and local contingency plan	8 new cities and 8 municipalities implementing earthquake preparedness programme	MoDMR, MoHPW, FSCD,
Strengthening Research & Development projects on DRM	Conducted Hazard specific research and DRR in development & paper produced	MoDMR, MoD
Establishing seismology and earthquake engineering department in universities	At least2 public universities	MoDMR, MoE, MoHPW
Integrating earthquake engineering module in private and public universities	At least 5 universities incorporated	MoDMR, MoE, MoHPW
Developing and implementing Risk Reduction Action Plan (RRAP) through Community Risk Assessment (CRA) & Urban Risk Assessment through multi-hazard approach	1000 UP level RRAP developed 300 ward level RRAP/contingency plan developed	MoDMR
Developing & implementing National DRM capacity building plan focusing on Disability inclusiveness and CPM-MH issues	At least 500 responders received Psycho-social management training and provide field services in disaster	MoDMR, MoH
Reviewing and updating of secondary, higher secondary and university level curricula on DM	Curium of the relevant subjects are reviewed and updated up to class XII and 12 university curricula reviewed	MoDMR, MoE, MoPME
Reviewing/updating/ developing all guidelines for preparedness and response as per SOD	10 guideline/SOP are updated or prepared	MoDMR
Expanding Capacity raising programme of CPP	Enhanced capacity raising programme to the 6 new CPP regions/districts	MoDMR/CPP
Capacity building of the professional (planner, designer, architecture/structural engineer) on earthquake resilient building construction system	1000 professionals/policy stakeholders are trained	MoDMR, MoHPW, MoE FSCD, AFD
Developing Master Plan of Fire Service for strengthening manmade and natural disaster management system	Mater plan are risk informed and response modality strengthened	FSCD, MoHPW
Preparing sectoral DRR strategies/guidelines for ministries/division as per SOD	5 ministries/division to be prepared sectoral guidelines	MoDMR, MoP MoA, MoFLS, MoWCA
Preparing recovery strategy/guideline for disasters	Strategies for 5 hazards	MoDMR, LGD, MoHPW, MoE
Mainstreaming of social protection in DRR of disaster resilience coordinated by cell/wing in MoDMR/DDM	Cell established and DRR integrated	MoDMR
Developing guidelines for risk-informed private sector investments.	Guideline produced and disseminated	MoP
Developing National Logistics Preparedness Plan for effective response	Plan produced and disseminated through	MoDMR
Developing National Displacement Management Strategy due to natural disaster	Strategy developed	MoDMR
Preparing DRR financing strategies for strengthening resilience	Strategies developed and disseminated	MoF, MoDMR, MoP

2.2.3.7. Coordination, Communication and Cooperation

All the government, non-government agencies and private sector must work together in a coordinated manner to ensure that their combined efforts are directed towards the same end result. Close working linkages are needed between bodies responsible for relief and mitigation programs to ensure that risk reduction measures are introduced in the immediate post-disaster situation and to enhance future preparedness. Links are critical between national, regional, district and community levels to facilitate implementation and ensure effective vertical communication with, for example, information flowing up and resources flowing down.

GoB will engage in bilateral agreements with donor agencies for recovery and rehabilitation. Line Ministries will be encouraged to develop appropriate project proposals to be submitted to potential donor agencies for funding. Moreover, GoB will engage the participation of the private sector and non-governmental organisations in DRM. In so doing it will also emphasise the importance of resilience and the benefits that can be derived from participating in disaster risk reduction activities.

2.2.3.8. Overall Assessment of NPDM Implementation

The overall judgemental assessment from the visible achievement of DRR in Bangladesh indicates that most of the well-thought planned programs have not being implemented in most part of the country, especially toward earthquake disaster risk reductions. This fact brings us to the fact that implementation is the biggest challenge toward “Resilient Bangladesh”.

Comments: *These outlined targets need to be quantified with respect to expected level of hazard. Otherwise it can be achieved and the success to be measured.*

2.2.4. National Emergency Operation Centre (NEOC)

Based on the experiences of the existing legal and institutional frameworks the government, guided by the instruction of the Honorable Prime Minister of Bangladesh, the National Emergency Operation Centre (NEOC), for an effective and efficient management of emergency operations following a disaster of massive level.

Vision: To enhance emergency response capacity, reduce the loss of life and property and alleviate the sufferings of people affected by mega disasters through establishing a centre of excellence, namely National Emergency Operation Centre (NEOC).

Mission: Provide a sustainable strategic (policy level) arrangement (capable of withstanding 7- 10 Richter scale earthquakes, level 4-5 cyclone and tornados, devastating floods, severe fire and chemical explosions, etc.) with a view to issuing command and policy guidance for a quick and effective response during any mega disaster.

Objectives: The broad and specific objectives are:
Broad objective: Functioning as an apex body for coordination of policy directions and emergency operation according to the instructions of NDMC and establish command over executing agencies for supporting emergency response activities during disaster and post-disaster situations.

Specific objectives:

1. To act as 24/7 central operation-point to response in any mega disaster of the country;
2. Provide a central coordination point (including coordination with foreign support providers) for ensuring smoothen humanitarian assistances.
3. Collecting and sharing information related to the impacts of disaster;
4. Developing comprehensive response mechanisms based on real time disaster situations;
5. Providing strategic advice based on evaluation of disaster situations, preparedness activities and previous responses;
6. Providing strategic directions and suggestions to implement the emergency response operations;
7. Institutionalizing an efficient monitoring and evaluation system to ensure the proper functioning of the NEOC;
8. Establishing data bank system regarding historical data related to disasters, preparedness and response activities in collaboration with National Disaster Management Research and Training Institute;
9. Securing an efficient communication system that will sustain during and post-disaster situation and act as a centre of information flow;
10. Ensuring functioning of the roles and responsibilities of the NEOC officials at policy and operational levels.
11. To enhance national emergency response capacity through effective operation facilities and data management systems.

Operational Procedures of NEOC composed of three parts:

1. Policy/ Advisory Body headed by the Honourable Prime Minister,
2. Operational Body headed by the Honourable Minister for MODMR, and
3. Routine Functional Body headed by the Director General (Additional Secretary/ equivalent).

The operational body and routine functional body will be under the direct control of the Ministry of Disaster Management and Relief (MoDMR) and thus under the leadership of its Minister. The NEOC operation wing composed of seven cells as shown Figure 2-4 with defined responsibilities for post disaster response operation.

NEOC covers all disasters. The specific responsibility of NEOC addresses the earthquake hazard through the Urban Development Directorate (UDD), Housing and Building Research Institute (HBRI) and the Bangladesh National Building Code (BNBC) for technical issues; and the Urban Community Volunteers trained in search-and-rescue and first aid, training on safe construction to masons and construction workers, and school safety and evacuation drills for non-technical related aspects.

Comment: *The idea of establishing National Emergency Operation Centre as it has been explained here briefly is very good and will be a step forward to institutionalize the DRM and clearly identify each agency's responsibility during the disaster. It follows the DRM incident command system.*

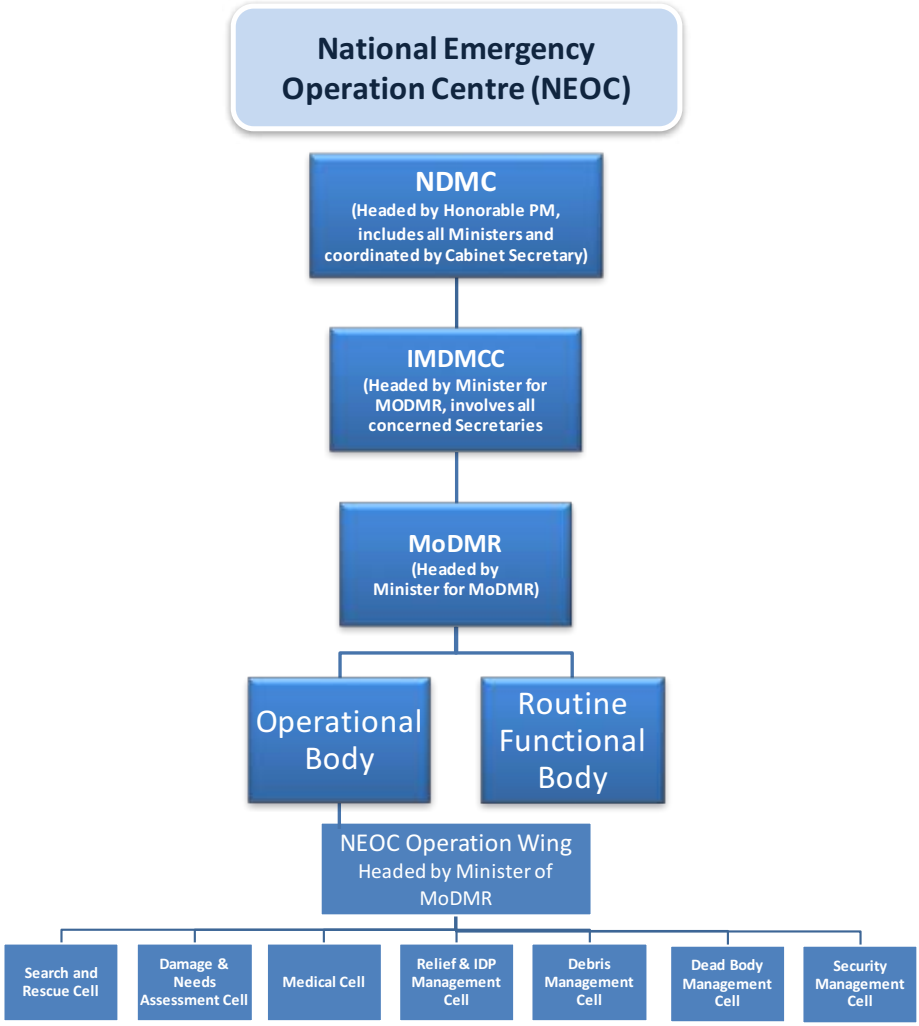


Figure 2-4 Proposed NDMC and NEOC operation structures (2020)

2.2.5. Standing Order on Disasters, 2019

The Standing Orders on Disaster Management (SOD) provides the institutional disaster management arrangements within the Government of Bangladesh (GoB). The SOD have been in effect since 1997 and have been revised almost every 10 years. The SOD of 2009 has taken into effect the Hyogo Framework of Action (HFA, 2005-2015) recommendations. The latest version of SOD was updated and adopted in 2019 based on the experience gained from its implementation since 1997; as well as the strategy of SDFRR 2015-2030 and link with SDGs 2015-2030. The objective of SoD is to clearly spelled out with clarity the tasks and responsibilities of the citizen, public representatives, ministries, agencies and non-government organizations. In the latest version, a comprehensive approach emphasizing risk reduction as well as emergency response relating to all hazards and all sectors with the following special feature such as: 1) Disaster management regulative framework, 2) Establishment of core groups for emergency response at various levels, 3) multi-agency disaster incident management system, 6) risk reduction roles and responsibilities for all committees and agencies, 7) new outlines for local level Plans, 8) More specific roles and responsibilities relating to earthquake and Tsunami hazards, etc.

The government expect and hope that all stakeholders prepare their own Action Plans in respect of their responsibilities under the Standing Orders for efficient implementation. According to the SOD, the National Disaster Management Council (NDMC) and Inter-Ministerial Disaster Management Coordination Committee (IMDMCC) will ensure coordination of disaster related activities at the National level. The Department of Disaster Management will render all assistance to them by facilitating the process. The Ministries, Divisions/Departments and Agencies should organize proper training of their officers and staff employed at District, Thana, Union and village levels according to their own Action plans so that they can help in rescue, evacuation and relief work at different stages of disaster. The different activities of different organizations are described at different Phase namely, Normal Phase, Alert and Warning Phase, Disaster Phase and Recovery Phase.

Although SOD is effective, the disaster preparedness and management operations of the country lacks in activity and long-term plans during normal times as well as the implementation of the action plans taken after recovery of a disaster. This is the basic reason behind the high level of vulnerability and risk as well as significant number of the expected human and economic losses caused by Disasters. In some cases, overlapping of the different activities, lack of collaboration and integration and system approach is one of the main reason that all objectives of the SOD has not being effectively implemented, especially in area of earthquake risk management and reduction. On the other hand, the SOD is not properly followed by the different organizations. The SOD lacks structural solution/mitigation which is sometimes required in the pre-disaster as well as post-disaster cases. The coordination between the international and national agencies is not clearly defined in the SOD. The SOD itself needs modification and clarifications of the roles of personnel and organizations.

According to the Standing Orders on Disaster (SOD), Department of Disaster Management under Ministry of Disaster Management and Relief (MoDMR) is responsible for:

- Advising the government on all matters relating to disaster management; and
- Maintaining liaison with different government agencies, aid-giving agencies, NGOs and Voluntary Organizations and ensure their maximum cooperation and coordination in all matters of disaster management.

Thus, MoDMR has the responsibility for coordinating national DM efforts and NDMC is the supreme body for providing overall direction. Functional and hazard-specific planning and execution responsibilities are vested in sectorial agencies. The Standing Orders on Disaster (SOD) is an important milestone towards guiding and monitoring DM activities in Bangladesh; and defines the key national level DM institutions include: NDMC; Inter-Ministerial Disaster Management Coordination Committee (IMDMCC); National Disaster Management Advisory Committee (NDMAC); National Platform for Disaster Risk Reduction (NPDRR); Earthquake Preparedness and Awareness Committee (EPAC); and Focal Point Operation Coordination Group of Disaster Management (FPOCG). There are number of disaster management committees (DMCs) in SOD at the national, district, upazila, union, pourashava and ward levels, where City Corporation/Pourashava (municipalities), Ward Disaster DMCs are crucial platform/institutions in case of earthquake preparedness and response. See Figure 2-2.

The SOD composed of 16 national level coordination and technical committee, 17 local level Disaster management committee, and Response Coordination groups; with defined role of

ministries and local level committees in managing land and pre-during-post disaster situation. At national level are:

1. Regulatory Framework;
2. National Mechanism for Policy Guidance and Coordination; and
3. Supporting Role of Ministry of Disaster Management and Relief.

At local level, these committees are:

1. City Corporation Disaster Management Committee (CCDMC)
2. Divisional Disaster Management Committee
3. District Disaster Management Committee (DDMC)
4. Upazila Disaster Management Committee (UzDMC)
5. Pourashava Disaster Management Committee
6. City Corporation Ward Disaster Management Committee
7. Pourashava Ward Disaster Management Committee
8. Union Disaster Management Committee
9. Union Parishad Ward Disaster Management Committee
10. Local Disaster Response Coordination Group (LDRCG)
    a) City Corporation Disaster Response Coordination Group (CCDRCG)
    b) District Disaster Response Coordination Group (DDRCG)
    c) Upazila Disaster Response Coordination Group (UDRCG)
    d) Pourashava Disaster Response Coordination Group (PDRCG)
    e) Union Disaster Response Coordination Group
    d) Ward Level Disaster Response Coordination Group
11. Local Level Multi-Agency Disaster Incident Management System

SOD, have also formed specialized committees such as earthquake, cyclone, flood, fire, chemical hazard, drought, etc. Considering that the scope of this study is related to earthquake disaster which is not known much on Bangladesh. The Earthquake Preparedness and Awareness Committee (EPAC) of the SOD structure, responsibilities and its mission as given in Appendix II.2.1. EPAC with 75 members is responsible to prepare the nation for earthquake risk management through advise (see Table II-2). This committee was first formed with 39 members in SOD 2010.

There is no significant activity that has affected the earthquake preparedness is reported. Quick observation indicates that considering that all of the agencies and members should work toward risk reduction, creating collaboration and cooperation among them would be a difficult task. Based on the SOD, the committee should be held two meeting every year with minimum of one-third of members. However, it is foreseen that sub committees may be formed for contingency planning and aspect of earthquake risk reduction.

Observations: *In SOD all players have the responsibilities and duties with respect to DRR. The accountability is not well known and described.*

2.2.6. Urban and Regional Planning in Bangladesh

The first urban policy document in Bangladesh, known as Town Improvement Act (1953) was the starting point for modern urban planning in Dhaka. This document is like a statute document that includes terms and rules about Kartripakkha which has published in 1953 to provide the development, improvement and expansion of the Capital of the Republic and

Narayangonj and Tongi Municipalities and certain areas to their vicinity and the constitution of a Kartripakkha therefor. This document comprises the following topics about RAJUK:

- Distribution of some relevant idioms and words;
- Constitution of Kartripakkha; (definitions of structure and employees of RAJUK)
- Improvement Schemes and Re-Horsing Schemes (namely about fit or unfit and construction of building, the formation, retention or enlargement of open spaces…)
- Role of RAJUK in acquisition and disposal of land;
- Improvement schemes and also rules and municipal contributions.

In conclusion, this document set regulation and rules of RAJUK's function as the main developing authority in Dhaka.

In 2011, the National Urban Sector Policy with the main objectives of the National Urban Sector Policy for Bangladesh was ensure regionally balanced urbanization through decentralized development and hierarchically structured urban system; facilitate economic development, employment generation, reduction of inequality and poverty eradication through appropriate regulatory frameworks and infrastructure provisions; censure optimum utilization of land resources and meet the increased demand for housing and urban services through public-private and other partnerships; protect, preserve and enhance the urban environment, particularly water bodies; and to devolve authority at the local urban level and strengthen local governments through appropriate powers, and resources and capabilities.

The National Urban Policy has developed policies with the consideration of urban planning issues such as development process, socio-economic, environment aspects, except their compatibility with the expected seismic hazard. In other word the urban planning and land use are not risk sensitive. Rajshahi Development Authority is also developing Risk Sensitive Land use plan.

Some of the recently adopted national and city land policies are briefly described in next sections. It can be seen that in none of the national policies, there is no criteria has been mentioned related to any natural hazard related landuse planning in this very important national policy. This kind of policy is creating risk and if it was risk-sensitive would reduce or avoid risk.

2.2.6.1. National City Policy (2014)

This document stated future vision, by identifying the positive aspects of urbanization, strengthening them and tackling the negative aspects in a planned way, achieving increasing economic growth through planned urbanization, with the participation of local urban dwellers, including various organizations, civil society and backward population. Objectives of this National City policy are as follows:

- To ensure regional balance and planned urbanization
- Economic development, creation of employment opportunities, reducing discrimination and reducing poverty through establishing appropriate legal framework and development of infrastructure;
- Preservation and development of the city environment
- Ensuring the best use of land resources and meeting the growing needs of housing and urban services through public-private partnership
- Participatory decisions

- To ensure the safety of all citizens
- Preserving the historic and cultural heritage of the city and enhancing aesthetic beauty
- Take effective measures to address the impact of natural disasters and climate change
- Good governance by establishing transparency accountability and participating stakeholders.

2.2.6.2. City and Regional Planning Act (2014)

This document is a comprehensive book of urban and regional planning by the Department of Urban Development, Ministry of Housing and Public Works which covers the following items:

- Definitions (description of basic issues of urban and regional planning for instance: region, development, city, plan, land and etc.).
- The work schedule and circumstance of agencies associated with urban planning (namely their functions and relevant activities.

2.2.6.3. National Land Policy (2016)

National Land Policy which has been prepared in 2016, consists of layers of policies issued by various ministries and have an important role in risk sensitive landuse planning and safe and resilience development. This document comprises land classification in Bangladesh and their identifications and also Land policy framework. Land policy framework includes following issues relevant to land and for each of these issues Policy Statements have developed. Objectives of the National Land Policy have presented in the Figure 2-5.

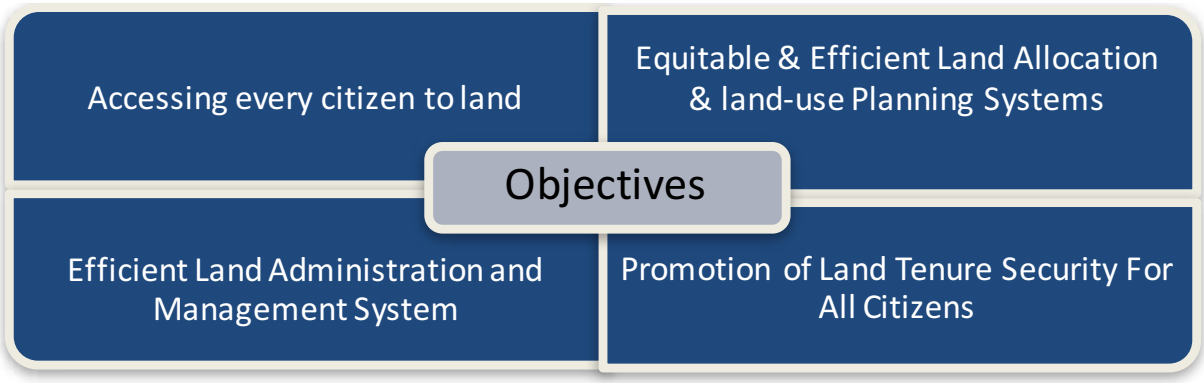


Figure 2-5 Objectives of the National Land Policy

It should be noted that there is no criteria has been mentioned related to any natural hazard related landuse planning in this very important national policy.

2.3. Scenario Based Contingency Plans, 2014

Comprehensive Disaster Management Programme (CDMP) was initiated by the Ministry of Disaster Management and Relief to reduce country's vulnerabilities to adverse natural hazards and extremes events. The phase I of this multi-donor international and national project was started in 2004 and its phase II was completed in 2014 as CDMP II. Some of the objectives of the contingency planning are:

1. Facilitate a rapid emergency response by allowing planners more time for advance preparedness measures for responses;
2. Provide a tool for maintaining control over events or limiting the risk of loss of control. Because of the scale of the problems that they pose, earthquakes sometimes provoke

erratic or unpredictable responses. Well-intentioned but ill-equipped agencies may rush to help, leading some agencies to over-react to the emergency. The risk of inappropriate responses is much lower when clear plans are in place.

3. Identification of projected needs that may arise as a result of an emergency and the resources that will be immediately available to meet those needs.
4. To lay the foundation for the paradigm shift from a post-disaster relief and response strategy towards a comprehensive risk minimization culture that encouraged disaster-resilience initiatives, through a series of interconnected strategic directives such as:
    - Raising the level of expertise of the disaster management systems;
    - Mainstreaming disaster risk management programming;
    - Strengthening community institutional mechanisms;
    - Expanding preparedness programs across a broad range of hazards; and
    - Putting the response systems into operation.

Based on these directives, one of the major sub-programs of CDMP included: (1) Capacity-building, (2) Partnership development, (3) Community empowerment, (4) Research and Information management, and (5) Response management.

Also in CDMP, the scenario-based Ward-level Spatial Contingency Plan for 5 cities and 3 major towns of Dhaka, Chottogram, Sylhet, Rangpur, Mymensingh, Rajshahi, Dinajpur,Tangail, Bogra Earthquake risk assessment was carried out in 51 Wards of three major cities- Dhaka, Chottogram and Sylhet City Corporation areas. The corresponding preparedness activities, mainly the scenario based earthquake contingency plans also were developed for these cities with the aim to create an efficient and effective collaborative approach to emergency response and management at city level with the participation of all city level stakeholders. CDMP II also was took initiatives to further scale up the earthquake and other urban risk reduction activities through carrying out similar earthquake risk and damage assessment and subsequent development of scenario based contingency plans for as well as to develop scenario-based Ward-level Spatial Contingency Plan for part of Dhaka, Chottogram and Sylhet City Corporation areas.

General Comments: Under CDMP hazard and risk analysis were done using HAZUS model (which was developed by the United States' Federal Emergency Management Agency (FEMA) and National Institute of Building Sciences) for analysing potential damages and losses from different earthquake scenarios in 6 cities of Bangladesh. Totally incompatible condition. Considering the likely earthquake threat in Bangladesh, three different scenarios earthquake have been developed based on different return periods (both short and longer) to identify the possible damage to buildings, infrastructures, utility services and facilities and casualties in were estimated. The study and plan as it will be explained in the following sections, provides some useful information and proposes disaster response related actions; but it is not compatible with the existing financial, technical and human resource capacity of the Bangladesh and goals are set too high to be reachable. Moreover, the proposed contingency plan has not provided any spatial prevention measures and risk reduction measures. It is mainly intended for disaster response based un-verifiable information.

2.3.1. National Earthquake Contingency Plan, 2010

The earthquake risk of the urban centre is growing in Bangladesh with every passing moment because of the unabated growth of human settlement and industrial and other economic activities. The rapid increase in vulnerability of urban areas is evident from the rapid urbanization, population growth in most of large urban centres, population migration and development of major economic zones in and around major cities like Dhaka and Chottogram, due to haphazard urbanization and sub-standard construction of buildings, residential houses and other infrastructures without any consideration of underlying earthquake hazards.

On the Contrary, present capacities in disaster management in Bangladesh are largely centred on emergency response and post disaster recovery, which is evident from the flood and cyclone events of high magnitude. But there is a demanding need for a comprehensive geo-hazard and earthquake risk reduction "Contingency Planning" strategy for low frequency high magnitude events, which occur without warning. In these circumstances, an earthquake specialized Contingency Plan was developed by the DoDMR to ensure better response towards earthquake hazard.

The aim of the National Earthquake Contingency Plan to create and promote:

1. Efficient and effective collaborative national approach to Emergency Response & Management at all levels with the participation of all stakeholders;
2. Appropriate command and control mechanism;
3. Partnerships;
4. Trust, mutual respect and understanding among all stakeholders;
5. Arrangements for sharing of resources and experience that will result in a highest level of safety and security of citizens of Bangladesh.

The ultimate goal of this contingency plan has been set to minimize adverse effects (loss of lives and properties, damage and disruption of critical facilities etc.) by developing a comprehensive geo-hazard risk reduction strategy that is linked to an easy implementation framework. The framework should be able to address the earthquake disaster specific needs and actions that could be implementable at all levels from national, city and agency levels and cover all the phases of disaster risk management from preparedness to response.

The planning assumptions have been defined as:

1. Earthquakes within the three cities of Dhaka, Sylhet and Chottogram **will cause large numbers of deaths** and injuries and extensive damage and destruction of buildings, emergency facilities and infrastructure (see next section);
2. There is likelihood of secondary effects following an earthquake or aftershocks which may include tsunami, fire, flood, liquefactions, subsidence, damming of rivers, landslides, and dam failure, release of hazardous and toxic chemicals;
3. Strong aftershocks will continue for several days resulting in further building collapse;
4. **Large numbers of persons (hundreds of thousands) will be in need of shelter, welfare, relief assistance, medical care, etc.;**
5. Access will be severely restricted due to debris, landslides, collapsed bridges, etc.;
6. Many national and international response and humanitarian organization other than the government institutions will also be involved during response and recovery to earthquake disaster.

Finally, the direct users of this National Earthquake Contingency Plan will be the first, second as well as third level Responder Organizations in order to save human-lives, provide humanitarian assistance, and restore the lifeline facilities and utilities respectively.

2.3.2. Earthquake Risk Assessment and Developing the Scenarios

A comprehensive earthquake risk assessment was conducted by CDMP in 2009. Considering the likely earthquake threat in Bangladesh, three questionable scenarios have been assumed for each cities and based on that that level of hazard, possible damages to buildings, infrastructures, utility services and facilities and number of casualties have been estimated. This Scenarios can be considered as mega disaster with low probability of occurrence. Based on the results of the risk analysis and estimated human losses, an operational contingency strategy and plan have been proposed for 6 main cities of Bangladesh at city and ward level (see Ref. numbers 10-23) for all the key players in the DRR. This plan is briefly described in next section.

For Dhaka, three different scenarios of magnitude 7.5 originated from Madhupur fault, and magnitude 8.0 and 8.5 originated from plate boundary fault have been assumed and its risk has been analyzed. For example, for 59,849 available hospital beds for use, it has been estimated that on the day after an earthquake of 7.5 Mw, only 24,242 hospital beds (41%) would be available for use by patients already in the hospital and those injured by the earthquake. After one week, 54% of the beds will be back in service. By 30 days, 72% will be operational. After an earthquake of Magnitude 8.0, only about 37,625 hospital beds (63%) are available for use by patients already in the hospital and those injured by the earthquake. During this situation after one week, about 76% of the beds will be back in service and by 30 days, 87% will be fully operational. There is no scientific justification for this kind of analysis is available. Also, Table 2-2 shows the building related economic loss estimates (millions of dollars) for different scenario. Based on the consultant's view of Dhaka, it seems that estimated economic loss is very under-estimated, which makes the validity of these information, questionable, even by scientific community of Dhaka.

Table 2-2 Estimated Building economic loss for different earthquake scenario (Ref. CDMP)

Case	Capital Stock Loses	Single Family Dwelling (SFD) Residential	Non-SFD	Commercial	Industrial	Others	Total
1	Structural	2.11	506.99	499.53	38.22	65.31	1,112.15
	Non_ Structural	6.07	2,548.89	755.94	154.86	238.45	3,704.21
	Content	1.59	685.41	461.56	114.56	129.86	1,392.99
2	Structural	1.10	316.55	278.97	19.71	33.71	650.04
	Non_ Structural	3.31	1,524.76	405.95	80.28	123.13	2,137.43
	Content	0.89	393.10	253.3	59.21	69.07	775.57
3	Structural	2.33	533.91	439.56	37.15	62.99	1,075.93
	Non_ Structural	6.92	2,797.11	670.53	158.32	221.42	3,854.31
	Content	1.95	820.14	427.30	118.46	125.78	1,493.63
4	Structural	5.39	1,216.98	1,071.05	88.15	154.42	2,535.99
	Non_ Structural	17.34	6,352.31	2,000.20	439.14	634.52	9,443.52
	Content	4.45	1,703.53	1,245.12	317.48	352.66	3,623.24

Source: Hazus calculation based on database, engineering geology and seismic hazard

CDMP has also calculated earthquake risk of Rangpur in north-west of Bangladesh, for three different earthquake scenarios with return period 43, 475 and 2475-years originated from Dauki Fault, all magnitude of 7.9 (!), without any scientific justification. The expected damage to buildings in Rangpur City Corporation are due to three scenarios are shown in Table 2-3 . This estimation is far from reality. The expert judgement on what has been seen is much more than this number. An earthquake with Magnitude 7.9 even 20 km from the city; will cause an extensive damage to all buildings, specially hospitals, fire station, government buildings, mosques, and most definitely common housing units. In general, the CDMP analysis are not seen reliable by any standard vulnerability and risk analysis.

Table 2-3 Expected damage to buildings in Rangpur City Corporation

Scenario	No of Buildings	Moderate	Extensive	Collapse
Scenario-1, 43-Years, M7.9	76,427	2,909	326	38
Scenario-2, 475-Years, M7.9	76,427	16,985	3,895	345
Scenario-3, 2475-Years, M7.9	76,427	27,594	12,180	1,601

Besides, the reliability and accuracy of the risk analysis, the goal for contingency plan has been set for mega disaster, for which requires an extensive level of preparedness and actions which in some cases are beyond the available human and financial resources. In other word the contingency plan will be hard to get implemented if one uses the minimum quantities of requirements of emergency supply in a disaster such as earthquake.

2.3.3. Spatial Contingency Plan

In the immediate aftermath of a major earthquake and its impact on the ward, there will be huge task related to emergency response activities such as damage and need assessment, control of fire, search and rescue of trapped persons, treatment of injured, providing shelters and relief supplies to displaced people, restoration of critical facilities, etc. Experiences show that these response activities are much complicated and many agencies are involved in accomplishing them. At the same time, the community and its residents have critical roles to play in the form of assisting first responders, participating in mass care, coordinating their own family reunification, and cooperating with recovery efforts. Therefore, all these stakeholders need to work together in a systematic and coordinated manner so that their capacities and resources are best utilized for optimum and efficient response. Ward-level Disaster Management Committee (WDMC) will play the lead role to support and coordinate the response operations in the ward with the active support of urban community volunteers; and should establish and activate a temporary Ward-level Emergency Operation Center (WEOC) within the ward immediately following a major earthquake or an emergency to support and coordinate the response operations.

Since WEOC will be the crucial coordination center, it is essential to ensure that WEOC itself is an earthquake-resistant structure, with appropriate safety and security. It will be based in dedicated office facilities with adequate space for meeting. Ward-level city corporation office/ Councilor office is appropriate but other government agency office or school buildings can be suitable for WEOC. It will be equipped with uninterrupted communication facilities, including VHF, HF, mobile telephone, satellite telephone, landline telephone, fax facilities, internet connection, computers, and GIS as response kits and personal protective equipment. In

addition, it will be stocked with necessary office supplies, adequate non-perishable food and water. The WEOC will function for 24 hours a day and establish a staff roster system to ensure adequate personnel are available at all times. It will operate as per structure given in Figure 2-6.

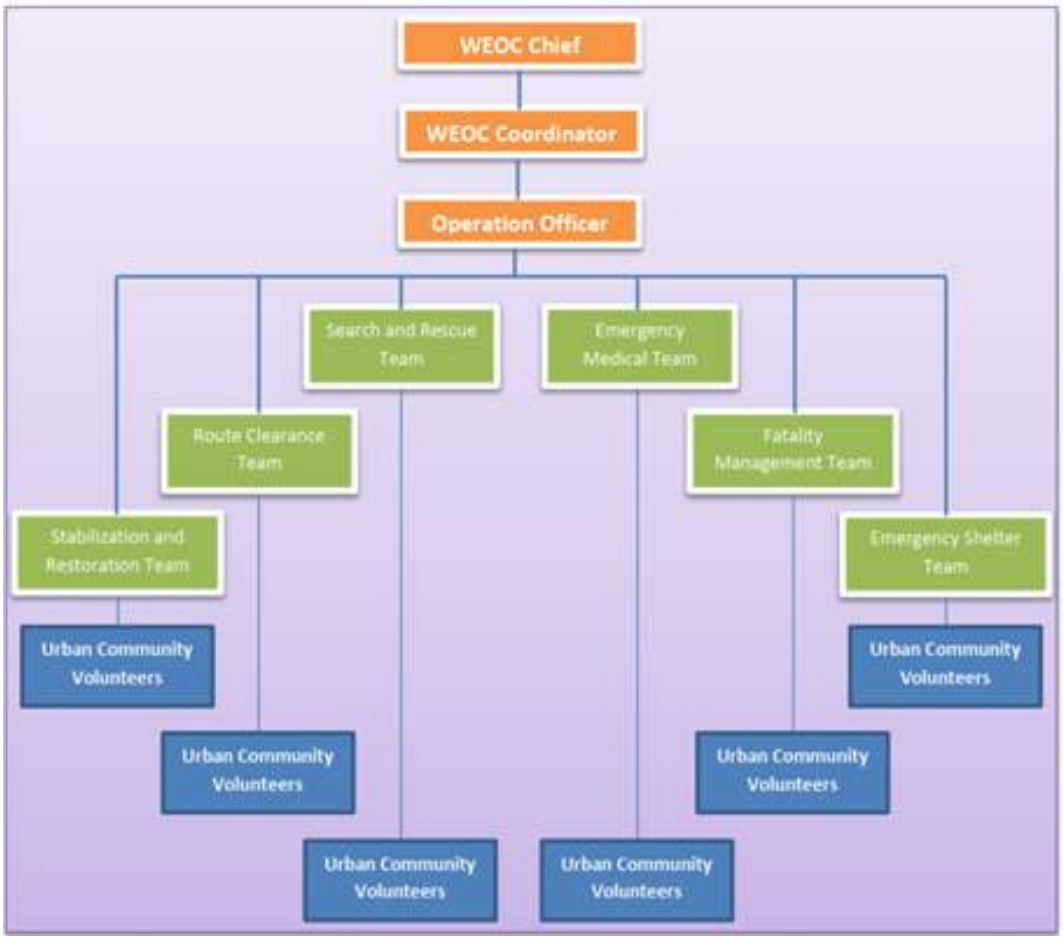


Figure 2-6 Uniform operational structure of Ward-level Emergency Operation Center (WEOC) for all cities in Bangladesh [Ref. 18-20]

Question about this proposal and structures are:

1. How many of the WEOC have been stablished, equipped and operational?
2. Are they prepared and ready for operational?
3. Do they enough technical and human capacity to answer the surge demand?
4. Do People know their location?

2.3.4. Operational Priorities and Response Strategies

Since the primary purpose of this ward-level spatial contingency plan is to support with immediate local response initiatives to save maximum number of lives in case of an emergency like building collapse or earthquake, with a goal of stabilizing the event within the first 72 hours, the priority response activities will be:

1. Delivering community search and rescue services and evacuate people to safe locations.
2. Ensuring the access of search and rescue teams and equipment to deliver the vital response services.

3. Providing immediate medical assistance and life-saving and life-sustaining medical services to the victims.
4. Providing fatality management services and returning deceased, to their loved ones.
5. Stabilizing or eliminating damaged buildings and infrastructures to minimize health and safety threats and stabilizing restoring the essential infrastructures to functional condition.
6. Ensuring temporary shelters, including provision of adequate food, water and sanitation facilities to the displaced population.

2.4. Building Regulation, Codes and Construction Situation

The first building construction related law in Bangladesh started with the Building Construction Act in 1952 with the objective of preventing the haphazard construction of buildings that would interfere with proper land use planning. In 1992, based on this Act, the Building regulations were introduced in Dhaka city. Later with slight changes, it became the National Building Regulation of 1996. Most of the built area in Bangladesh which somehow followed this regulation have the following many deficiencies from the urban and structural safety issues. Moreover, there were no mechanism to check construction and verify that it had followed the authorized plan was not adequate; (Building Regulation Changes: Effects on Residential Building Design in Dhaka for Energy Efficiency). Some of the above gaps were corrected in 2007 by the Dhaka Metropolitan Building Construction Act by assigning the specifying the floor area ratio (FAR) for various site conditions and functions, by which the density of settlements could be brought under control to limit density. To sum up, these documents are terms and rules in two domains for building construction and building based on use regulation.

2.4.1. Bangladesh National Building Code (BNBC)

The National Building Regulation of 1996 was being enforced until the Bangladesh National Building Code (BNBC) became mandatory through national legislation in 2006. The Ministry of Housing and Public Works formed a steering committee and tasked Building Research Institute (HBRI) to provide update. In 2017 the revised BNBC was approved by the Ministry of Housing and Public Works and also vetted by the Ministry of Law. Since 2017, the BNBC is still awaiting notification through public gazette. Without such notification, the document cannot be legally enforced. Gazetting is being delayed apparently because diploma engineers are not happy with the role assigned to them in BNBC 2017.

The NBC consist of three volumes pertaining to the structure of building namely:

- The basic consideration of building and structure,
- Structural system,
- Foundation design requirement,
- Foundation and
- The geotechnical subject of construction and etc.

The definitions presented in this document providing meanings of different terms and general requirements for the structural design of buildings, structures, and components thereof are specified in building codes. These requirements shall apply to all buildings and structures or their components regulated by this Code which defined in this document.

2.4.2. Building Construnction (BC) Committee

The administrative and operational chief of the code enforcing office shall be designated as the Building Official who shall act on behalf of the Authority. The Building Official will exercise the power and perform responsibilities and duties of Authorized Officer as laid down in the Building Construction Act. The Building Official may designate an employee or employees who shall carry out the specified duty and exercise the specified power of the Building Official.

The Authority may direct that power of Building Official may be exercised through a Building Construction (BC) Committee. The BC Committee is responsible authority for the issuing the permits for any construction in Bangladesh. 75% or more members of BC Committee shall comprise of professionals like architects, civil engineers and town planners. Building Official should work as ex-officio member-secretary of the BC Committee. Depending upon the area of jurisdiction, the relative building authorities are shown in Table 2-4. Considering that most of the BC Committee members do not have sufficient/required knowledge about seismically safe design and construction; they cannot enforce or consider the seismic design consideration in the permit process.

Table 2-4 List of the building development and construction authority

No	Area	Authority
1	Areas falling under the master plan control of RAJUK, Dhaka	RAJUK
2	Areas falling under the master plan control of Chottogram Development Authority (CDA)	CDA
3	Areas falling under the master plan control of Rajshahi Development Authority (RDA)	RDA
4	Areas falling under the master plan control of Khulna Development Authority (KDA)	KDA
5	Areas falling under the master plan control of any Development Authority to be established in future	Relevant development authority
6	Areas falling under the geographical jurisdiction of any City Corporation where no Development Authority exists	Relevant City Corperation
7	Areas falling under the geographical jurisdiction of any Municipality where no Development Authority exists	Relevant Municipality
8	Areas not falling under any of the above	PWD division office in each district
9	Special areas, if any	To be declared by the GoB

2.4.3. Construction Situation and Vulnerability in Dhaka

Dhaka is a city that is being relentlessly threatened by rampant urbanization. Buildings are cropping up indiscriminately and haphazardly around the extremely dense city. The population is expected to rise significantly, and being generated yet the need for new buildings. Moreover, the complicated building construction process in Dhaka cause the construction violation. Figure 2-7 shows the building construction approval process and monitoring process in Dhaka by RAJUK, which in practice is not well implemented. This process is getting re-designed within the scope of the WB-Urban Resilient Project with the objective a bringing more transparency and code enforcement.

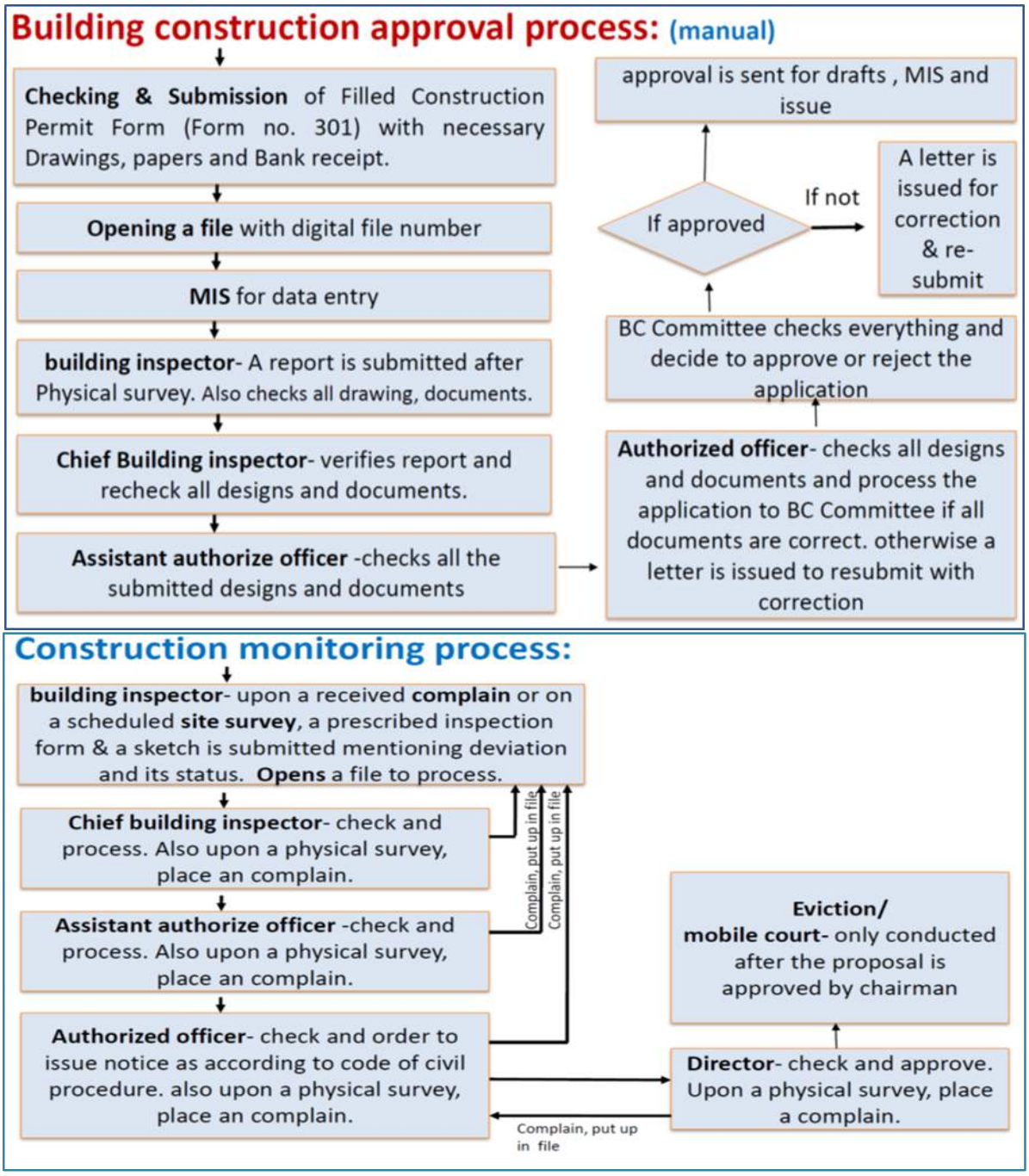


Figure 2-7 Building Construction approval process and monitoring process in Dhaka by RAJUK

In Dhaka, the seismic vulnerability is enhanced by: (1) large number of concrete frame buildings with unreinforced masonry infill, (2) significant number of buildings with soft stories, and (3) use of concrete flat plate construction in many buildings. The results of rapid visual vulnerability analysis of 2million meter square of the Dhaka important building (1217 schools, 84 hospitals, 28 police station and 91 government offices) performed by group of experts under WB-UR project in 2019, indicates that the structure of more than 90% of them are highly vulnerable to expected level of earthquake in Dhaka. Considering the socio-economic value of these building and their impact on the city; 60% of them have risk factor of 70-85%.

High vulnerability of existing (old, new and under-construction) buildings (residential, school, hospital, fire station) getting added by old and time-worn fabric of the Dhaka, makes the overall risk of Dhaka high. Figure 2-8 shows many improper design and construction of a newly made hospital in Rangpur; and Figure 2-9 shows under-constructing school building in a rich area of Dhaka. This question arises, if these important buildings are have design faults, what would be the situation of other common buildings?? These facts is one of the main reason that the risk of Bangladesh very high in the world. This is a big disaster alarm and a fact that all should accept to plan accordingly. The only way that this trend of day to day rise of the building vulnerability, could be reduced by safe construction and building code implementation and enforcement.

Figure 2-8 Improper construction and code violation of private hospital

Figure 2-9 Improper design and construction of “Model” school in a rich area of Dhaka

2.4.4. Possible Reason for Vulnerability of Buildings in Bangladesh

With the above explanation and considering that the key factor in risk reduction is aseismic design and construction of Built environment and building code enforcement; one of the main challenges that was found from the observations, are low quality construction and lack of basic structural and non-structural deficiencies that are important from a disaster management point of view. Some of the reasons can be outlines as followings:

1. Outdated Building Code, which has caused and created risk; and bad construction create demand for disaster management and relief. The new revision of the BNBC can help to improve the aseismic design and construction of the buildings. There is urgency for changing the construction practice in all Bangladesh and in Dhaka and important cities urgently, by ensuring that new construction meets updated codes and standards to avoid a creating a new risk, while efforts are toward reducing risk.
2. Lack of ownership and financial incentive for safe construction. As it shown clearly in Figure 2-10; around 70% living in rented house and more than 50% live in semi or non-permanent houses. This means owner of rented house and the tenant have least concern about the safety of the buildings.

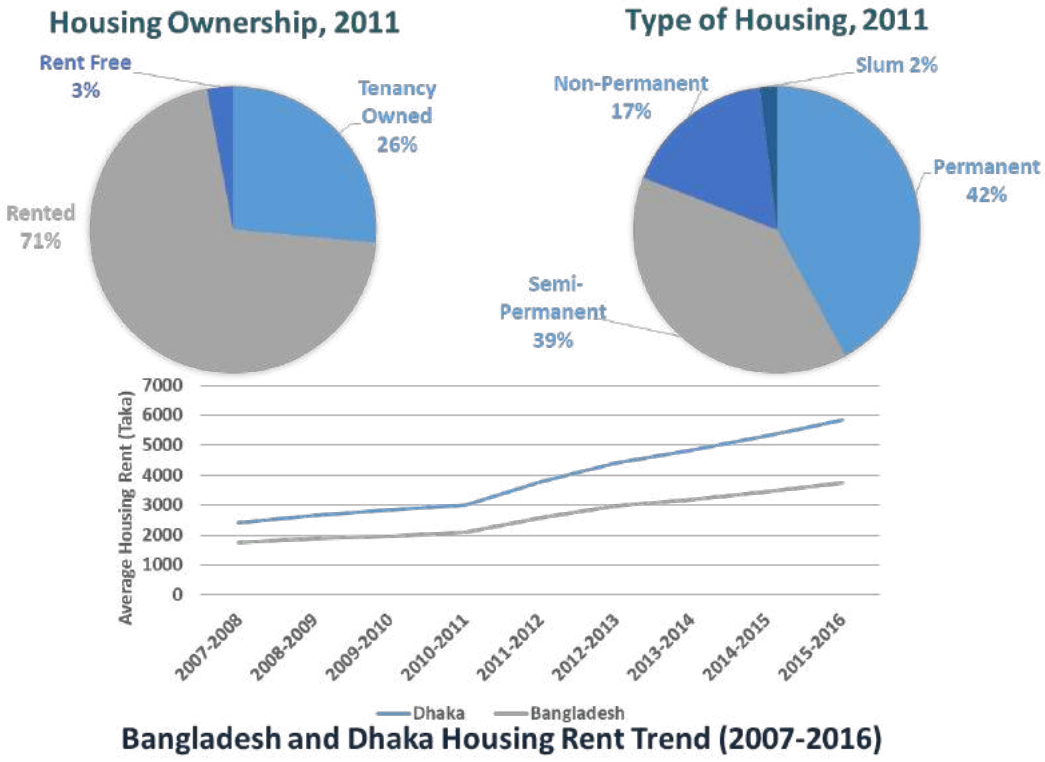


Figure 2-10 Type of ownership and housing in Dhaka and Bangladesh

3. Profit oriented construction business. The rapid economic growth and high demand of building and housing create incentive to most developers that to build to sell. This has the epidemic of many countries (developed or developing). See sample of this kind of construction in an above average income residential area of Dhaka and Rangpur.

Figure 2-11 Inappropriate design and construction of residential buildings in Dhaka and Rangpur

4. Lack of sufficient seismic design guidelines for safe planning, design and construction of buildings and infrastructures against potential hazards in Bangladesh.
5. Visible improper and wrong common construction practice of the new buildings; as well as the use of low and non-standard construction materials.
6. Extensive code violations due to the lack of enough and appropriate knowledge of designers, builders and inspectors; as well as lack of awareness of the owners.
7. No legal regulatory provision exists to keep inefficient and incapable construction firms/builders from entering the construction industry.
8. Complicated approval procedure and paper works for construction permit. There is corruption and a lack of transparency in the approval process
9. Conflict of interest of some authorities, such as:
    - Complaints filed by RAJUK against builders or building owners for alleged violations of code provisions.
    - Complaints filed by third parties to RAJUK about violations of RAJUK rules by owners/developers that affect the third parties.
    - Complaints filed by builders or building owners against RAJUK for a lack of timely response, a lack of due process, unreasonable requests, unjustified decisions, etc.
10. Almost there is no occupancy certificate is required. Sometimes, building approval is obtained for a particular land use zone and use purpose, but then the design is changed and the building is used for other purposes; since design engineers and/or architects can change an approved design plans, almost without a penalty.
11. Authorized Officers have no authority over inspectors and other subordinates to influence their performance.
12. Fire safety check is completely missing for low-rise residential buildings which are shorter than 7-stories.

2.5. Bangladesh Disaster Risk Management Status Report 2016

The disasters that can cause losses in Bangladesh are primarily originated from natural hazard (cyclone, flood, earthquake, etc.), man-made conditions (road accidents, building collapse, fire hazards etc.) and climate change impacts. These hazards caused 567,587 human losses during 1950 to 2016 in which 10,715 of them were during the period 2005 to 2015. 90% of these was cause by cyclones. Earthquake poses huge threats considering the high exposure (built environment and people) of many cities in Bangladesh to high level seismic hazard.

In this report it has been stated that "*Earthquake* hazard poses huge threats to the lives of people, damage of property and economy in Bangladesh because of its location in the tectonically active Himalayan orogenic belt. In recent memories, 1997, 1999 and 2003 earthquake in greater Chottogram regions caused local level damages. Study suggests that around 250,000 buildings in the three major cities- Dhaka, Chottogram and Sylhet are extremely vulnerable to earthquakes. *Lightning* has created its sudden onslaught as something more than a hazard, rather a disaster. 142 people died of thunderstorms until in 5th June 2016 with the highest 15 people in Habigonj district. Collapse of multistoried garment industry during production hours on 24th April 2013 was one of the major *man-made disasters* in Bangladesh where 1176 people died and 2438 injured people were recovered.

It should be noted that due the GoB-DRM program, the human casualties due to natural disaster has been reduced in recent years. In 1970 cyclone, one million lost their lives, while in 1991 cyclone only 140,000, in 2007 only 4000, and in 2019 cyclone Mora, only 6 people lost their lives. This is a great success in Bangladesh, since people are aware, government is prepared and have learned how to live with cyclone. Lessons learned from this success should be transformed into a resilient effort for another hazard most importantly to seismic hazard.

Based on this report the Disaster Risk Management (DRM) Status and Progress are outlined as:

1. Understanding Disaster Risk:
    - Introduction of Risk Assessments tools: MoDMR developed Community Risk Assessment (CRA) tool to identify and better understand the local level disaster risks. CRA is a participatory process for assessing hazards, vulnerabilities, risks, ability to cope, preparing coping strategies and finally preparing a risk reduction implementation plan by the local community.
    - Risk informed human resource development: MoDMR has developed partnership with 17 universities of Bangladesh to help creating an enabling atmosphere for generating disaster management professionals and up to now about 1000 professionals received degrees of different kinds from these universities.
    - Incorporation of Disaster Management aspects in School Curriculums: Inclusion of disaster risk reduction and climate change adaptation issues are done in the primary, secondary and higher secondary education levels through the partnership between MoDMR and National Curriculum and Textbook Board (NCTB) of Bangladesh. In the year 2014, NCTB distributed 320 million books among 30,680,172 students where disaster management issues had been incorporated in 31 subjects (primary level 9, Secondary level 14 and higher secondary level 8) along with write up on supplementary learning materials (e.g. stories, poem, novel focusing on disaster risk reduction issues) related to disasters.

2. Strengthen Disaster Risk Governance to Effectively Manage Disaster Risks:
   - Policy Framework: A shift from post-disaster relief distribution to a disaster risk reduction culture, the GoB has gradually focused on mainstreaming efforts adopting inclusive approach including gender and disability mainstreaming in DRR. The National Plan for Disaster Management (2016-2020) and the Disaster Management Act (2012) have become functional.
   - Institutional Framework: The government established the Department of Disaster Management (DDM) focuses on risk reduction through community mobilization, capacity-building and linking risk reduction with the socioeconomic development of the poor and vulnerable groups and with developing the DDM's partnership with other government agencies, NGOs and international organizations.
3. Investment in DRR for resilience: The GoB has dedicated funding to DRR, CCA, and recovery/rehabilitation in their annual budget. Also fund for DRR funds are available from Federation of Red Cross-Bangladesh, UN and other international agencies to GoB for DRR activities.
4. Enhance Disaster Preparedness for Effective Response and to 'Build-Back-Better': All of the activities are related to the flood and cyclone. The Bangladesh achievement related to the flood and cyclones DRM can be applied for earthquake DRM as well.

The reports conclude with introducing the Key Challenges and Priorities that appears to be general limitations that are being faced by government institutions, nongovernment agencies setting the priorities for implementation of Sendai Framework for Disaster Risk Reduction:

1. Lack in understanding, knowledge, and capacity: The elected office bearers of local government institutions (e.g., Union Parishads, Pourahava Councils, Municipal Corporations, etc.) lack in management skills to deal with needs which in turn has been making institutional efforts not adequately effective. Most of the officials need immediate capacity enhancement trainings in order to equip themselves to act as per mandate of the DMA. Bureaucratic processes also increase complexities and undermine available national capacities to deal with DRR.
2. Priorities in financing for DRR: Despite SOD has given a list of programs; the lack in prioritization of thematic projects and programs; the relevant ministries and their officials are finding it difficult to identify projects that might be more useful towards reducing vulnerability. The disaster management financing is largely focused on relief assistance through various social safety nets (2.0 % of GDP invested in extensive social safety net programs) with DRR investment largely financed through international cooperation.
3. Weak Integration with Development Efforts: There exists a general lack in understanding regarding the fact that most of the development activities have direct or indirect linkages with impacts of climate change.
4. Lack of a comprehensive policy in recovery and reconstruction is a major challenge in disaster recovery and rehabilitation phases following disaster events.
5. Weakness in Implementation, Monitoring and Shared Learning: The prevailing system has difficulties in designing and implementing projects in a participatory manner. Recognizing that adverse impacts of disaster will be location specific, DRR sensitive

projects should be designed and monitored through a proper participatory process, involving local people and vulnerable groups in particular.

6. Strengthen institutional capacity within planning cells/units, finance/budget cell, and monitoring cell/unit of each ministry and department so that climate change may be integrated in planning, financing and implementation monitoring process of all sectoral development projects and initiatives.
7. Increase financial allocations to implement DRR elements in addition to usual development. Promote structural and non-structural investment like disaster and climate resilient housing, roads, embankments, flood and cyclone shelters and other infrastructure construction and risk reduction programs at community level.
8. Lack in Decentralization: Despite having policy, institutional arrangements and legal framework for spearheading DRR activities, the entire operation of disaster management is yet to be decentralized. Effective coordination and management, inclusion for participation of all groups, relief oriented response expectations from local government and community level, lack of access to and dissemination of information as well as limited technical support have also been identified as limitations in decentralization.

As part of the CDMP capacity building program; MoDMR has developed partnership with 20 universities or institutes of Bangladesh (see Appendix II, Table II-3) to help creating an enabling atmosphere for generating disaster management professionals. It was aimed that these professionals will play important roles in generating data, information, undertake critical analytical works on understanding disaster vulnerability and risks more clearly. However, the partner universities are running programs through different departments and institutes like Masters, Post Graduate Diploma (PGD), Undergraduate Bachelor Programs and 19 Certificate Courses. Higher level graduate degrees on disaster management related fields are also being supported by these institutes. Based on the 2016 statistic, 1911 students have been successfully passed the DRM courses, in which 500 where female. 55% of the students were supported by CDMP. See more detail information on the status of students' enrolments on disaster management courses in Appendix II (**Error! Reference source not found.**). The ajor achievements of this project concentrated mostly on non-seismic hazard could be as follows:

- Capacity development of institutions for better disaster preparedness and response (e.g. policy, institutions, human resource, tools and equipment).
- Alignment of sectoral policies with disaster risk reduction objectives.
- Introduction of systematic disaster impact assessment procedures (e.g CRA) to produce RRAP (Risk Reduction Action Plan) aiming to mainstream DRR activities into regular development programs.
- Risk identification and early warning measures development.
- Knowledge management through information generation, information dissemination gateway.
- Partnership development for innovative program design such as CDMP and delivery aiming at reducing underlying risks.

Emphasize of the CDMP capacity building program has been on the disaster management or disaster response with special emphasize on flood and cyclone. Based on the interview with

universities professors, experts and student, it has been observed that the program has not covered any earthquake science and engineering related program which is highly needed for seismically safe and resilience buildings and infrastructures such as: earthquake engineering, aseismic design of structures, seismic hazard analysis, geotechnical earthquake engineering, etc.

2.6. National Resilience Program (NRP), MoDMR-UNDP

The National Resilience Program (NRP) is a Program of the GoB (mainly MoDMR, MoP, MoWCA and LGD); 3 UN agencies of UNDP, UN-Women and UNOPS UNDP; funded by the Department for International Development (DfID) and the Swedish International Development Cooperation Agency (SIDA) with the goal of providing strategic support to sustain the resilience of human and economic development in Bangladesh through inclusive, gender-responsive disaster management and risk informed development. The purpose of the Program will be to achieve substantial increase in resilience and reduction in disaster risk, loss of lives and livelihoods of men, women, girls and boys and better protection of the health of persons, businesses, and communities in Bangladesh. NRP consists of four sub-projects, where 3 of them could have direct effect on earthquake risk reduction: 1) Department of Disaster Management (DDM) of the MoDMR; 2) Programming Division of the Ministry of Planning; 3) Local Government Engineering Department of the Local Government Division; and 4) Department of Women Affaires (DWA) of Ministry of Women and Children Affair.

The NRP- DDM part will work towards improving community resilience by creating replicable, cost-effective models for local disaster risk reduction, risk management through social safety nets, disability inclusive disaster risk management, Flood Preparedness Progarmme, Forecast-Based Financing and Ward-Level Earthquake Preparedness with the objectives of:

1. To provide strategic support in strengthening national capacity to keep pace with the changing nature of disasters.
2. To sustain the resilience of human and economic development in Bangladesh through inclusive, gender responsive disaster management and risk informed development.
3. Substantial increase in resilience to disaster and reduction in disaster risk, loss of lives, livelihoods and health of men, women, girls and boys, and protection of persons, businesses and communities in Bangladesh.
4. Advocacy for implementation of SFDRR and developing necessary monitoring mechanism to oversee implementation progress of SFA.

It is imperative that rapid urbanization and increasing knowledge of the seismic hazard exposure of Bangladesh have led to the realization that the country's national preparedness for a large-scale earthquake is inadequate. The present system for disaster preparedness and response remains untested in the face of high-impact disaster in general, and the specific technical capacities for earthquake risk preparedness and response are not yet well developed. While the country has a number of professional and voluntary institutions with large human resources to deploy in disaster response, they lack skills and knowledge about earthquake preparedness and response in particular. The target Disaster Hotspots for Resilience are: Urban area of Dhaka, Rangur, Tangail, Rangamati and Sunamganj; Seismic, flood and drought area and coastal zones.

NRP would pay special emphasize on the issues related to the poorest, woman and children safety during disasters since they have been found to be disproportionally impacted before, during and after disasters due to persistent gender inequalities, gender-based discrimination and violence, which are often reinforced, perpetuated and exacerbated by disasters. Current national disaster management systems and mechanisms are inadequate in managing risks in a gender-responsive manner, with limited leadership by women as a key gap. While mortality from disasters have been declined radically in the past decades, the impact of disasters on poverty graduation and the national economy is significant. Moreover, in the past decade has seen the development of a comprehensive disaster risk governance and institutional architecture in Bangladesh, with a number of mandated public and volunteer institutions and organizations with mandated roles and responsibilities for disaster preparedness and response. However, this system remains largely gender and disability blind and there is a lack of disaggregated data to inform it. NRP is designed to provide solution for this gap.

NRP Expected Results:

Considering the NRP focuses on developing national capacity, it is expected to fill gaps in five key areas.

1. Improved capacities for risk-informed and gender responsive development planning;
2. Strengthened gender-responsive national capacities to address recurrent and mega disasters.
3. Improved capacity of GoB to achieve resilience through designing and constructing risk-informed and gender-responsive infrastructure system.
4. Enhanced women leadership capacities for gender-responsive disaster management decisions, investments and policies at national and local levels.
5. Strengthened disability inclusive, gender responsive community preparedness, response and recovery capacities for recurrent and mega disasters.

NRP is mainly focused on the socio-economic part of risk assessment, visualization and capacity building, and providing strategic support to enhance government capacity through its own structures and programmes; and does not aim to implement local risk reduction activities at scale; while Urban Resilience Project (URP) of Dhaka and Sylhet, which is funded by WB and implemented by MoHPW and MoDRM is mainly concentrated on engineering aspects of multi-hazard risk, risk sensitive land use planning and giving recommendations for fixing the existing construction practice, mainly in Dhaka. See next section for description of URP. Considering that both project has been approved by GoB and MoDMR plays a key role in both project; it would have been better that more coordination and exchange could be seen during the course of their implementation. This is one example that coordination is key point that need to be improved in the future.

2.7. World Bank-Urban Resilience Project of Dhaka and Sylhet, 2019-2022

Over the years, government of Bangladesh has demonstrated that investment in flood management and cyclone preparedness saves lives, reduces economic losses and protects development gains. Despite all of the work that has been done, Disaster Risk Management solutions in an urban context present greater challenge. The vulnerability of Bangladesh's urban areas is still neither well understood, nor adequately addressed in the country's policy framework. The Urban Resilience Program (URP) is a ground-breaking project that plan to:

- Assess the vulnerability of essential infrastructure, public facilities, and lifelines to

better guide future investments in retrofitting;
- Equip national and local disaster risk management agencies with relevant response resources, including emergency operations centers, communication systems, and related training; and
- Improving construction practices by integrating disaster risk into development planning and zone processing.

A broad cross-section of stakeholders (including senior government officials, concern community and technical experts) provided inputs into the outcomes of the project. This broad, collaborative process allowed all participants to share knowledge and best practices and equally important connected technical experts to decision-makers. Among the different components of URP, RAJUK has several sub-components where Risk Sensitive Land Use Planning practice is one of the core activities. Land use planning regulations and emergency service delivery systems have been unable to keep up with the rapid pace of growth. These major cities involved in this project also lack a proactive approach to urban management and economic asset protection. Land use planning regulations and public service delivery in urban areas could not keep up with the pace of growth. Risk-Sensitive Land Use Planning (RSLUP) involves mainstreaming DRM within the governance and operations of public and private institutions particularly in spatial and physical development plans. RSLUP incorporates DRM through institutional and legal reforms, plans, programs and projects that dictate land use, land management, and infrastructure development. RSLUP is a new practice – especially in developing countries like Bangladesh – planners and planning organizations lack experience and methodology. For planning institutions which are only familiar with traditional planning, the main difficulty is in how to use disaster risk information in determining its implications to development and spatial plans. This is necessary to formulate strategies to reduce risks and mitigate the impact of disasters in development planning practice.

The current regulatory environment is opaque and enforcement mechanisms for urban development control do not address structural safety, leading to lack of enforcement capability and accountability. In this context, any hazards, such as floods, fires, building collapses, or earthquakes, present a formidable threat to life and prosperity. With the nearest major fault line is believed to be in less than 60 km away, Dhaka is vulnerable to seismic risk and fire. Moreover, the city is poorly prepared to respond to a crisis of a significant scale within the metropolitan area. Recent tragedies of building collapse or building fire underscores the extreme vulnerability of the built environment and need to increase capacity to respond to disasters.

The URP is expected to address seismic risk and reduce structural vulnerability of future building constructions in Dhaka and Sylhet. It helps strengthen the capacity of the public agencies to respond to emergencies and strengthen systems. The project will help put an emergency management system in place; mobilize resources at all levels; and assign roles and responsibilities more efficiently. It will develop a consensus-driven analytical foundation required for longer-term investments to reduce risk in the built environment of Dhaka, Sylhet and other cities. The project also supports the institutional infrastructure and competency to reduce long-term disaster vulnerability in Dhaka. It will address both the existing built environment as well as future development.

2.7.1. Overall Objectives of the World Bank Urban Resilience Project (URP)

The overall objective of the URP is to strengthen the capacity of GoB agencies to efficiently and effectively respond to emergency events in Dhaka; the secondary objective is to improve quality of new construction in City. The general Structure of WB-Urban Resilient Program is shown in Figure 2-12.

The Specific objectives of URP is to perform, especially components B and C are:

1. Conduct a Vulnerability Assessment of Critical and Essential Facilities and Lifelines;
2. Development of a Risk-Sensitive Land-use Planning Strategy and Practice in Dhaka;
3. Create and Operationalize an Urban Resilience Unit (URU) in RAJUK;
4. Establish an Electronic Construction Permitting System;
5. Set up a Professional Accreditation Program for Engineers, Architects and Planners; and
6. Improve Building Code Enforcement within RAJUK Jurisdiction.

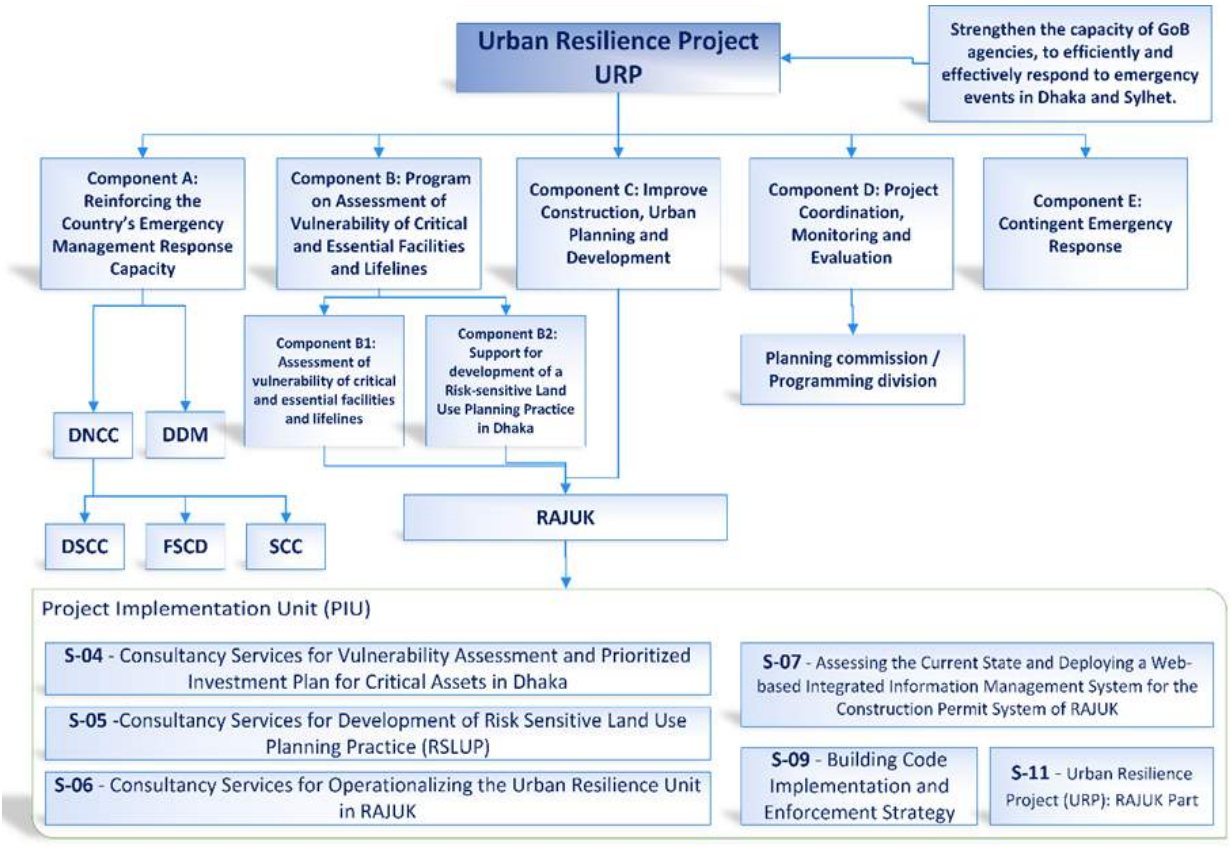


Figure 2-12 General Structure of WB-Urban Resilient Program. 2018-2022

2.7.2. Expected Results

The major expecting results of this important project are:

1. Increased decentralized emergency response services in Dhaka and Sylhet.
2. Increased capacity of officials and emergency management response personnel.
3. Systems and assessments established to reduce vulnerability of buildings.
4. Risk information in land use planning and management.

The risk information can be used as one of the basis to identify future directions and intensities of land uses. It begins with an assessment of natural hazards in relation to human and physical vulnerability, capacity, and development. This is included in the situational analysis of the different sectors. When stakeholders have a grasp of the impacts and implications (e.g. to plans, investments) of the hazard risk, disaster risk management is taken as a development concern and is carried forward through development policies, goals, objectives, strategies and PPAs (Program, Project and Activities). Avoidance and mitigation strategies, capacity and capability building are built into the different development sectors and residual risks are managed. It should be the goal of mainstreaming that risk governance prioritizes human, physical and environmental system resilience, and thus, various interventions (e.g. policies, investments, capacity building) address core needs (e.g. risk assessment, risk reduction, managing residual risks).

Several entry points in the conventional process of land use planning provide opportunities for integrating risk reduction measures into land use plans through specific activities. The RSLUP process necessarily includes building the capacity of technical concern personnel including policy makers familiar with conventional land use planning on what elements to mainstream. The process to mainstream using the mentioned entry points to be developed through participatory approach.

One of the final output is the RSLUP for Dhaka. The RSLUP should address the identified gaps in land use planning and management for DRM in Dhaka, a set of policy recommendations is to be proposed. The recommendations are meant to serve as a guide for implementing a series of practical and effective actions to enhance the enabling environment for DRM. The key policy recommendations could be:

1. The planning structure and process, plan outputs and the structures to implement them must be risk-sensitive.
2. Make the process of plan development and implementation participatory at all levels.
3. Use the Multi-Hazard, Vulnerability and Risk Assessment (HVRA) findings to guide land use planning formulation, zoning ordinances and development regulations.

2.8. JICA Urban Safety Projects in Bangladesh

Japan International Cooperation Agency (JICA) has implemented several project toward increasing the earthquake safety in Bangladesh as shown in Figure 2-13. The list of the projects are given in Appendix II, Table II-4.

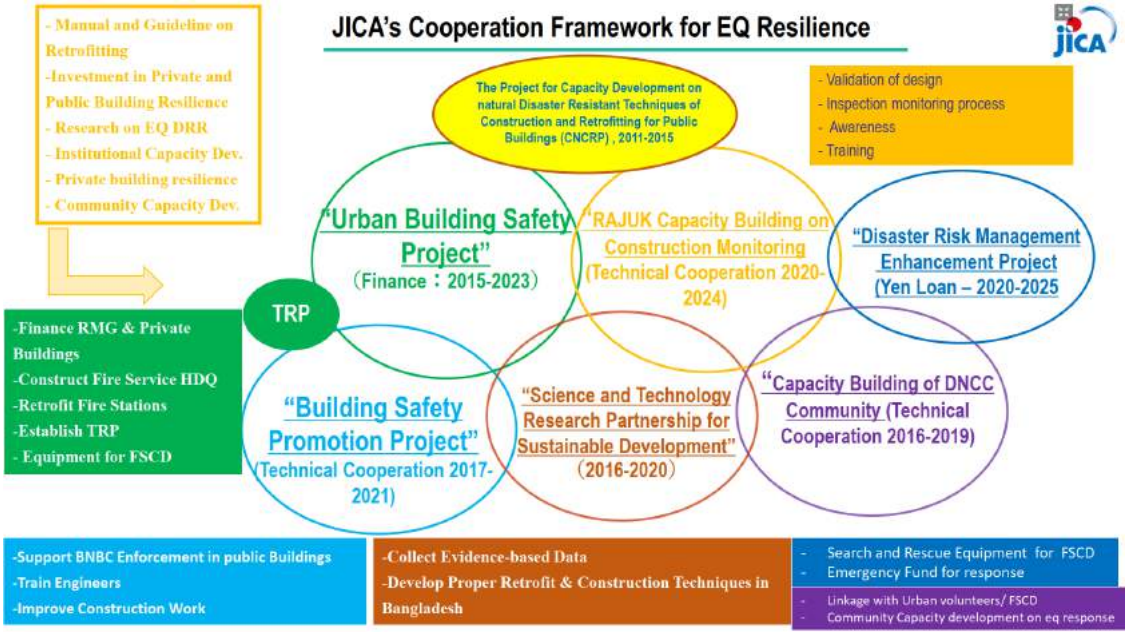


Figure 2-13 JICA Cooperation framework for earthquake Resilience in Bangladesh

3. EARTHQUAKE HAZARD, VULNERABILITY AND RISK MODELLING IN BANGLADESH

Earthquake hazard poses huge threats to the lives of people, damage of property and economy in Bangladesh because of its location in the tectonically active Himalayan orogenic belt. The major earthquakes happened in Bangladesh include 1548 earthquake hit in Chottogram and Sylhet regions, earthquake stricken in 1642 in Sylhet district, earthquake took place in 1918 in Sylhet district, 1762 earthquake that shaken most parts of Bangladesh, great Indian earthquake happened in 1897 (8.7 magnitude on Richter Scale) caused huge damage in Dhaka, Sylhet and Mymensingh districts. In recent memories, 1997, 1999 and 2003 earthquake in greater Chottogram regions caused local level damages. The latest earthquake that has affected Dhaka, Chottogram, Barisal, Rajshahi, Dinajpur, Rongpur, Kushtia and different parts of the Bangladesh was the Nepal M7.8 with epicenter of 81 kilometers (50 miles) northwest of Kathmandu, Nepal on April 25, 2015; with an aftershock of M6.7 on April 26. This earthquake caused 13 people killed and 100 injured due to panic and rushing out from school buildings and factories. Also, 23 buildings were damaged, mobile phone were temporary disrupted in Dhaka, electric transformer explosion, hospitals in Dhaka and Rangpur and airport service were temporary disturbed (https://reliefweb.int/sites/ reliefweb.int /files /resources/SitRep_Earthquake_April%2026,%202015.pdf)

CDMP risk study suggests that around 250,000 buildings in the three major cities of Bangladesh like Dhaka, Chottogram and Sylhet are extremely vulnerable to earthquakes (CDMP 2009). Some 142,000 among 180,000 (79%) buildings in Chottogram; 24,000 out of 52,000 in Sylhet (46%); and 78,000 out of 326,000 buildings (24%) in Dhaka were detected as risky to earthquake hazards. MoDMR has carried out several studies to assess earthquake risks especially for urban conditions. For example, risk assessments were carried out for Dhaka, Chottogram and Sylhet (CDMP 2009) and also for cities like Bogra, Dinajpur, Mymensingh, Rajshahi, Rangpur, and Tangail (CDMP 2015).

Despite the fact that many good and useful studies has been carried out by universities and MoMDR (See Figure 3-1) toward better understanding of the potential seismic sources (active faults), their seismic activities in Bangladesh, in order to obtain seismic hazard; and as well earthquake vulnerability of buildings and infrastructures, and risk assessment (in terms of human and economic loss); most of the studies does not provide up-to-date and reliable information for disaster response preparedness.

Figure 3-1 Sample of the reports, papers and books related to seismic hazard and risk of Bangladesh.

3.1. Seismic Hazard Analysis

Based on the comprehensive review of all of the available and the latest seismic hazard, vulnerability and risk studies that has been done; several reports were found to be more comprehensive and useful for DRM. These were: CDMP (2009, 2014) by MoDMR; BUERP (2014) by WB-EMI project; MRVAM (2016); Global Earthquake Model (2019) and paper by Alam and Dominey-Howes (2016). Even though all of these reports provided a good overview on risk of Bangladesh; their shortcoming, and the gap/challenges and what need to be done can be classified as:

1. Due to the lack or a big gap of not having a national seismic network and earthquake strong ground network, not enough information is available about the seismic sources and seismic activities of Bangladesh. In other word the local knowledge about the seismicity of Bangladesh is not enough. University of Dhaka operate seismographic network under FDSN Network with limited coverage and not as an independent national network. Not much information about this network can be obtained in internet, in contradiction with the common network. Figure 3-2 shows main seismic faults (source) and the recent and historical seismic activity of Bangladesh (Ref. WB-URP-RSLUP-S5 components, 2019)

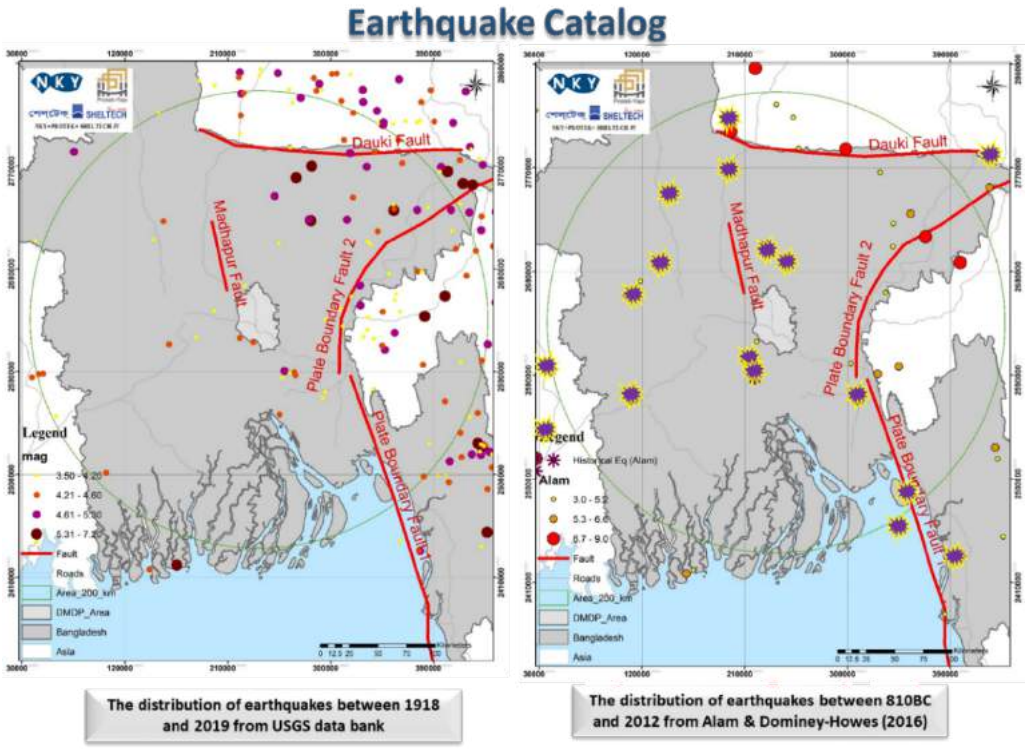


Figure 3-2 Main seismic faults (source) and the recent and historical seismic activity of Bangladesh (Ref. WB-URP-RSLUP-S5 components, 2019)

2. Lack of reliable Earthquake catalogue with uniform magnitude of M_w for both historical and recent (1900-2020) period.
3. Lack of reliable seismic model due to lack of data
4. Lack of enough knowledge on the identified faults and blind or unknown faults, especially in the Dhaka and large cities in Bangladesh.

5. Not accessible/recorded strong ground motion acceleration data
6. The attenuation relationship used for seismic hazard analysis are not compatible with plate boundary fault and tectonic condition of Bangladesh.
7. Unjustifiable identification of the earthquake scenarios for each cities.
8. Better use of the geotechnical data for SHA.
9. In general, short return period (43 years), the observed seismicity in and around Bangladesh controls the hazard for most considered structural periods.
10. Ground motion across Bangladesh represented by PGA has been estimated in the range of 0.1 to 0.6g, corresponding to the 475-year return period and in the range of 0.1 to 1.0 g, corresponding to the 2,475-year return period.

Recommendations:

1. Design and establishment of Bangladesh National Seismic Network; as well as sharing and exchanging seismic data
2. Design and establishment of Bangladesh National Strong Ground Motion Network for engineering purposes.
3. Comprehensive and detail analysis of the seismic sources in Bangladesh in cooperation with the neighbouring countries.
4. Design a portal for sharing all of the required data for SHA, including all of the results of the geotechnical (Soil) investigation.
5. Perform reliable SHA at national and city level with the scale that can be used for urban development, aseismic design of structures and reliable risk analysis.

3.2. Building Vulnerability and Risk Analysis

Many studies have been performed under CDMP and WB and other international agencies toward qualitative vulnerability analysis. As an example, the estimated building vulnerability in different cities of Bangladesh to earthquake hazard (MoDM, 2015) is shown in Table 3-1. Despite the fact that none of can be considered and effective toward improvement of the construction quality and/or avoiding risk; but they had positive achievements or strength and some weakness which can be outlined as following.

Table 3-1 Building vulnerability in different cities of Bangladesh to earthquake hazard (MoDMR 2015)

Cities	Total number of buildings	Generation of debris		Concrete Structure			Masonry Structure			Informal Structures		
		(Metric Ton)	% of steel followed by brick/wood	Total buildings	Moderate Damage (%)	Complete Damage (%)	Total buildings	Moderate Damage (%)	Complete Damage (%)	Total buildings	Moderate Damage (%)	Complete Damage (%)
Bogra Municipality	92830	3.850	73, 27	9829	22.86	8.37	61288	19.79	32.19	20227	18.54	0.1
Dinajpur Municipality	41955	1.390	75, 25	3929	22.74	1.78	23318	25.7	16.16	8057	14.48	0
Mymensingh Municipality	45033	4.55	70, 30	7703	0.58	97.77	26789	0.57	91.77	10541	38.36	1.57
Rajshahi City Corporation	93885	1.610	68, 32	7982	23.85	8.62	80618	29.73	18.84	5142	18.07	0.14
Rangpur City Corporation (old municipal area)	76444	2.81	73, 27	6294	31.33	29.32	37436	13.84	42.18	32694	10.66	0.15
Tangail Municipality	68348	0.35	72, 28	4864	20.54	10.57	13076	40.04	5.93	44417	12.07	0

Strength:

1. The studies provide an overview of expected vulnerability of the buildings, essential facilities in main urban area. These results are very useful toward understanding of the risk, policy decision and showing the importance of earthquake disaster in urban area at ward level.
2. Good GIS-based data collections has been done. But they are not available.
3. Some of the studies have used fragility curves from the neighboring developing countries, to provide a more accurate analysis.
4. Hazard and vulnerability micro zonation maps were produced.
5. Vulnerability assessment of the buildings, lifelines and Casualty losses are estimated based on a GIS database.
6. CAPRA analysis of Bangladesh was very approximate which was developed based on limited data and expert judgement to consolidate hazard and risk assessment methodologies and raise risk management awareness.

Weakness:

1. HAZUS which is a US model were used without any adaptation to Bangladesh cases.
2. Part of Dhaka and other cities were covered and only 10-20% of the total building data were used.
3. Fragility functions that has been used were either from Nepal, India or HAZUS, which their compatibility with Bangladesh is under question
4. Insufficient building data and inventory
5. Not reliable data and results and were not GIS based and are not retrievable and reproducible.
6. Limited vulnerability analysis of lifeline was done.
7. The studies were considered only reinforced concrete building (RC) whereas the area under survey had more unreinforced masonry buildings than RC.
8. Detailed data were collected only for 20% of buildings.
9. The extended of study area is very small.
10. This study focused only to one type of building structure
11. The methodology only determines the percentage of each seismic risk group and is a qualitative analysis therefore it doesn't has adequate accuracy.
12. Only one scenario earthquake was considered (7.5Mw earthquake on the Madhupur Fault)
13. There are uncertainties remain inherently in case of selecting building samples, and the overall results could be either conservative or overestimated
14. Losses are illustrated in regional (91 ward) and general scale so the detailed damage maps are not generated

Recommendations:

1. Local hazard, vulnerability and risk model is required in order to obtain reliable analysis.
2. Investigate HAZUS fragility curves for lifelines

3.3. Findings

The overall judgemental assessment from the visible achievement of DRR in Bangladesh indicates that most of the well-thought planned programs have not been adequately implemented in most part of the country, especially toward earthquake disaster risk reductions. This fact brings us to the fact that implementation is the biggest challenge toward "Resilient Bangladesh".

The overall views on the existing situation or status of earthquake risk and risk reduction actions are:

1. The facts based on the existing studies indicate that approximately two-third of the Bangladesh is exposed to high earthquake hazard, most of the built environment (buildings and infrastructures) are vulnerable, risk is high due to high density of building and population specially in Dhaka, large number of human and economic loss is expected; and it seems that system is not ready for such as disaster, even a small one. Moreover; it will be hard to recover due to low capacity and resiliency of the country and delays the ongoing economic growth of the country.
2. High Risk are mainly due to incompatible development and growth of the cities with respect to expected level of natural hazards, high density of building and population. This high risk can cause large number of human and economic losses in the case of an average intensity disaster.
3. Low capacity and preparedness to cope with disaster for effective and on-time response, restoration recovery and reconstruction that would not affect the ongoing economic growth.
4. **Strong will and High Incentive of the Government to cope with disasters and risk reduction.**
5. GoB has developed many policies, orders, guidelines, organizational and institutional arrangement. All of these need to integrate, harmonized and become specific objective oriented.
6. GoB has not yet built enough national technical capacity required for risk avoidance and risk reduction.
7. Many risk related studies have been done and many ongoing projects exist such as National Resilience Program (NRP), Urban Resilience Project (URP) to deal with natural disasters. Unfortunately, it seems that they are not fully correlated, integrated and complementary.
8. Low level of implementation of rules and regulations related to earthquake risk reduction and preparedness.
9. Low level of building code enforcement and application and implementation.
10. Lack of monitoring for the implementation of existing projects and program in Bangladesh. So many programs/projects have been developed and approved and documented. But there is no system is in place to monitor their implementation. Also, there is no feedback of the policies.
11. Considering the existence of all of the Strategies, Acts, Policies, Studies, Knowledge, Technology, Standards, Guidelines, etc. for DRR in Bangladesh; one would expect that at least the new part of the cities would have or at least meet the minimum safety and quality standards. Bangladesh seems is not fully ready, even for a small disaster.

12. There is no visible concern about earthquake risk among the people and public due lack of knowledge or lack of priority. In other word, demand for safety is not visible; while there is a large demand for security is visible.
13. Results of most of the risk related studies (done and are being done) are not getting used, implemented and getting built-on and create capacities; or the results are not available.
14. Lack of effective and operational risk governance, as it has been analyzed by Worldwide Governance Indicators (WGI), see Figure 3-3.
15. Lack of national research-technology and educational institute concentrating on seismotectonic, seismology, geotechnic and structural earthquake engineering, and earthquake risk. This institute can act as science and technical advisor to the GoB.
16. Finally, the wish lists for resilient Bangladesh has too many goals and objective; without considering its doablity, affordability, technical capacity and resources.

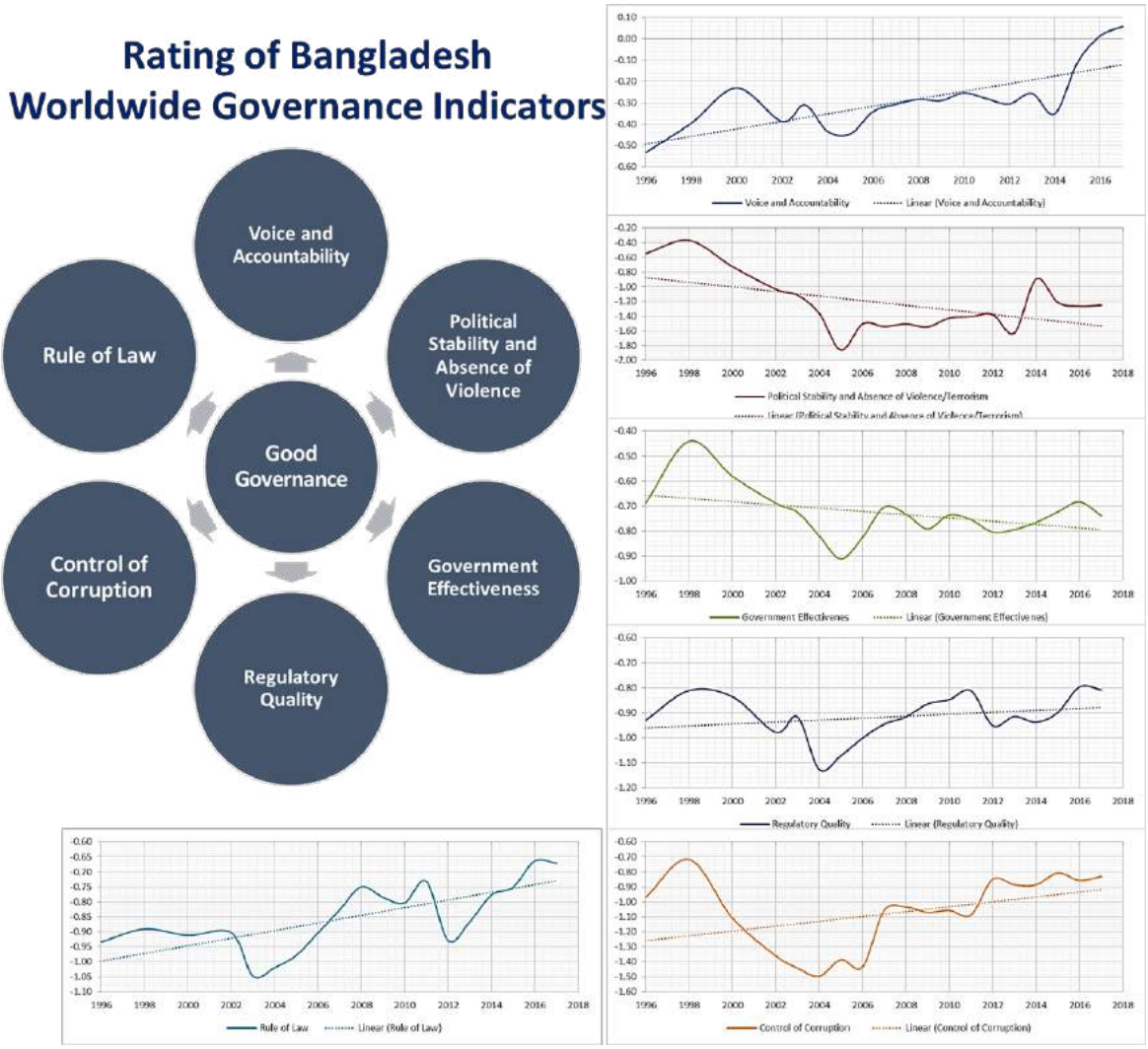


Figure 3-3 WB-Rating of Bangladesh Governance based on the Worldwide Governance Indicators (https://info.worldbank.org/governance/wgi)

4. GLOBAL DISASTER RISK REDUCTION FRAMEWORKS

In the modern world, increased dynamics of natural processes and environmental deterioration caused by human activities damaged the ecological equilibrium. As a result, the last decades were marked by a significant global increase in the frequency of natural disasters and consequent human and material losses and damages.

4.1. Evolution of Global Effrorts from Disaster Response to Resiliency

During the last century, an uncontrolled impact of human activities promoted the global climate change which is considered to be one of the causes of increasingly frequent natural disasters. In parallel, excessive urbanization and construction of settlements in dangerous locations, negligence of relevant regulations and planning in developing countries, low level of risk awareness, extreme climatic events etc., enhanced the effect of natural disasters on people.

United Nations as the world largest humanitarian organization has actively working on promoting the approaches and global frameworks in this field. They have started from humanitarian affairs to post-disaster response to risk management and now to resilience. Evolution of these activities as shown in Figure 4-1 are also briefly presented as follows:

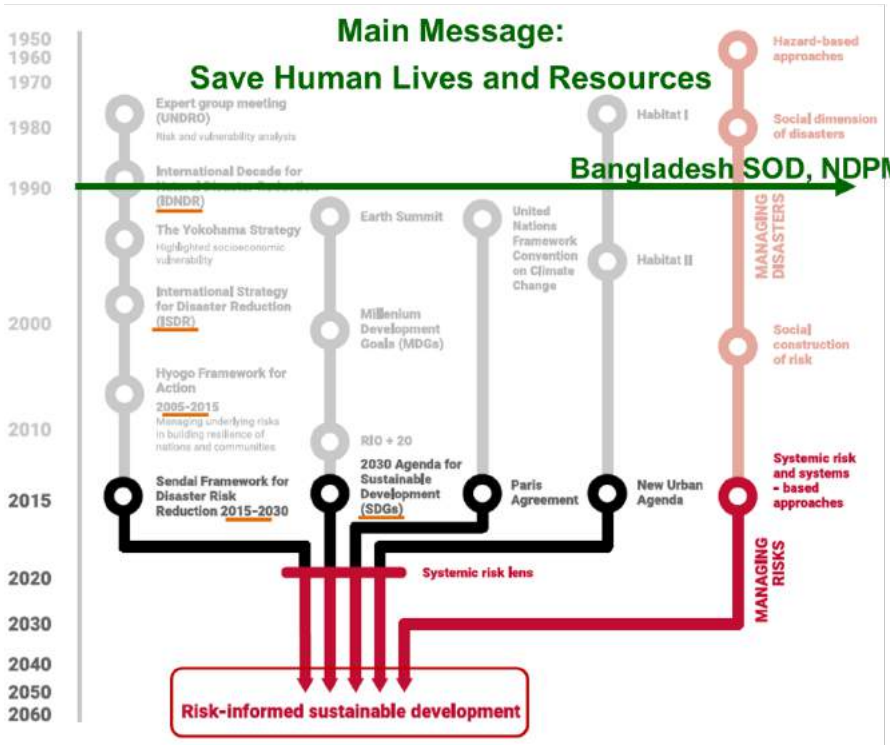


Figure 4-1: History and future of Global Disaster Risk Reduction and Resiliency; 1950 to 2060

1990 – 2000: The United Nations designated the years 1990–2000 as the International Decade for Natural Disaster Reduction (IDNDR). The First World Conference on Natural Disasters in Yokohama, Japan 1994, adopted the Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action, endorsed by the UN General Assembly in 1994. It was the main outcome of the mid-term review of the In IDNDR and established 10 principles for its strategy, a plan of action and a follow-up.

Furthermore, it provided guidelines for natural disaster prevention, preparedness and mitigation. After 2000, an International Strategy for Disaster Reduction (UN-ISDR) was developed according to which national governments are the main management bodies, while comprehensive approaches are prioritized among previous rehabilitation and preparedness approaches. Priority is given to risk reduction, preventive measures, and rising the public awareness and responsibility levels.

2005- 2015: Based on the International Strategy for Disaster Reduction, the UN Second World Conference on Disaster Reduction was held in 2005 in Kobe (Hyogo, Japan) and the Hyogo Frame of Action 2005-2015: Building the Resilience of Nations and Communities to Disasters was adopted. In March 2015, by the end of the term set in the Hyogo Framework for Action, the Third UN World Conference on Disaster Reduction was held in Sendai (Japan) and the Sendai Framework for Disaster Risk Reduction 2015-2030 - a successor international DRR instrument to the Hyogo Framework for Action was adopted. Government of Bangladesh is a signatory of both documents which once again emphasizes the commitment of its government to implement DRR practices in the country.

2015-2030: The global framework documents adopted by the UN in 2015: The Sendai Framework for Disaster Risk Reduction 2015-2030 (March, 2015), Sustainable Development Goals (September, 2015) and the Paris Agreement on Climate Change (December, 2015) are interlinked and targeted to reduce disaster risks, promote sustainable development, and reduce consequences of the climate change.

4.2. Sendai Framework For Disaster Risk Reduction 2015-2030

The Sendai Framework for Disaster Risk Reduction 2015-2030 implies the development of mechanisms for management of small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters caused by natural or man-made disasters at all levels (global, regional, national and local) and in all sectors.

The Sendai Framework has a clearer explanation than HFA of the purpose of managing disaster risks and on the role of coordination horizontal, vertical and with various stakeholders. Overall, the HFA provided critical guidance in efforts to reduce disaster risk and has contributed to progress towards the achievement of the Millennium Development Goals. Its implementation has, however, highlighted a number of gaps in addressing underlying disaster risk factors. Furthermore, issues were identified in formulating goals and priorities for action, in fostering disaster resilience at all levels and in ensuring adequate means of implementation. The gaps indicated a need to develop an action-oriented framework which governments and relevant stakeholders could implement in a supportive and complementary manner. This would help to identify disaster risks to be managed and guide investment to improve resilience.

The Sendai Framework focuses on disaster risks while the HFA focused on disaster losses. Now there is a focus on reducing the occurrence of risks and the magnitude of disasters The present framework, the Sendai Framework for Disaster Risk Reduction 2015-2030, has a broader and a more people-centered preventive approach to disaster risk. It builds on the understanding that DRR practices, to be efficient and effective, need to be multi-hazard and multi-sectoral, inclusive and accessible.

The Sendai Framework calls on communities across the globe to prevent and reduce disaster risk in order to substantially reduce losses in lives, livelihoods and health and in the various assets of individuals, businesses, communities and countries.
The Framework covers disasters caused by natural or man-made hazards, and "related" environmental, technological and biological hazards and risks such as contamination of ecosystems, cascading infrastructure failures and public health risks. The SFDRR intends to creates synergy between 4 priorities and 7 following global targets that have to be achieved by 2030:

1. Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality rate in the decade 2020-2030 compared to the period 2005-2015;
2. Reduce the number of affected people globally by 2030, aiming to lower average global figure per 100,000 in the decade 2020 -2030 compared to the period 2005-2015;
3. Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030;
4. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030;
5. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;
6. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this Framework by 2030; and
7. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

The SFDRR builds on elements, which ensure continuity with the work carried out by countries, municipalities and other stakeholders under the HFA (2005-2015). However, it also introduces new elements, such as:

1. A policy shift from managing disasters to preventing and managing risks
2. An understanding that DRR and climate change adaptation are both dependent variables of sustainable development
3. A broader scope, which includes small-scale and slow-onset disasters caused by natural or manmade hazards, as well as related environmental, technological and biological hazards and risks
4. A renewed focus on preventing the creation of new risks as well as reducing existing risks
5. A focus on reduction of disaster risks - not only on post-event loss reduction;
6. Strengthened coordination and national platforms for DRR and support for local level implementation
7. A set of global targets to be followed by indicators enabling national and local targets and indicators to be aligned to track progress
8. Promotion of national and local DRR strategies building on current analysis of levels of resilience, hazard mapping, risk assessment, future challenges and disaster loss data.

9. Increased emphasis on understanding risk drivers, governance, responsibilities and national platforms, local level implementation across sectors and investments in economic, social and cultural resilience and preparedness to build back better after disasters
10. A focus on livelihoods, health, physical and cultural assets, infrastructure and basic services and special attention to persons with disabilities, women in addition to lives and social, economic and environmental assets; and risk sensitive investments by public and private sector.

4.3. UNDRR Disaster Resilience Score-Board For Cities (DRSC)

The DRSC, structured around the "Ten Essentials for Making Cities Resilient", was first developed as part of the HFA, and has been updated to support implementation of the SDFRR, as shown in Figure 4-2.

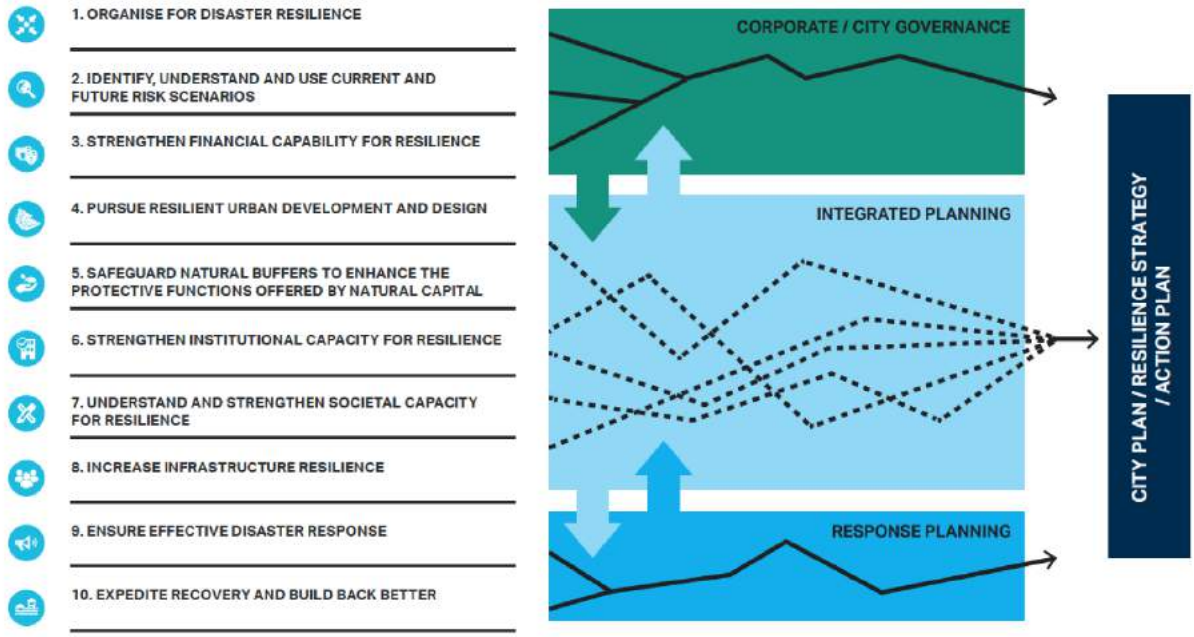


Figure 4-2 Ten Essentials for Making Cities Resilient

The objective of DRSC are: 1) To assist countries and local governments in monitoring and reviewing progress and challenges in the implementation of the SFDRR; and 2) To enable the development of a local disaster risk reduction strategy (resilience action plans). The DRSC supports the cities to: 1) Establish a baseline measurement of their current level of disaster resilience; 2) Increase awareness and understanding of resilience challenges; 3) Enable dialogue and consensus between key city stakeholders who may otherwise not collaborate regularly; 4) Enable discussion of priorities for investment and action, based on a shared understanding of the current situation; and 5) Ultimately lead to actions and implementable projects that will deliver increased resilience for the city over time.

The Quick Risk Estimation tool (QRE) developed by UNDRR provides a simple spread sheet tool aimed at improving risk awareness and is designed to be used alongside this Scorecard. The QRE tool can be downloaded from: http://www.unisdr.org/campaign/resilientcities/home/toolkit. Consultant has also proposed an Urban Resilience Monitoring Model, adopted for Bangladesh as shown in Appendix III.

4.4. UNDP

UNDP's Strategic Plan includes key results specifically related to disaster reduction and recovery. These include:

1. Enhancing conflict prevention and disaster risk management capabilities.;
2. Strengthened national capacities, including the participation of women to prevent, reduce, mitigate and cope with the impact of systemic shocks from natural hazards;
3. Ensuring improved governance functions post crisis;
4. Post-disaster governance capacity strengthened, including measures to ensure the reduction of future vulnerabilities;
5. Restoring the foundations for local development and post-conflict situations;
6. Gender equality and women's empowerment enhanced in post-disaster and post-conflict situations;
7. Post-crisis socio-economic infrastructure restored, employment generated, economy revived; affected groups returned/reintegrated;
8. Strengthen partnership with UNDRR to further integrate disaster risk reduction measures into country planning and decision-making processes;
9. Supporting national reporting on the implementation of the Sendai Framework, including DRR-specific SDG indicators;
10. Achieve the greatest number of countries to adopt and implement national disaster risk reduction strategies (Target E of the SFDRR) while ensuring coherence with the climate change agenda and the SDGs; and
11. to provide countries with guidance and technical assistance to support risk-informed and sustainable development.

5. EARTHQUAKE DISASTER RISK REDUCTION EXPERIENCE of IRAN and NEPAL

Disaster, despite its irreversible losses, create a window of opportunities for most of the countries to change their perspective on natural disasters and develop risk reduction strategies. Turkey, Iran and Nepal are among those countries that have worked hard to reduce their risk, specially earthquake risk. In Turkey, the earthquakes in Erzurum (M6.9 on October 30, 1983), Erzincan (M6.7 on March 13, 1992) and Izmit (M7.6 on August 17, 1999 with 17,127 death) caused the changes. In Iran which will explained in next section, two large earthquakes in 1990 and 2003 created a milestone for changes in DRR. And in Nepal, continuous occurrence of disasters in past three decades caused a movement on DRR.

In this section risk reduction success of Iran and Nepal has been explained as lesson for Bangladesh. Iran success in DRR without any international aid with dependence on its own in human resources; and in Nepal which international supports provide lots of opportunity to reduced its risk. Case of Nepal is very similar to Bangladesh.

5.1. Risk Reduction Experience and Success in Iran

Iran being located in high seismic hazard regions of the world, with frequent occurrence of devastating earthquakes, for so many years had experienced high human, social and property losses due to vulnerability of the built environment, rapid growth of population, and seismically-incompatible urban development. This situation continued until 1989, where two events changed the earthquake risk path of Iran. Establishment of International Institute of Earthquake Engineering and Seismology (IIEES) in 1989, with the cooperation of UNESCO, on a right time six month before the second event which was the Manjil Earthquake of June 1990. IIEES provided an excellent platform for answering the increasing demand for safety, development of the required disaster reduction program and providing the required know-how and expertise for hazard and risk mapping, vulnerability reduction and public awareness and preparedness after this earthquake. From beginning, a multidisciplinary risk reduction strategy with the objective of saving human lives and resources; along with an effective implementation program was developed to ensure the sustainable development of Iran. In summary, the risk reduction efforts in Iran can be divided into three main eras: Before 1990, post Manjil Earthquake (1990-2003), and post Bam earthquake (2003-Present).

5.1.1. Before 1990

Iran has a history of disaster risk governance and legislation. The first disaster management system in Iran was enacted in 1907, in response to some natural disasters including Persia Famine (1872) and cholera epidemic (1904). In the years after, the system has been improved gradually, especially after the occurrence of each devastating disaster without any national program for earthquake safety. In absence of any national program to deal with disasters, most of the activities were limited to scientific research and studies, and individual initiatives. Examples of this individual initiative was the establishment of the Iran strong ground motion network, or the earthquake engineering programs in only one University. In general, the view to earthquake and seismic safety consideration before 1990 can be summarized as:

- Very limited investments on research, education and institutional activities.
- Few earthquake related specialist with an integrated program or research agenda.
- No specific educational program in universities, except geophysics program at Tehran University.

- Poor seismic monitoring with few analog seismic stations.
- Good coverage strong ground motion stations.
- Limited knowledge on seismic hazard of Iran and aseismic design of structures
- Publication of the first Building Code and enacting the first engineering law after the Tabas earthquake of 1978.
- Poor engineering practice, code enforcement and almost no implementation.
- Rapid development of the country, especially in the rural area with main objective of reconstruction of the country due to war and answering the demand of public.
- Lack of awareness and Preparedness.
- Very low political will for prevention.
- Disaster response due to experience of 8-year war, the rescue and reconstruction process were acceptable.

5.1.2. After Manjil Earthquake (After 1990)

Occurrence of Manjil Earthquake (June 30, 1990 with M=7.2, PGA=0.69g) in north of Iran with its heavy building damage, socio-economic impact and loss of around 14000 people, became a turning point in earthquake hazard mitigation activities in Iran. After this event and in the beginning of IDNDR, the government decided to implement a multidisciplinary research and mitigation plan entitled “Iran Earthquake Risk Mitigation Program” with the following objectives:

- Increasing the scientific knowledge required for earthquake hazard mitigation.
- Reduction of risk of failure in different types of constructions and the needs to build safer structures.
- Increasing public awareness of seismic hazards and promoting a collective prevention culture.
- Developing plans for post-earthquake actions.

The comparison of the several risk indices before and after the implementation of the program indicates the significant step (though not yet sufficient) that have been taken toward the risk reduction, especially in the area of research, education, building codes, construction quality and public awareness. The distinguished achievements of the program were:

- Recognition of hazard, vulnerability and risk in Iran by decision-makers, engineers and public.
- Move toward planning and long-term actions in all level of decision-makers.
- Improvement of technical knowledge, capabilities, research, education, engineering practice, etc.
- Improvement of preparedness and helping toward the implementation of mitigation actions.
- Construction quality: Due to the gradual code and law enforcement and construction controls as well as the training program and people awareness, the quality of construction in the urban area has been improved with positive trend toward aseismic construction of public and private buildings.
- Disaster management: View to Disaster management had started to change toward more long term planning and prevention.
- Strengthening of public funded buildings and infrastructures.

- Increasing the technical knowledge on aseismic design and construction, vulnerability assessments and strengthening of structures.
- Capacity Building: Training the qualified engineers and the consulting firms to become able to do the mass strengthening projects like schools;
- Development of guidelines for the protection of historical buildings.
- Vulnerability analysis and reduction of the lifelines and infrastructures, and development of the required technical capacity.
- Development of seismic vulnerability functions for typical Iranian buildings;
- Establishing an awareness program for the oil and chemical industry manager on their risk and approach for its reduction.
- Helping and advising authorities to develop a work plan for vulnerability analysis of their facilities.

5.1.3. After Bam Earthquake (After 2003)

The Bam earthquake disaster of December 26, 2003 (mb=6.5, PGA=0.7g) which caused the destruction of most of the buildings and infrastructure of ancient city of Bam, created another window of opportunity and became the second turning point in the history of DRR in Iran. Eventhough the efforts after Manjil earthquake were very important, effective and useful, but had not been effective enough in reducing the risk. It showed that the government needs to make more benefit and optimal use of existing know-how on earthquake risk reduction and its integration into the country's development programs to ensure the sustainable development of the country. This event also compels the scientific and engineering community to provide more doable, usable and socio-economic-cultural compatible solutions to national needs. Moreover, the public at large should become more concerned about the hazard and increase its own preparedness level. Based on these facts, 13 years of the risk reduction experience, the lessons learned from the Bam earthquake; an action-oriented strategy entitled "Natural Disaster Risk Reduction Strategy of Iran" was developed and approved by the leadership of Iran in 2005. This strategy covers main natural hazard, namely earthquake, flood and drought with a special emphasis on earthquake. The main outlines of this strategy are:

1. Increasing public awareness and promoting a collective prevention and safety culture at all level of society (people and government) through an extensive educational program.
2. Increasing the scientific and technical know-how required for risk mitigation through the increasing support and expansion of existing research institutions, specially related to earthquake.
3. Creation of united command and management system in order to be fully prepared for an effective disaster response (rescue and relief operation) using all type of civil and military resources.
4. Development of a comprehensive disaster information database for the facilitation of research and "early warning system".
5. Development of a comprehensive and scientifically sound program for management and implementing an effective plan for post-earthquake recovery (mental, social and physical) as well as for rehabilitation and reconstruction of the damaged area. This

answer to the need for more effective and timely reconstruction process with special emphasize on rehabilitation process.

6. Development of an effective system for financial recovery and compensation through insurance, financial incentives, and supporting funds.
7. Reducing the risk of future construction and developments of urban and rural area and increasing the safety level through adequate urban and rural planning and management; and making sure that all structures are build safer by full implementation of building codes with "Zero Tolerance" for any type of violation.
8. Substantial risk reduction of existing structures with the main objective of saving human life, especially the schools, hospitals, public buildings, lifelines and infrastructures within next 10 years; as well as providing special loan and incentive for the strengthening of the private buildings.
9. Improving the quality of city planning and management; and the legal framework in order that the severe building violation would be treated as criminal act and not simple a civil violation.
10. Improving the understanding of the climate change and its environmental effects; and developing an effective program for reducing the effects of floods and drought related disaster.

It should be noted that the above-mentioned strategy was formulated into executable program by the respective organizations in Iran. The scientific communities should take a multi-disciplinary approach in striving to translate the current technical know-how into doable format and simplified solutions that are socio-economically and culturally accepted to the general public. Following examples of the implemented cases that are very useful for the Bangladesh DRM are presented: 1) School Safety Act; 2) Guidelines for Safe and Resilient Hospital; 3) Iran earthquake insurance; and 4) Technical capacity building programs are introduced.

5.1.4. Iran School Safety Act

Safe school as a key for the successful earthquake education program in schools began in 1992 by enforcing the building codes for the school buildings. In 2000, the Organization of School Renovation, Development and Mobilization of Ministry of Education implemented a more rigorous inspection and peer review process in order to make sure schools were built according to the codes.

With this background and experience, one of the first and most important outcomes of the Iran Strategy for DRR was the School Safety Act which was passed by Iran's Parliament in 2006 with a USD 4 billion budget, following the IIEES campaign for School Safety since 1993. This Law calls for the reconstruction and strengthening of 258,000 vulnerable classes from (64% of the total 394,000 public classrooms in Iran); in which 132,000 classrooms (35% of total) should have been demolished and reconstructed, and 126,000 classrooms (29% of total) should have been retrofitted. Also based on this law, IIEES as the technical body and Ministry of Urban Development and Transportation became responsibilities to ensure the quality control and safety of the reconstructed school. Also equal budget has been allocated from the regular development fund for the construction of new, safe school buildings. This shows the awareness and concern of policy makers regarding earthquake safety in Iran. The successful

implementation of this program reduced the unsafe school to 30%. This law was extended to make all school safe by 2025. Another important outcome of this Act, is buildup of the extensive technical capacity for strengthening existing schools and improving the school resiliency.

5.1.5. Guidelines for Safe and Resilient Hospital

The initiative for improving the safety of Iranian hospital and healthcare system against earthquake and prepared them for disasters had been started in 2005. Specialized office in the Ministry of Health and Medical Education (MoHME) of Iran became responsible for making sure that hospitals are built with safe standards. Even though, in the course of the implementation of this initiative many guidelines were developed, but it was realized the most advanced design codes and standards only ensure the life safety performance of the newly constructed hospitals and healthcare facilities. Also the recent disasters (specially the M7.3 earthquake of November 2017 in Sarpol-Zahab, Iran) have demonstrated that most of these buildings suffer significant losses to multiple hazards, which results in losing or limiting their functionality following the disasters, because of neglecting performance-based considerations during design phase. Accordingly, as one of its main priorities, the MoHME in cooperation with UN-Habitat initiated the Project for Improving the Resilience of Hospitals (BEHTAB). As a part of the BEHTAB project; the Guidelines for Safe Hospital Planning and Design have been developed to provide special design requirements for performance-based design, and to assure the expected performance and functionality of the hospitals (structural and non-structural components) after a disaster. Also the Guideline for Assessment Analysis and Retrofitting of Existing Healthcare Facilities has been developed to strengthen the existing hospitals.

Vision: The vision of the Safe Hospital guidelines is to “protect the lives of people in emergencies and disasters”; and ensure health-care services during emergencies and disasters.

Objective: The objective of these guidelines is to provide information to the interdisciplinary design team that ensures that hospitals are planned, designed, structured and constructed to maintain safe and resilient against natural disasters such as earthquakes and floods. The guidelines provide guidance for planning and designing of a safe and resilience hospital as follows:

1. Protect the physical integrity of hospital buildings, equipment, and critical hospital systems;
2. Ensure the functionality of hospitals as a core element of broader health and societal system for managing the risks of emergencies and disasters;
3. Enable hospitals to continue to function and provide appropriate and sustained levels of health-care during and following emergencies and disasters; and
4. Protect health workers and patients.

5.1.6. Iran Earthquake Insurance

Despite the fact that voluntary earthquake insurance has been offered by insurance companies in Iran since 1992, but in practice the government by providing reconstruction funds to those who have lost their properties, has acted as free insurer to the private and public owners. To change this trend and use insurance as an effective risk transfer mechanism,

Article 5 of the IRAN-DRR states that: "Develop an effective system for financial recovery and compensation through insurance, financial incentives, and supporting funds; as well as promoting and regulating financial incentives for the general public and integrating earthquake risk insurance into the construction process". Based on this strategy, the following actions were done: 1) Building the insurance culture; 2) Improve and update the existing earthquake insurance rate and zoning; 3) Expansion of the use of risk modeling for industry and important structures and infrastructures, instead of fixed rate or black box rating; 4) Providing disaster insurance for all home owners; 5) Mandatory insurance for building construction with bank financing; 6) Providing risk-based insurance premium and policy for buildings; and finally 7) Establishment of Basic Disaster Insurance Pool.

For risk-based insurance rating, the Iran Central Insurance Authority revised the building loss index which were used for earthquake insurance premium calculation. For this purpose, the mean annual loss zonation for different building typology in Iran has been evaluated and used. To do this: 1) Earthquake hazard model of Iran has been modified based on latest information on seismic sources and seismicity to obtain earthquake hazard curve for 328 city provinces of Iran; 2) Updated building inventory and its classifications has been obtained; 3) 25 building types have been identified according to the construction material, year of construction and number of stories; 4) The fragility function has been assigned according to the available information; 5) The mean annual loss of each building type has been evaluated for each city provinces.

Basic Disaster Insurance Pool Act (2019) has been designed to recover limited economic loss on the residential and commercial buildings due to natural disasters (earthquake, flood, tornado, thunder, snowfall, liquefaction and tsunami, etc.). The coverage limit for Basic Disaster Insurance based on the hazard and vulnerability of buildings, is defined by Central Insurance Authority in coordination with the National Disaster Management Organization (NDMO), Ministry of Housing and Urban Development. Insurance Pool collects part premium from all building owners. The premium shall increase until 2030 in way that the building owners share of the actual premium become almost 100% and NDMO become 0%. Central Insurance Organization shall provide reinsurance coverage. NDMO shall allocate 15% of its annual budget for this program. From the effective day of this law, NDMO would not be responsible for the reconstruction of the damaged buildings due to disasters. Moreover, private insurance companies should provide the complementary insurance coverage for those who requires more than basic coverage. Finally, 1% of the collected premium shall be allocated for public awareness program and promotion of insurance culture.

5.1.7. Technical Capacity Building Program:

Following the Manjil earthquakes, a special emphasize has been made on the "Increasing the scientific and technical know-how required for risk mitigation" and "Technical capacity and institutional building"; with the consideration of the fact that without national technical capability, no DRR program can be implementable and sustainable. All countries should help, share and learn from each other experiences, but each nation requires to develop its own special tailored risk reduction program and this cannot be duplicated. With this fact in mind, a serious efforts started by the scientific communities toward the development and expansion of earthquake engineering know-how with the objective of reducing the earthquake risk. IIEES

(www.iiees.ac.ir/en) along with other universities and research centers have either initiated or expanded their earthquake engineering research and educational program and made a major and noticeable contribution toward the development of the knowledge required for the earthquake safety of Iran. As the result, the number of earthquake engineering specialist, research reports, scientific papers, guidelines, codes, specialized consulting services had expanded.

However; despite the great scientific achievement in past 30 years that can be easily adopted in engineering practice, there is a wide gap between the practice and implementation of know-how with the theoretical knowledge. This is the biggest challenge for the earthquake engineering community in Iran and in the world as well.

5.1.8. Iran DRM Organization

National Disaster Management Organization (National Unforeseen Incidents Management Law 2019). The Organization is responsible for integration of addressing national disaster management and promoting its effectiveness. In addition to all national and provincial responsibilities of The Organization which are well detailed in the law, The Organizations has the following international responsibilities:

- Fund raising, leading and distributing domestic and foreign governmental assistance.
- Development of necessary frameworks for effective cooperation in regional and international levels including provision of guidelines for absorbing and distributing international assistance.

Disaster Mitigation, Coordination and Command Taskforce. The Taskforce would be established in three levels including National, Provincial and County to facilitate the coherence, co-ordination and co-operation of the activities of the entities and institutions covered by this law in disaster management. Heads of national, provincial and county taskforces would be the head of NDMO, Provincial Governor and County Governor respectively.

In the metropolis of Tehran, in addition to the provincial governor, the county governor and mayor of Tehran would be added to The Taskforce, and The Taskforce would be chaired by the Interior Minister. The new law has obliged the development of 7 national and provincial documents as below:

- National disaster management strategy
- National incident and disaster risk reduction program
- Provincial incident and disaster risk reduction program
- National preparation and response program
- Provincial preparation and response program
- National reconstruction and rehabilitation program
- Risk reduction appendix

A document describes how to reduce the risk of incidents and disasters within planning and implementing of any national or equivalent program through field and evidence-based studies. This document is prepared by the entities of this law responsible for the above programs and should be approved by the head of the Organization.

Good timing for the establishment of IIEES, timely response of scientific communities to the safety demand, good decision by Iran's government after Manjil earthquake for implementing

earthquake risk reduction activities, good cooperation among the scientific communities, and excellent effort on internal capacity building; have made visible achievements toward a seismically safe Iran.

5.2. Disaster Risk Management in Nepal

Nepal with many similarities to Bangladesh, faces high risk due to natural hazard such as flood, landslide, earthquake and epidemic. In past 15 years, more than 750 thousand people lost their lives, and over 1.7 million were injured and approximately 25 million were made homeless; with more than $1.5 trillion economic loss (Disaster Preparedness Network- Nepal, DPNet-Nepal; 2019, https://www.dpnet.org.np/). Like Bangladesh; Despite the severity of earthquake hazard it is exposed to, structural system for earthquake disaster risk management in Nepal is a relatively new phenomenon compared to many other countries. Earthquake risk in Nepal has significantly increased in recent years, mainly due to rapid population growth, uncontrolled development, poor construction practices, the absence of effective earthquake safety considerations, and a general lack of internalization of knowledge on earthquake safety among the public and government authorities [55].

5.2.1. Lessons Learned from Nepal Earthquake of April 2015

A major earthquake of M7.8 with epicenter in Gorkha District in Nepal occurred on April 25, 2015, followed by more than 300 large aftershocks including one with magnitude of 7.3 on the May 12, 2015. This earthquake has resulted about 9000 deaths, 22300 injured, 900000 houses, 26000 classrooms and 1000 healthcare unit were damaged and leaving millions of people homeless. Moreover, the earthquakes pushed an additional 2.5 to 3.5 percent Nepalese into poverty in 2015-2016 which translates into at least 700,000 additional poor. This disaster forced the Government of Nepal to change its policy and approach to DRM. Here the challenges after this earthquake and lessons learned are explained briefly.

Disaster Response Operational Challenges:

- Lack of policy, technology, tools and equipment, and skills to dismantle the damaged structures.
- Reaching remote areas for rescue and relief, single government agencies was not effective enough during immediate response in the remote areas.
- Temporary settlement of displaced
- Challenge to manage the space for rubbles
- Selection of appropriate caring of children with good faith who lost their parents and
- guardians.
- Challenges for immediate repair of rural roads and for immediate transportation
- Collection of integrated field information and dissemination
- Lack of office space for the government operations as significant number of government buildings were damaged /destroyed.

Recover and Reconstruction:

- National Reconstruction Authority (NRA) has been established with full and independent authority.
- Mostly affected 14 district are divided in to 7 cluster headed by chief for action.

- 1000+ engineers and social mobilizers are mobilized for the collection of digital information of households and damage of houses.
- Government has developed resilient models of houses, provide technical support and help delivery of construction material to accessible areas.
- Government provided grant for each house affected by the earthquake and additional soft loan from commercial banks.
- Detailed Rapid Visual Analysis for house to house survey were done to facilitate reconstruction work and deliver.

Lessons Learnt and Areas for Future Direction:

- Need of new disaster management act to address the present challenges. The national mechanism for disaster response has been changed to enhance the coordination and effectiveness.
- Perfect implementation of building codes. Strict building construction monitoring mechanism was needed.
- Strengthen the capacity of National Search and Rescue team specially focusing for security forces.
- Assured international supports in Search, rescue, relief and recovery.
- Need of helipads in rural areas.
- Emergency warehouse and adequate stockpiling of appropriate supplies and equipment
- One window system is very important in Rescue and Relief to distribute food and nonfood items in remote areas and to the backward and deprive people.
- Establishment of call centres in each village and need of GIS based integrated information system
- Recovery should follow a community based approach which encourages communities, utilization of social networks, and built self-reliance efforts using local skills and Knowledge. It will largely be an owner driven recovery programme.
- Central policy/plan, decentralized implementation will be adopted.
- BBB (build back better) principle were adopted for reconstruction.
- Owner driven and self-reliant effort for reconstruction in private housing for optimum utilization of local resources, skills, labor.
- An effective institutional were set up in community level and capacity building of local people.

5.2.2. Institutional/Organizational Structure on Disaster Risk Management

Disasters in Nepal were traditionally managed on an ad-hoc basis and attended to as and when they occurred. For the first time, in 1982 the Natural Disaster Relief Act (NDRA) also known as the Natural Calamity Relief Act (NCRA) was formulated. Most of the disaster policies in Nepal emphasize on response and relief efforts, with relatively less strategic focus on preparedness and mitigation. Moreover, regulatory and legislative gaps and institutional weaknesses have persisted in terms of mitigating disaster risk. In this context, currently ratified Disaster Risk Reduction and Management Act-DRRMA (2017) was a milestone in disaster management of Nepal because it has replaced about 40 years old Natural Calamity (Relief) Act, 1982 and for the first time it saw disaster management as a process focusing on

different stages of disaster management cycles, preparedness, response and rehabilitation and mitigation and has classified disaster as natural and human-induced. The provision of well-structured functional institutional set-up from the center to local level, it may still take some time and effort to change the institutional inertia at national and provincial and local levels. Most of the policies, plans and strategies have laid emphasis on flood and landslide followed by earthquake and avalanches and treated as centrally rather than locally. Most of them have paid less attention towards rehabilitation and mitigation.

DRRMA within the structure of Local Government Operation Act (LGOA) 2017, recognized that local people and local bodies are the most appropriate points of entry to meet the disaster management needs at the local level. The salient features of the Act are:

- Covers the whole spectrum of disaster management cycle and the diversity of disasters, and integrated all previous Acts from 1982 at level of governance and phases of disaster management cycle as shown in Table 5-1.
- Provides detailed action plan right from the central government to the district and local levels to draw implement and execute a disaster management plan. According to the act, a National Council for Disaster Management (NCDM) will function under the chairmanship of the prime minister. National Disaster Risk Reduction and Management Authority (NDRRMA) under the NCDM will be set up under Ministry to act as the focal point for disaster management functions in Nepal from formulation of appropriate strategies and plans to implementation and supervision of disaster management activities. Similarly, the state disaster management authorities will be under the Chief Ministers and the district disaster management authorities under the Chief District Officers (CDOs);
- Ministry of Home Affairs (MoHA) is the sole responsibilities of implementing disaster management.
- Clarifies the role, responsibility and functions of security forces including Nepal Army;
- Made provision of recommendation to the government of Nepal for the declaration of disaster prone zones, streamlining of responsibilities and involvement of local communities.

Table 5-1 Legislative provisions for disaster risk management [55]

Regulatory Framework	Types of Disaster					Level of Governance			Phases of Disaster Cycle		
	Flood and Landslide	Earth- quake	GLOF/ Avalanche	Fire	Epidemic	National/ Federal	Regional/ Province	Local	Preparedness	Response	Rehabilitation and mitigation
Soil and Watershed Conservation Act (1982)	■					■			■	■	
Water Resource Act (1992)	■					■			■		
The Forest Act (1993)				■		■			■		
National Building Code (1994)		■		■		■		■	■		
Environment Protection Act (1996)	■			■		■			■		
The Building Act (1998)		■		■		■		■	■		
Prime Minister Relief Fund Regulation (2007)	■	■	■	■	■	■		■		■	
Constitution of Nepal (2015)	■	■	■	■	■	■	■	■	■	■	■
Local Government Operation Act (2017)	■	■		■	■	■		■	■	■	■
Disaster Risk Reduction and Management Act (2017)	■	■	■	■	■	■	■	■	■	■	■

As shown in Figure 5-1, the DRRMA has made provision of set-up National Council for Disaster Risk Reduction and Management (NCDRRM) under the chairmanship of the Prime Minister as an apex body in order to disaster risk reduction and management. In order to implement policies and plans formulated by the council, there will be an executive committee under the Home Minister and expert team as well not exceeding five numbers from the different thematic areas such as, geology, environment, infrastructure and others. National Disaster Reduction and Management Authority (NDRMA) will be set-up under the Home Ministry. At Province level, there will be Province Disaster Management Committee (PDMC) under the chairmanship of chief minister. At local level, there will be District Disaster Management Committee (DDMC) and Local Disaster Management Committee (LDMC). Table 5-2 shows the institutional set-up by disaster types, level of governance and disaster management cycles. The major rights, responsibilities and duties of each of the authority and committees has also been defined [55].

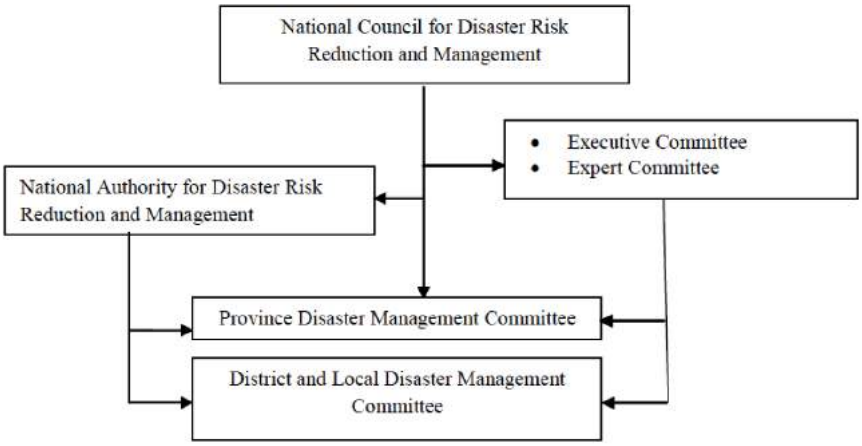


Figure 5-1 Institutional structure according to the Disaster Risk Reduction and Management Act 2017 [Ref. 55]

Table 5-2 Institutional provision for different types of disaster [Ref. 55]

Name of the Institution	Types of Disaster					Level of Governance			Phases of Disaster Cycle		
	Flood and Landslide	Earth- quake	GLOF/ Avalanche	Fire	Epidemic	National/ Federal	Regional/ Province	Local	Preparedness	Response	Rehabilitation and mitigation
National Council for Disaster Risk Reduction and Management (NCDRRM)											
National Disaster Reduction and Management Authority (NDRMA)											
Province disaster management Committee											
District and Local Disaster Management Committee											

Source: Disaster Risk Reduction and Management Act- 2017.

Finally, the LOGA (2017) authorizes the local bodies to undertake following functions with respect to DRR:

- Local level policies, legislation, standards, plan implementation, monitoring and evaluation related to disaster management;
- Disaster preparedness and response plan, early warning system, search and rescue, advance store of relief materials, distribution and coordination at local level;
- Local embankment, river and landslide control, river management and evaluation;
- Hazard mapping and identification of settlements at risk and transformation;
- Coordination between federal, state and local level and local community organizations and coordination with private sector in order to disaster management;
- Establishment of disaster management fund and operation and utilization of resources;
- Plan formulation, implementation, monitoring and evaluation for disaster risk reduction;
- Resettlement and rehabilitation after disaster;
- Data management and study and research about local level disaster;
- Development of local emergency work operation system; and
- Implementation of community based disaster management.

Though currently promulgated this Act has made several provisions to undertake activities on disaster risk reduction at local level, it requires some times to achieve the outputs. The capacity building and formation of functional organs at the local level can have positive impact of the Act.

5.2.3. Integration of Disaster Risk Management into Development Policies and Plans

The disaster management is a development issue that is realized by the policy makers of the country. For the first time, disaster Management issue was included in the Tenth Plan (2002-2007) of the government of Nepal. In the Thirteenth Plan (2013/14-2015/16) directly spelled out about disaster management. This plan aims to bring disaster management issue as mainstream of development process in order to reduce its effects to human population. Therefore, the plan made three strategies to cope with disaster: i) develop appropriate legal institution for effective disaster management, ii) strengthen relation of private/local community with NGOs and INGOs for disaster management, and iii) develop early preparedness for disaster event. This plan also focuses on preparedness plan against disaster event which ultimately helps to reduce human causalities (NPC, 2013). The current Fourteenth Three Year Plan (2016/17-2018/19) has set its updated disaster management goal with the aims to reduce human, physical, economic, cultural and ecological losses due to disasters. It has made strategies for different types of disasters management, such as, earthquake, flood, landslide, epidemic and others focusing on different phases of disaster management cycles, such as, preparedness, response and rehabilitation and mitigation. It has also emphasized on governance of disaster management at national, regional and local levels.

5.2.4. Ongoing Issues, Challenges and Gaps in Nepal DRM

The earthquake risk in Nepal is rapidly increasing due to the combined effects of seismic hazard, earthquake vulnerability of the building stock and infrastructure, limited investment, limited political will to implement building related legislation and codes, fatalism, and a weak

economy. Furthermore, there is no legal framework to improve the seismic performance of the existing building stock despite the vast majority of buildings remaining highly vulnerable to earthquakes. The scaling-up of successful pilot projects and the institutionalization and internalization of achievements is a major challenge for further enhancement and sustainability of earthquake disaster risk reduction (EDRR) endeavors made thus far. Many DRR programs in Nepal are driven by international donors. Therefore, the sustainability of EDRR efforts remains doubtful once international support recedes. In addition, these programs generally operate with a limited time frame. For these reasons, the long-term sustainability of EDRR efforts requires continuous investment and a reasonable time frame to cope with changing scenarios and dynamic planning. Although community-based DRM (CBDRM) programs are centered on communities, the decision-making process is controlled by international donors and national experts.

Even under the new DRRMA (2017), Home Ministry is the sole coordinator of Disaster Risk Management, which leaves other ministries as passive partners and might create incoherence between and among the ministries and departments. The shortcomings of this arrangement can be the exposure to greater political instability at the highest level of government. It can result in a lack of recognition by other ministries and less opportunities to take initiatives vis-à-vis other ministries. It is necessary to educate and raise the awareness of the communities in order to grass root the disaster management.

Moreover, the DRM policy and institutional provisions conflict and lack of integration exist almost in most countries, from Nepal to Bangladesh to USA. Today, without any doubt, there is a consensus among all of the expert that the only way for the success of disaster risk management activities largely depends on integration and systematic formulation of policy strategies, legal provisions, institutions and its roles and responsibilities in dealing with disasters. The policy and integration should cover actions and arrangements that covers all dimension of disaster risk, generally composed of prevention (including risk avoidance and risk reduction), preparedness, response, recovery and reconstruction.

Another critical challenge in Nepal, which is similar to Bangladesh is limited training and knowledge transfer in Nepal, engineers and technicians are typically required to complete tertiary education in order to work in the construction industry, whereas craftspeople acquire their knowledge by the passing down of skills through generations. The engineering education system in Nepal is mainly focused on building construction using modern materials, and seismic design is not part of the regular engineering curriculum (although some education on this subject has been included recently). As a result, most graduate civil engineers are unable to provide meaningful input on the seismic resilience of buildings constructed with even modern materials, since more than 70% of the current Nepalese building stock is constructed using vernacular materials. This scenario is expected to continue in the future due to socio-economic reasons, resulting in the construction of additional earthquake vulnerable buildings. More than 82% and 92% of buildings respectively in urban and rural areas of Nepal are produced by craftsmen who have no training on earthquake-resistant construction and no access to engineering resources. While this scenario has changed slightly in recent times, any investment made for the formal training of craftspeople/masons is very limited. This scenario significantly impedes improvement of the seismic resilience of the building stock in Nepal.

6. SITUATION AND GAP ANALYSIS ON EXISTING DRM CAPACITY

The goal of the gap analysis is to improve operational capacities and reduce impacts by eliminating shortages that exist between institutions and operational sectors in Bangladesh DRM framework in order to achieve a resilient Bangladesh. The objective of the gap analysis can be categorized as follows:

- Provide a deliverable planning tool that facilitate the elimination of organizational and institutional gaps between different operating parts in Bangladesh DRM framework.
- Strengthen state and local capacities and reducing reliance on the central government in disaster response and recovery plans.
- Increase pre-disaster awareness on institutional gaps which can improve cooperation among responsible parts in DRM framework that are essential and indispensable to response and recovery success.

6.1. Approach

To perform gap analysis on what has been done and what needs to be done with respect to policy and technical related issues to risk reduction and disaster preparedness and response; in order to:

1. Provide doable recommendation for effective disaster risk management and risk reduction.
2. Effective implementation to realize inclusiveness of all multi stakeholders
3. Provide a deliverable planning tool that facilitate the elimination of organizational and institutional gaps between different operating parts in Bangladesh DRM framework.
4. Strengthen the coordination, collaborations and linkages among the sectors Improvements for institutional capacity.
5. Strengthen state and local capacities and reducing reliance on the central government in disaster response and recovery plans.
6. Increase pre-disaster awareness on institutional gaps which can improve cooperation among responsible parts in DRM framework that are essential and indispensable to response and recovery success.
7. Lacks of enough skills in hazard, vulnerability and risk assessment
8. Lacks of sufficient skills in post disaster needs and loss assessment for effective response.
9. Lac of technical know-how and human resource for building earthquake resilience infrastructures with adequate seismic knowledge

The following analysis procedures were done to identify the gaps:

1. Situation analysis based on the desktop study of the existing and available documents related to the national regulations, decrees, laws, strategies, plans, programs and projects for natural disaster risk reductions and resilience.
2. Benefiting from all of the reports on situation analysis of existing programs, especially those that has been done for World Bank Project on URP in Dhaka
3. Defining the questions (such as those listed in section 4.2) and try to find answers.
4. Interview with officials, experts, people as much as possible; as well as organization of stakeholder meetings. 3 stakeholder meetings with the DDM of the MoDMR; Rangpur Mayor and related officials; and UNDP with experts from BUET and Dhaka University

and international organizations. These meeting not only provided valuable information, but provide confidence on the consultant finding of the DRM situation in Bangladesh.

5. Understand or identify the acceptable/tolerable level of earthquake risk in terms of human losses.
6. Identify the political and technical challenges toward the NRP.

6.2. Questions and Evaluations

From this analysis outlined in previous section, we intend or try to understand that considering the facts that many Initiative, studies, project and documents have been done/generated along with many rules and regulation such as SOD, etc. using national and international human and financial resource; what are the demands and challenges ahead of us to define the gaps. Thus the report would look for some answers to the following questions:

1. Evaluate governance, institutional and organizational arrangement of DRM
2. Evaluate correlation between policies and programs
3. Evaluate the level of achievement of defined objectives outlined in CDMP, NDM
4. Evaluate collaboration among the key responsible organizations
5. Evaluate compatibility of policy and responsibilities as well as the studies are getting performed in Bangladesh.
6. Overall assessment of existing and on-going risk and resilience related project in Bangladesh such as URP and NRP
7. Overall assessment of building construction process and code enforcement and implementation.
8. Overall assessment of public awareness.
9. Evaluate the level of skills and capacities in risk and loss assessment that need to be done at national level.
10. Evaluate Strength, Weakness, Opportunities and Treats of all national activities. Preliminary evaluation of SWOT.

6.3. Assessment of Current Situation

Many laws and plans are being developed that aims at improvement of disaster risk assessment and reduction system in order to reduce the risks of natural and man-made disasters. However, The GoB does not have a well-integrated-holistic approach to encounter the implementation of natural and man-made disaster preparedness practices yet.

Based on the existing report and some expert opinions, it seems that Bangladesh should have a more unified DRR and disaster preparedness system. Even though crisis and emergency response are systematized both at national and local levels, the duties and responsibilities are widely distributed among many organizations. There is an urgent need to integrate all powers and responsibilities into one unified system.

6.4. SWOT Analysis

Based on the discussion with the experts listed, some listed in Appendix V; the Strengths and Weaknesses of the existing DRM related policies, capacities, awareness, etc. in Bangladesh has been identified. Also for improving DRM effectiveness and implementation; Opportunities that can be exploited and Threats that might need to be avoided during a disaster risk management plan development have been identified. The results of the SWOT analysis of the Bangladesh disaster risk management legislations and laws are outlined in Table 6-1. Definitely the

parameters of SWOT are not limited to those that has been mentioned in this table. It should be noted the content of this tables are listed column-wise.

Table 6-1 Strength, Weakness, Opportunities and Threats with respect to earthquake disaster

Strength	Weakness	Opportunities	Threats
Legal framework and policy	Low risk awareness Little recognition of earthquake	Political will and opportunity to bring together all key players and stakeholders	No clear assessment of the risk
Laws, Policies, NRP, URP	Low implementation and enforcement power	Economic growth	Authority of MoDMR over other ministries in relation with disasters
Good Experience in Flood and Cyclones	Earthquake is not considered as a threat	Investment and property value	Lack of concern among public
International Technical assistance	No local knowledge	Donors interest in supporting Bangladesh	Lack of ownership
International funds	Not risk sensitive Land-use plan	Construction benefit	No economic incentive for safety
Qualified Universities	Lack of Earthquake engineering program in Universities	Quality guidance	Transparency and accountability among engineer and developer
Young Civil engineers	No earthquake engineer experts (lack of expert human resources)	Social capacity building in legislations and laws	Too many DRR objectives with ambitious targets
Bangladesh National Building Codes (BNBC)	Structural engineering is not included in Building codes. Not Updated	Institutional arrangements in DRM visions	Create an environment for code violation
Building Construction Committee (BCC)	Not enough expert to implement BCC objectives and mission	Risk, resilience and hazard studies, researches and development	Lack of system memory
Extensive Institutional infrastructures	Incompatibility with local resources	Consideration of renewable energy production	Large committees and large Government
Consideration the economy related risks	Multi-hazard approach	developing scalable and innovative models	Immunity
Risk based cooperation in legislations and laws	Lack of vision, framework, perspectives, plans and benchmarks	Gap elimination in preparedness programs	Unsafe development with greater disaster risk
Urban and suburb risk reduction plans	Policy-practice disconnect and the missing middle	Early warning systems for important infrastructure	Lack of resilience based and risk sensitive building codes

Meteorological risk consideration	Gaps in training policy, design and delivery	A paradigm shift from disaster response to risk reduction	Lack of social related risk consideration
Disaster-proofing of development funding (across ministries)	Lack of risk sensitive land use strategies	DRR mainstreaming across ministries	Parallel functional organizations
Consolidated regulatory framework and planning	Lack of multi stakeholder cooperation in DRM strategies	Improving overall effectiveness and timeliness of disaster preparedness and response nationwide	Lack of inter-institutional consultation and coordination
Disaster management training and education	Resilience based regulations are required	Develop strong and well-managed institutional at national level	Lack of legal authority, monitoring and oversight
Volumes of reports from performed projects at national and International level	No earthquake insurance or insurance pool	Big market for earthq. engineer to strengthen public buildings, school and Hospital.	Vulnerable and un-prepared hospitals and school and public buildings
Government willing to have safe school and hospital	Lack of Special codes for safe design of school and hospitals High vulnerability of existing buildings	Create insurance market and business	High Dependency on vulnerable building and infrastructures
4 to 5 million volunteers	Volunteer are not adequately trained and properly utilized for preparedness	Big demand for seismology and earthquake engineering research	Very low financial capacity to recover from Avg. Intensity Eq.
School earthquake educational program: Kindergarten to 5th Grade	High vulnerability of existing buildings	Change construction practice	Not sufficient experts and coordination. Lack of demand driven project efforts
Young-smart generation with high intensive to build Bangladesh	No National Seismic monitoring and SGM network	Create a big demand of research	Lack of enough government capacity to use the Int. funds effectively
Strong cultural and religious belief and devotion	Duplicate projects instead of being complementary	Large demand for housing and buildings	Lack of trust among people and on part of the Government
Many development projects	Lack of clear understanding of earthquake risk and resilience concept and what need to be done among decision makers	Need and thirst for reliable information among people and government	Pseudo scientist, pseudo engineers, pseudo developers, etc.
Willing to build better, especially public funded buildings	Shortage of national experts	Creating job opportunity for qualified engineers	Business and non-qualified engineering corruption

6.5. Gap Identifications:

Based on the findings from review of the documents, interviews and expert discussion, SWOT analysis, and being involved with related projects in Dhaka with the consideration of past 40 years of experience in risk reduction policy development and implementation in Iran and some other countries; the existing DRM gaps in Bangladesh can be classified as procedural (policy) gap or as substantive (content or technical) gap as shown in Figure 6-1.

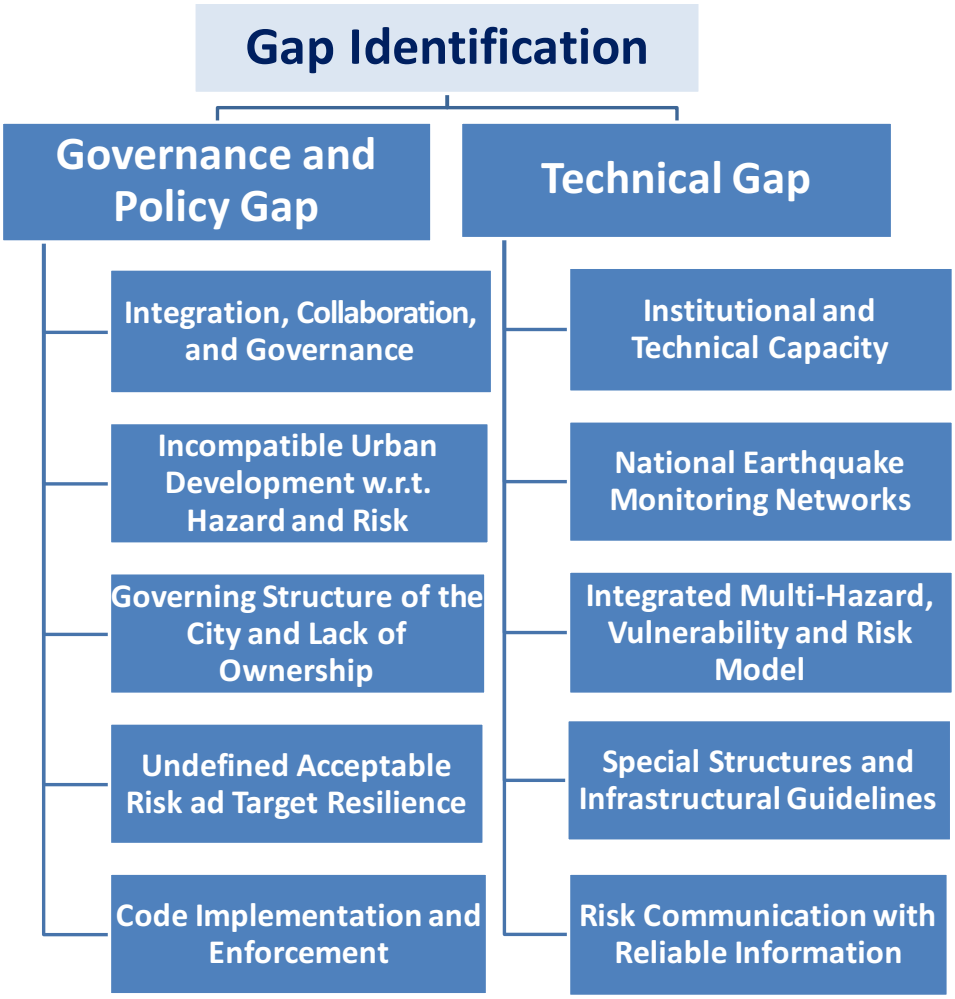


Figure 6-1 Gap identification and classifications

Governance and Policy (Procedural) Gaps are ones creating challenges in the plan implementation process such as lack of national policy or lack of a feasibility and implementation document in the plans include institutionalization, legislation and coordination mechanism.

Technical (Substantive) Gaps related to technical expertise that are required for effective implementation of the DRM policies and regulations.

Some of the identified gaps and challenges are as follows:

1. Lessons learned from previous projects related to earthquake DRM and safety indicates the results and recommendations of most of them were not fully got implemented, mainly due to lack of full participation of local experts and the

recommendation were not compatible with socio-economic condition of the Bangladesh.

2. The responsibilities of managerial sector of project manager are not clear enough and operational accountability should be categorized in different levels. It seems that the DRR capacities in field level are not adequate, and thus field capacity development should be considered in NRP.
3. The institutional arrangements for the safety of hospitals and emergency centers are not considered thoroughly and new initiatives are needed for safe and resilient planning and design of future hospitals considering as critical infrastructures; as well as strengthening the key hospitals.
4. The institutional arrangements for the safety of school is not considered thoroughly and some initiatives are needed in education programs on school safety.
5. Across Bangladesh DRM frameworks, lack of development experts can be seen, and the government should hire them.
6. In Bangladesh weak integration between DRM frameworks and local development plans can be seen; for example, time gap exists between undertaking a framework and its implementation.
7. The intervention of legislations and laws is required at community level which is have a great impact on DRR.
8. Inadequate implementation process is exits in delivering needs to the most vulnerable groups of people.
9. Comprehensive analysis on institutional strength and threats and weaknesses is required across Bangladesh DRM frameworks in order to build higher capacity.
10. It should be paid more attention to the role of community volunteers in disaster preparedness and response phase and their capacity needs to be improved.
11. Lack of systematic conjunction between Bangladesh DRM frameworks and the activities in community level.
12. There is no especial time to hold regular meeting for some national level committees' coordination.
13. Provisions should be made to establish Ward DMCs in urban areas, with a view to strengthening local coordination mechanisms.
14. A clarification process is required for issues on accountability and coordination at local national level.
15. The disaster management policy should consider risks from both natural and human causes of disaster.
16. There is a need to define coordination mechanism in document to address existing issues and challenges among different operational agencies.
17. In order to reduce the dependency on foreign assistance, the capacities in financial, technical and human resources should be developed.
18. A strong monitoring, oversight and management system is needed to ensure plans implementation and consider well-organized participation of local communities.

19. Lack of a legal command and decree for humanitarian organizations to act regarding the plans can be seen across Bangladesh DRM frameworks.
20. The responsibilities in emergency response activities should be more detailed and defined at personnel level.

6.5.1. What are the Reasons, Challenges and Solutions?

Through extensive discussion with experts, officials, students, engineers, consulting companies, home owners, and general public; as well as visiting many places and projects in Dhaka and Rangpur; it was found out that the main reasons for the existing situation, challenges and solutions where proposed recommendation have been based, can be summarized as:

Possible Reason: Existing policies, programs, know-hows and other risk and safety relates issues are not effectively being used in the Bangladesh or have not integrated into the development process. It should be mentioned that under the NRP, Disaster Impact Assessment tools to be applied in TAPP/DPP will be developed.

Main Challenge: Implementation of existing safety and disaster prevention and management know-how in the development process of Bangladesh.

Solution: Making the bridge between science and development policy fully operational, and mainstream the science into policy, and policy to action (GoB have built the bridge, but it has been working effectively). Bangladesh citizen need to see and feel the foot print of knowledge, technology and policy in their daily life and decision making process and in the cities.

6.5.2. Who Should Do What to Fill the Gap?

To fill the exsiting gap in DRM requires a joint efforts by all social groups as defined below:

Scientist and Technical Experts:

1. Development of Implementable, Doable and Affordable solution; instead of researches that are paper oriented and are not concenterated on national needs. Universities in Bangladesh should promote people-demand-drieven-science.
2. Effective method for communicating risk to the decision makers and people is to translate safety into economic benefit to influence for incresing private and public investment. Simple economic models should be developed to show how investment in saftey and quality construction would provide long-term financial benefits.

Decision Makers:

1. GoB and decision makers should trust the scientific and technical advise and make the best benefit from them and form a risk advisor position at the Ministrial level.
2. GoB should invest more and generously for Risk Reduction and Resilience and truly implement the MoDMR mission of “Achieving a Paradigm Shift in Disaster Management. from conventional response and relief to a more comprehensive risk reduction culture”.

Engineers:

1. Improve their technical knowledge with respect to safe design of structures, as well as improving and building the technical capacity required for safe development.
2. Building trust and confidence among people. General public do not trust much on the engineers, specially civil engineers due to poor performance of some builders. This

trend needs to be chnaged by offering quality and devoted services in order their actual presence will be visible in the development process.

Public, People, Endusers, and Stakeholders:

1. Trust the Scientist, Rules, Codes and regulations. The public need to trust that all of these safety requirements are useful for their wellbeing and their socio-economic development of their country; and implement all preparedness recommendations.
2. Accept that safety can be achieved at Low Cost. Safety through prevention can be achievd almost at no cost and follow the recommendations of the sceintific, engineers and DRM officials.

6.5.3. How and What Should be Done?

The recommendation given in section 5 are the 10 key recommendations that need to be implemented in order to improve the earthquake safety of the Bangladesh on a gradual basis within at least next 30-years period, or by 2070 as another.

7. RECOMMENDATIONS FOR IMPROVING DISATSER

Based on the situation analysis on Bangladesh extensive disaster risk management activities and the gap analysis, several recommendations has been proposed to be implemented by the GoB. These recommendations intended to address the key strategy of SFDRR 2015-2030, Goal 11 of the Sustainable Development (2015-2030), and Bangladesh NPDM Strategies as shown in Figure 7-1.

Figure 7-1 Main SFDRR, Sustainable Development, and Bangladesh NPDM Strategies on DRR

Section 5.1 provides the rationale and strategy and classifications of proposed recommendations; Section 5.2 Provides the summaries of the 10 recommendations; Section 5.3 provides a detail description of each recommendation; and Section 5.4 provides the prioritization and interlinkage of the recommendations.

7.1. Rational and Strategy of Proposed Recommendations

Considering that based on the principle of risk reductions, principle definition of the risk given in the introduction; occurrence and intensity of natural hazards are not in control of the human and socio-economic-cultural-security value of the exposures cannot be reduced unless one stops the growth and development process; the risk can only be reduced in Bangladesh by two undisputable and coupled strategies of 1) improving risk governance and management and capacity; and 2) reducing vulnerability.

Moreover, the key to achieving safe and resilient Bangladesh is the “Integration of All Policies” and “Implementation all of the Policies and Decisions”.

1. Improving the effectiveness, quality, capacity, and performance of the integrated governance and management related to various aspects of disaster risk; as well as increasing the national capacity and level of preparedness to cope with disaster. This strategy is a pre-requisite for the second strategy which is engineering and technical solution, which can be done or get implemented with good and effective risk governance. It should be noted that the implementation of these sets of recommendations does not cost or have a minimum cost to the GoB. It only requires a strong will from the GoB which exists.
2. Reducing the vulnerability of built environment (Urban and rural, buildings, lifelines, and infrastructures) for expected natural hazard by safe and resilient planning, design and construction of future developments and structures; as well as by strengthening of existing structures, especially critical service structures such as hospitals, schools, and fire station.

7.2. Outline of the Proposed Recommendations

Based on the above strategic approach and undisputable principals, the element of in which and gap analysis and past experience of the consultant in the development and implementation of Iran Risk Reduction Strategy and working in various UN Agencies and developing countries; 10 recommendations have been introduced, according to the above-mentioned classifications as follows:

I. Integrated-Good Governance:

1. Integration of all programs, policies, regulations, institutions, and stakeholders by creating synergy through systematic and NEXUS approach.
2. Design and develop an integrated and compressive “Bangladesh Risk and Resilience Model” with the objectives of quantifying the actual risk (physical, human and economic loss).
3. Optimized and prioritized DRM and resiliency objectives and actions that can be implementable, achievable, doable, and affordable to reduce risk effectively with a high level of implementation. For optimizing the activities, the acceptable level of risk, and the target resilience should be defined with emphasize on the main urban settlements.
4. Creating demand for safety through effective and reliable risk communication. Human safety against all disasters (natural or man-made) is part of the basic human right. An undeniable right that should be observed by the decision makers and governments of Bangladesh. The religious incentives should be used for creating demand and public participation.
5. Comprehensive and integrated capacity building. To build the specialized capacity that is required for effective risk avoidance and risk reduction and sustainable development; and being able to implement existing and available know-how toward safe urban development, building safety, human safety, and sustainable development of Bangladesh.

6. Implementation of Risk-Based Disaster Management, Response, Recovery and Reconstruction. Improving effective disaster response capacity through integrated and unified disaster response and Command System; and development of post disaster recovery and reconstruction program.

II. Avoiding, Reducing and Transferring Physical Vulnerability and Risk:

7. Avoid creating new risks through safe and resilient planning, design, construction and maintenance of buildings, lifelines and infrastructures. This recommendation can also be grouped in the above category since it is more management and governance oriented.
8. Gradual vulnerability and risk reduction of existing built-environment, especially important and vital ones with the objective of saving human loss and resources and improve disaster response.
9. Design, Develop and implement financial incentives for reducing vulnerabilities, and disaster risk finance and insurance.
10. Continuous Risk and Resilient monitoring of urban area through a safe and resilient index.

The proposed recommendations are completely integrated and complementary with full interdependency and equal importance. The effective implementation of the recommendation can be achieved by the implementation of all components.

For example; Figure 7-2 shows schematically the integration of Recommendations 2, 4, 7, 8, and 9 and its effect on saving human lives, reduce the dependency on post-disaster response, and improve resiliency.

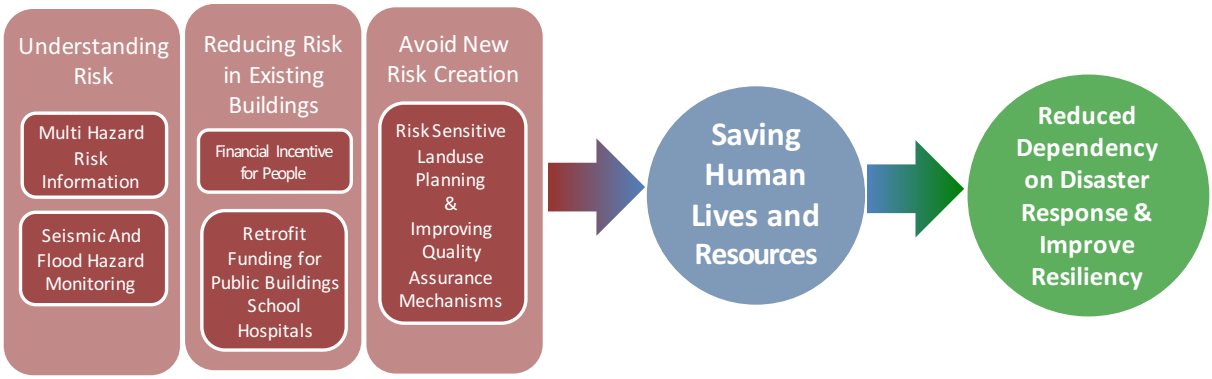


Figure 7-2 How Reducing Risk and Building Safety Can Save Human lives in Bangladesh [Ref. WB-GFDRR Build Back Better]

Recommendations 7 and 8 have the highest priority and can be started immediately. Construction of even one safe building or strengthening the safety of one structure is important and would have an immediate effect on risk reduction and reduces the post-disaster needs. Among the safety of the buildings, the school and hospital are vital. Thus it is highly recommended that safe school and safe hospital initiatives should be started immediately, which in turn requires the development of the special guidelines for “Safe and Resilient School” and “Safe and Resilient Hospital” as their basis.

In the following sections each of the recommendation have been explained and prioritized.

7.3. Detail Descriptions of Proposed Recommendations

The section provides a detail description of the proposed 10 recommendations.

7.3.1. Recommendation 1:

Integration of all programs, policies, regulations, institutions, and stakeholders by creating synergy through systematic and NEXUS approach.

As the first priority and based on the recommendation of almost all experts and stakeholders; holistic integration of all policies and creating coordination and collaboration among all is highly necessary. Thus, as the first recommendation; GoB (MoDMR on behalf of GoB) should form a Risk and Resilience Science Advisory Body to look into all of the existing policies and try to develop the process of the integration and harmonization of all of them into unified long-term policy and order. This process can be done gradually in 4 steps: 1) creating cooperation within sectors, 2) creating synergy between sectors, 3) integrate all sectors in one system with inter-disciplinary cooperation, and 4) ultimate goal is creating nexus integration of all sectors. This is the principal of good governance, where the elements of a system should work together in order to solve the complex problems of being safe against natural disasters. As an example, Iran is on the second step of this integration process, and Japan is on the third step of this process.

Step 1. Improving coordination, collaboration and cooperation among all stakeholders and key players as shown in Figure 7-3(a). The expected results from this step would increase the performance of the risk management system.

1.1 Governing bodies of Bangladesh; including the government, parliament and judicial system.

1.2 Scientific and Engineering stakeholders: Universities and engineering communities (especially earthquake specialists and experts and professionals) should establish a closer link to identify the engineering knowledge and technical gaps and needs. They should work hand-in-hand (close partnership) to provide doable-affordable-simple solutions that can be applied by GoB and end-users. This is a very important issue that is needed for the success of all the 10 proposed recommendations.

1.3 Close coordination and integration between all planning, construction, building, lifeline and infrastructure authorities and regulatory bodies at national sub-national and city levels such as: City corporations/Municipalities, City Development Authorities-CDA (RAJUK, etc.), water, electricity, communication, transportation and gas. Without effective coordination, safety and resiliency can never be achieved. There is an urgent need for evaluation of city development authorities' performance from DRR point of view and implement reform if the evaluation shows that is needed. CDA cannot be a developer and regulatory body in nature.

1.4 Coordination among the financial sectors including banking, stock market and insurance.

1.5 Cooperation among real estate developers and property owners for better safety and quality construction to achieve more sustainable profit.

1.6 Integration and coordination and cooperation among end-users by improving awareness and preparedness. Considering the residential and working population demography of Dhaka and the main urban area in Bangladesh; the urban and rural community interest and risk behavior cannot be separated. Therefore, an integrated awareness and

preparedness program should be implemented for both communities in order to reach the community participation in all aspects, from building illegal construction, code violation reporting to emergency operation. The community should be trained to take the lead as the first responder in time of disaster.

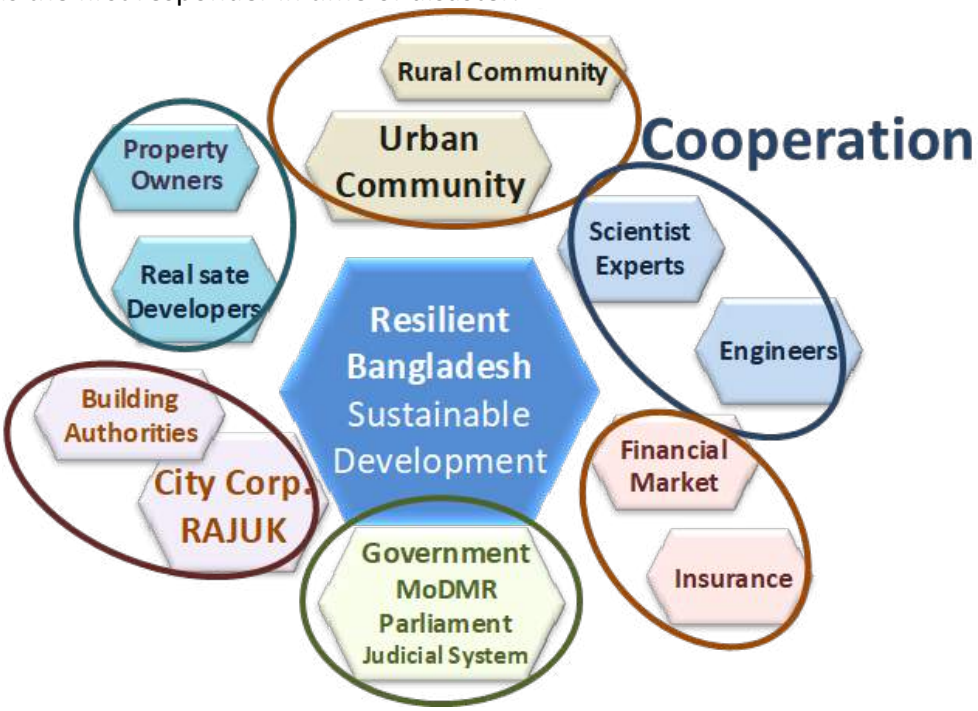


Figure 7-3(a) Step 1: Cooperation among sectors of stakeholders and end-users toward integration of all activities required for safe, Resilient, progressive and sustainable Bangladesh

Step 2. Create synergy among all sectors that are working toward development of Bangladesh and with having the common objective of safety and resiliency. In other words, the earthquake safety should become an integral part of the decision making and development process of all. This can be achieved on a gradual basis as shown schematically in Figure 7-3 (b).

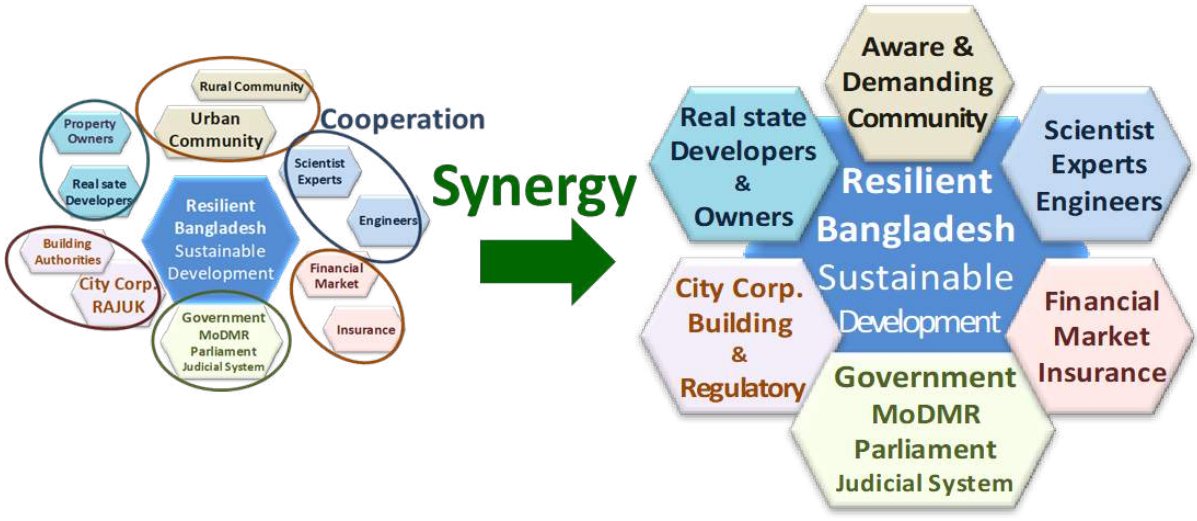


Figure 5-3(b) Step 2: process of creating synergy between all stakeholder and end-users.

Step 3. Integrate all sectors in one system with inter-disciplinary cooperation, See Figure 7-4.

Step 4. Finally achieving a resilience nation, is a complex issue that requires all elements and sectors of a society and government work together and solving a complex system, requires nexus approach as has been shown in Figure 7-4. In the Nexus system we all have one objectives and all have to tune their work to that directions.

Note: The Nexus approach is essentially about moving beyond traditional sectoral thinking to achieving overall safety and sustainability of all resources. Nexus in disaster risk management systematically incorporates the interlinkages, interrelatedness and interdependencies of all contributing elements, components, players and parameters affecting the risk as well as their transitions and fluxes across spatial scales and between the components.

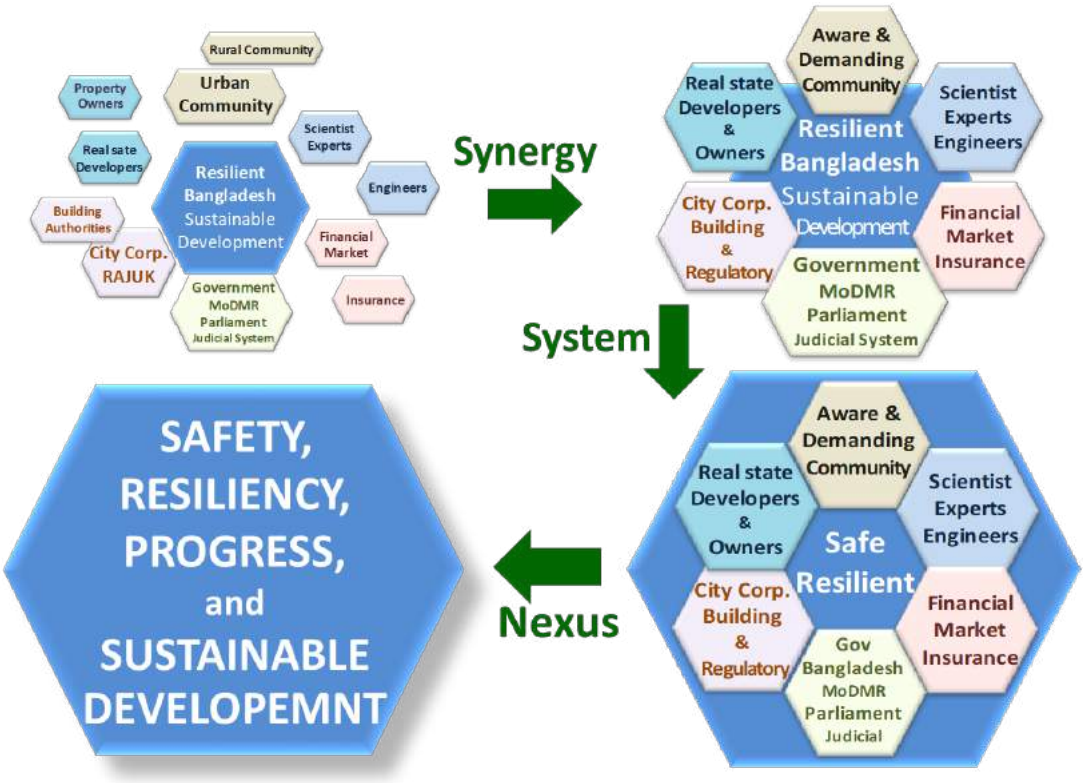


Figure 7-4 Schematic view of the present situation of risk management situation of Bangladeh to the ideal system concept and what need to be in order to acheieve for resilient Bangladesh.

7.3.2. Recommendation 2: Bangladesh Risk and Resilience Model (BRRM)

Design and develop an integrated and compressive Bangladesh Risk and Resilience Model (BRRM) with the objectives of quantifying the actual risk (physical, human and financial loss); as well as defining the Acceptable Level of Risk and the Target Resilience with the emphasize on the main urban settlements.

The preliminary gap analysis on the past hazard, vulnerability and risk analysis performed in various cities with different scale and approaches as explained in Section 3; indicates disintegrated and continuously repeated without being added on each other. Most of the studies were based on assumptions that had not been validated, such as the detail understanding on the nature and seismicity of Duaki or Madhapour faults. Or in most of the

vulnerability and risk analysis, were based on the building fragility functions or human loss functions of other countries with different characteristic.

This recommendation proposes the need for the development of an integrated and comprehensive Bangladesh Hazard, Vulnerability, Risk and Resilient Model (BRRM). This recommendation should be implemented in 2 main step or phase as shown in Figure 7-5.

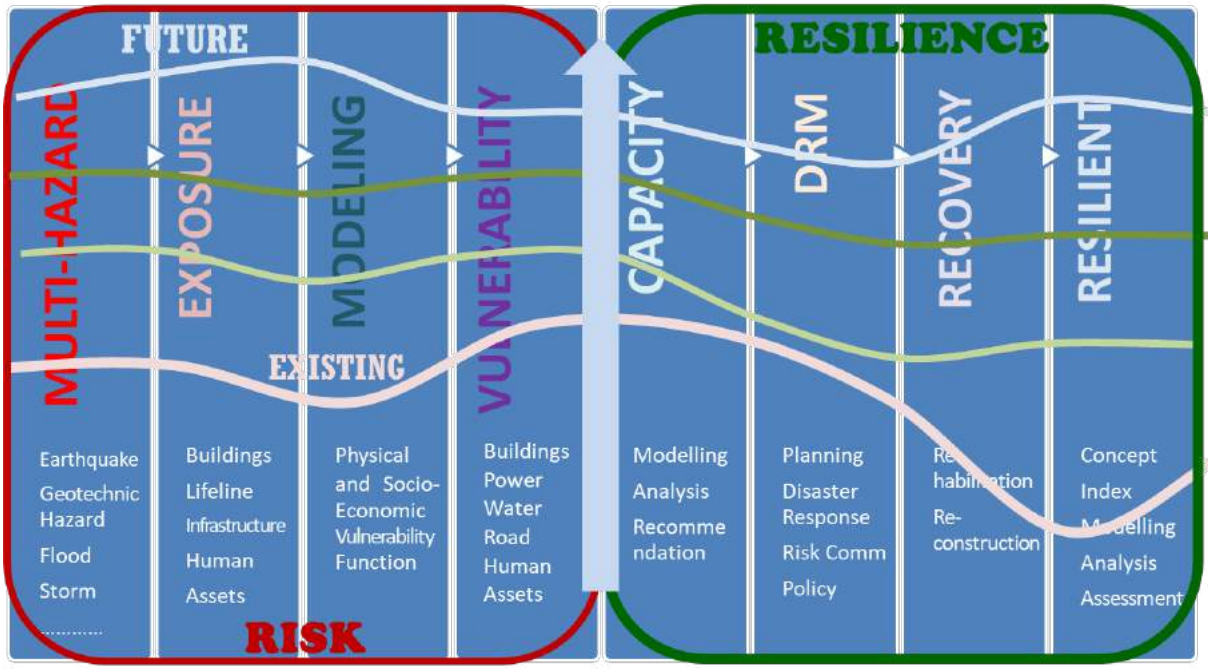


Figure 7-5 Integrated and comprehensive Hazard, Vulnerability, Risk and Resilience Model

Key Guiding Principles that need to be followed for the design and implementation of BRMM are:

1. Integrated and Comprehensive Resilience Approach.
2. Multi-Hazard Approach.
3. Consider Urban Interdependency.
4. Tangible, Implementable and Doable Actions.
5. Joint Collaboration and Partnership.
6. Create Added Values and Incentive for All Partners.
7. Avoid Duplication by Starting Gap Analysis.

Step 1: Bangladesh Risk Model

In this step the Risk portion of the BRRM should be developed based model and process shown in Figure 7-6**.** Part of this model is being applied for vulnerability and risk analysis of Greater Dhaka (DMDP) in the UPR projects. It is recommended that their achievement and lessons learned should be used toward the adaptation of the model to the Bangladesh, in order to be completed and used in other cities.

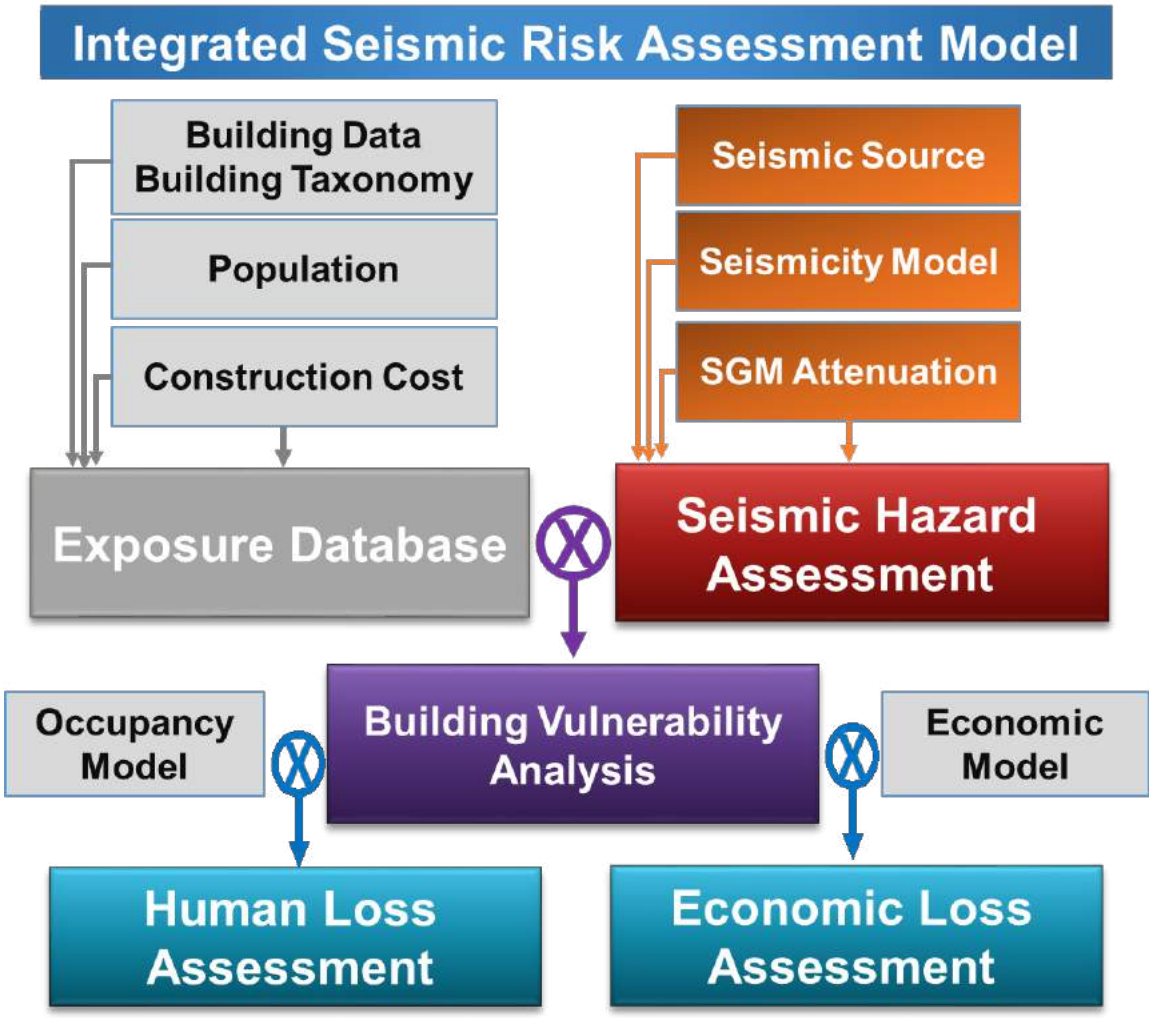


Figure 7-6 Main Framework/structure of integrated risk assessment model of Bangladesh

Following implementation process for this step are:

1.1 Form a specialized advisory group consisting of seismotectonic, seismology, seismic hazard, geotechnic, earthquake engineering, risk, GIS, and system model experts, SA-BRRM.

1.2 Design and develop the GIS-based information system required for the BRMM.

1.3 Compile all available studies and define the data and information gap. The advisory group should define what kind of complementary scientific studies need to be done in order to have a good understanding on the nature of the hazards, building taxonomy, vulnerability functions, etc.

Develop the road map for integrated seismic risk assessment model for the all future hazard, vulnerability and risk projects need to be done in Bangladesh and by the scientific communities, GoB, UN, etc. Figure 7-7 show a process that need to be completed by an expert opinion for identification of challenges, capacities and gaps needed to be address for the development of the BRRM.

1.4 Implement the BRRM Risk Module, and apply it to high-hazard prone urban area of Bangladesh.

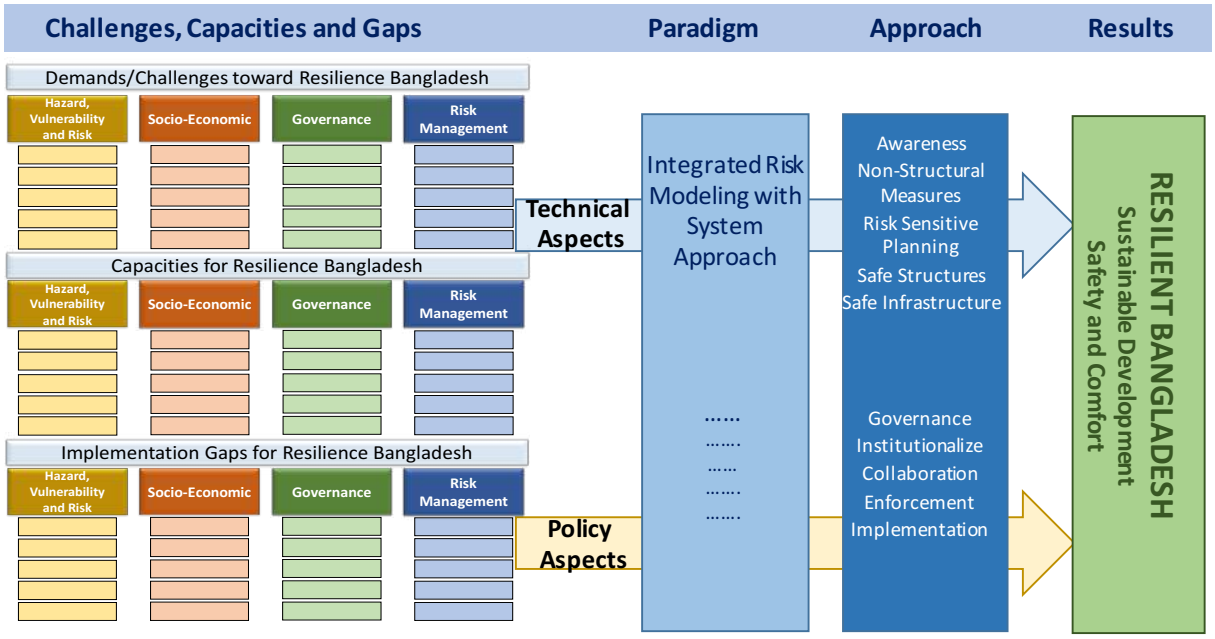


Figure 7-7 Identification of Challenges, Capacities and Gaps toward Resilient Bangladesh [Ref. Dr. M. Rahmani, Report MD3.1, URP-S5-Risk Sensitive Land Use Planning]

Step 2: Bangladesh Resilient Model

BRRM should be done by buildup on the developed risk module to cover the capacity modeling, pre and post disaster management need assessment, recovery and reconstruction model and data.

7.3.3. Recommendation 3: Optimized DRM and Resiliency Objectives

Considering that: 1) Existing resources allocated by GoB and International organizations have been distributed across too many activities and projects (unfortunately with low implementation); and 2) Achieving preparedness and strengthening resilient for mega disaster is almost impossible for most countries (even with unlimited resources); it is recommended that:

1. The resilience or even the disaster response goals to be set for getting prepared for smaller disaster and gradually plan for larger disaster. The targets goal and acceptable risk should be defined based on the BRRM (Recommendation 2); and
2. A process for optimizing resource allocation to projects and activities that are doable and achievable should be applied. Funds and budget should be firstly allocated to the low cost and effective projects, which are mainly policy oriented with emphasize on implantation such as code enforcement and education.

Based on the above principals; the proposed steps are crucial and very important which should be implemented simultaneously with the recommendation 2.

Step 1: Define Existing Risk by Quantitative Risk Analysis

Existing urban risk should be based on the available information, studies, international norms and experience, and expert judgment of the Science Advisory Body.

Step 2: Define Acceptable Level of Risk (Risk Threshold)

The acceptable level of risk (Risk Threshold) should be defined by a group of related experts based on the technical, human and financial resources and capacities of Bangladesh with the consideration of following points:

1. Define acceptable level of risk that is compatible with the country condition and not as a wish-list. Propose a process for the Government of Bangladesh to define their Risk Target or "Acceptable of Risk for Buildings and Infrastructures" that are compatible with their technical, human, financial and political resources.
2. Acceptable level of risk is dependent on the structural and infrastructural type and their importance and function in pre and post disaster time.
3. Defining acceptable risk is a living process in which the acceptable risk can be modified based on annual urban risk and resilience monitoring report (Recommendation 10).
4. Defining the cost implication for each action and the benefit.

Step 3: Define Resilience Target

Define the target for achieving resilient with the proper justification based on urban resilience index given in Recommendation 10. The set targets or goals should be implementable, achievable and tangible. As an example the targets by a group of experts in consultation with GoB could be defined as:

1. Dhaka should become resilience for an Earthquake Scenario with "Intensity A" or "Magnitude 6.5" in next 10 years.
2. Rangpur should become resilience for an Earthquake Scenario with "Intensity B" or "Magnitude 6" in next 10 years.

For each of the defined targets, the capacity and cost implication for the required actions need to be identified; as well as its benefit for the people and officials.

The results of this model in forms of up-to-dated seismic hazard and risk maps should serve as a basis to formulate relevant policies and site-specific countermeasures of disaster risk reduction. Also, the result should be used as the basis of formulating urban plans and land use plans to integrate disaster risk reduction in infrastructure development, as it is planned to be done for Dhaka under URP. Finally, the results of the risk model can be used as reliable information to raise public awareness, preparedness and evacuation.

Step 4: Optimized and Prioritized the Implementable, Achievable, Doable, Affordable Risk Reduction Actions Objectives with high level of implementation.

To achieve the resiliency against natural disaster such as earthquake, as it was explained in Section 1.3 of the report is an ambitious target that requires lots of changes. The biggest challenge/obstacle toward "Resilient Bangladesh"; is that the GoB has set up too many goals, objectives, plans, projects and activities with limited human and financial resources. This will result to low implementation and effectiveness of all the planned projects; which consequently would result to low resiliency. It will be recommended that NPDM should set their goal step by step with achievable targets (defined in Step 3) and more effective implementation. This concept is schematically is shown in Figure 7-8. Table 7-1 shows an example of prioritization for actions based on the identified need or gap for Bangladesh.

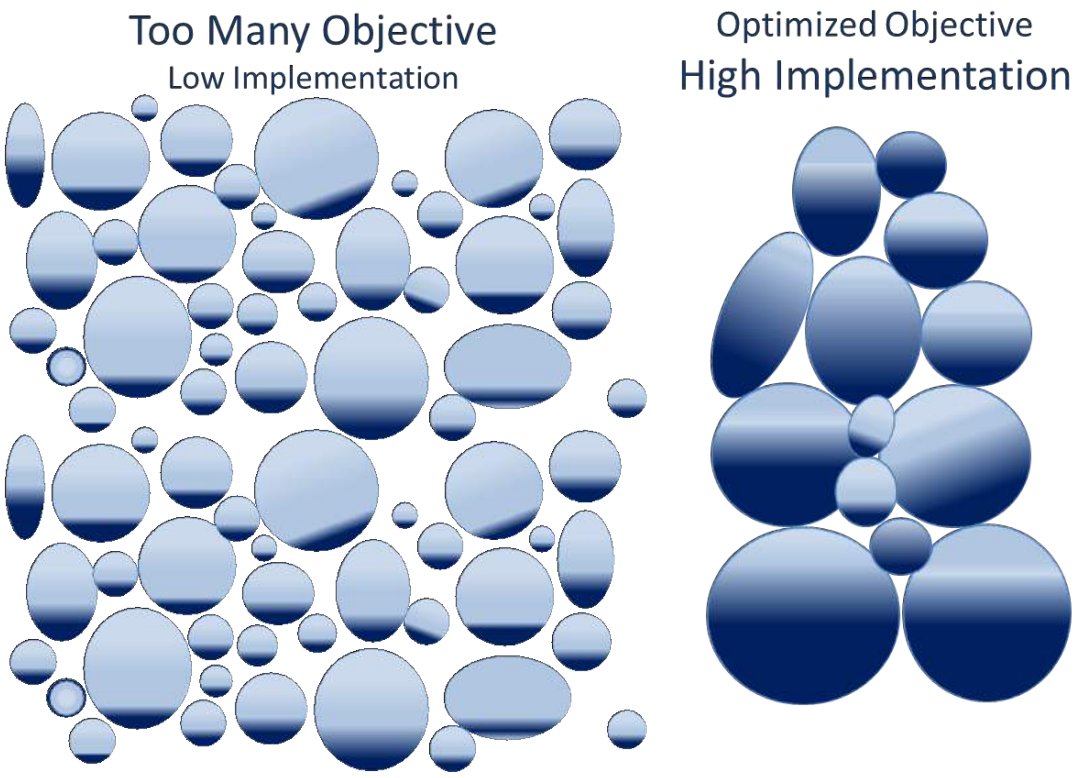


Figure 7-8 Schematic view on optimized objective and resource allocation vs. level of implementation

Table 7-1 Identified gaps/needs, solutions, and prioritized actions for disaster risk reduction and resilience in Bangladesh

Gaps/Needs	Solutions	Priorities for Action
Integrative Urban and Disaster Governance Planning Systems and Framework	Update/develop an integrated risk sensitive land use planning	Ensuring that urban planning tools are future oriented and include mechanisms that strengthen adaptation, and empowering disaster risk governance to manage disaster risk and facilitate implementation, learning, and sharing of knowledge
Assessment Tools for Disaster Risk and Resilience	Urban Resilience index or Multi-hazard and risk toolbox for disaster risk and resilience assessments	Risk mapping and putting disaster risk and resilience information to practice by advancing existing tools and risk mapping
Open and Updated Risk Information and Communication	Inclusive social media app	Understanding disaster risk and enhancing risk awareness

7.3.4. Recommendation 4: Creating Demand for Safety through Risk Communication

Risk Communication is essential to raise awareness of disaster risk in order to achieve resilience, particularly in relation to earthquakes, fire and flood. Without people acceptance of the fact that they are at risk and by awareness, preparedness and preventive actions with almost no cost their lives and properties can be protected. People need reliable information from reliable sources in order to trust and cooperate with the government in risk reduction programs. Reliable hazard maps providing graphic information on the risks of disasters and information on evacuation routes, shelters, and response resources; along with religious and socio-economic incentives are good tools for risk awareness and public participation.
The following complementary steps to the ongoing MoDMR public awareness programs should be taken toward creating demand for safety:

1. Develop Bangladesh model of integrated risk communication program and outreach campaign with consideration of age, gender, education, social background, living condition, economic capacity, cultural and religious belief, etc.. The program (to be effective) should be socio-economically and culturally compatible with each of the target group and should cover all sectors of the society from the top government officials to simple citizen of Bangladesh.
2. Increasing disaster risk awareness and safety culture among officials and people in order to be prepared for natural and man-made hazards. Preparedness and safety cultures have different meaning for each target group and each type of hazard. For decision makers, safety culture means risk-based decision making and preparedness means that the system under his/her control and management should be prepared for the effective response and recovery, which requires the full understanding of their system risk and how can be reduced. For simple citizen, should be limited to their knowledge and life style capacity and ability to cope with the disaster. See References 44 and 45 by the Consultant on how religious teaching can be used for improving risk awareness, risk reduction and risk avoidance in Bangladesh where religious and cultural values are highly respected and observed.
3. Risk aware society should demand (from their governments as their basic right) for safe urban development, safe housing, safe city, safe infrastructure; as well as the infrastructures and system that building codes and standards could be easily implemented.
4. Risk aware society should demand for safety as their Basic Human Right. **Safety is our Basic Human Right** that should be observed by the decision makers and governments.

This is a process that will take time and requires patient toward its achievements. Thus the process and efforts should be sustainable and continuous and effective.

7.3.5. Recommendation 5: Comprehensive and Integrated Capacity Building

Capacity/capability can be defined as a combination of all the strengths and resources available within a community, nation or region that can reduce the level of risk, or the effects of a disaster. It includes physical, institutional, social or economic means such as financial, political and technological resources, as well as skilled personal or collective attributes such as leadership and management at different levels and sectors of the society. Capacity building aims to develop human skills and societal infrastructures within a community, nation or region in order to reduce the level of risk.

The objective of **"Comprehensive and Integrated Capacity or Capability Building"** is to build self-sustaining capacity at various levels, establish continuity, and to ensure that Bangladesh can produce, have access to and use effectively scientific information and data and more over can lead and implement the risk related education and research and studies, engineering designs and project implementation by itself and would become self-sufficient. Iran and Turkey are excellent examples for the education, science and technology risk related capacity development. People of Bangladesh can do it as well.

This important task can be done through the following actions:

1. Increasing the scientific and technical know-how required for risk mitigation through the increasing support and expansion of existing research institutions, specially related to earthquake.
2. Establish National Research-Education-Technology Institute on Earthquake Science, Engineering and Risk similar to IIEES in Iran.
3. Design and implement integrated, comprehensive and specialized training programs for each Ministries with respect to their DRM functions. As shown in Figure 7-9 the program should cover all ministerial level with the aim of effective implementation of disaster-risk related policies and plans; including:
   - Decision makers and top officials of ministries on how to use the existing know-how in their working process, and enabling them to use the risk-based information;
   - Middle Management and technical implementing officials
   - Technical experts and employees.
4. Expanding earthquake related technical educations in the universities curriculum and extension education for the existing engineers. In other word, to adopt engineering education to Risk and Resilience objective of the country.
5. Development of required engineering guidelines that requires for Safe building design and construction; specially "Safe and Resilient School and Hospital".
6. Development of required engineering guideline for strengthening of existing buildings and especially for school and hospitals.

Figure 7-9 Structure of the proposed Integrated and Comprehensive capacity building program at each Ministries with respect to their function in DRM

7.3.6. Recommendation 6: Risk-Based Disaster Response, Recovery and Reconstruction

The CDMP report which is one of the key basis for the disaster management/earthquake risk management in Bangladesh provides an estimate on the post disaster needs for nine cities including Dhaka at ward level for different earthquake scenarios. The proposed DRM plans which has been have not been implemented need to be modified in order to become more realistic, doable and implementable. Moreover, the DRM situation analysis has shown that the DRM responsibility has been spread-out between many organizations, especially at city level. To provide an effective response that can save human lives after a disaster the following actions are recommended:

1. Creation of united command and management system in order to be fully and permanently prepared for an effective disaster response through:
   - Development of comprehensive information management system through utilization of all of the natural hazard monitoring networks operated by responsible scientific organizations in order to provide on-time reliable and accurate information on the nature of the event and issuing early warning.
   - Strengthening the MoDMR and other relevant key agencies to become more prepared and enabled for quick and effective search and rescue operation at early hours of disasters, and to provide relief and temporary shelters; using all type of civil and military resources and capabilities at the time of the disasters; as well as mobilization of the post disaster national and international aids.

- Developing the required policy and guidelines for post disaster public information dissemination and media.
- Reliable Pre-Disaster Need Assessment. Table 7-2 and Table 7-3 can be used as a guide for need assessment and gap analysis for DRM based on the BRRM.

2. Development of a comprehensive and scientifically sound program for management and implementing effective plans for post-earthquake recovery (mental, social and physical).
3. Establish Bangladesh Post-Disaster Need Assessment Model (B-PDNA) to be compatible with the socio-economic-cultural and religious condition of urban and rural area. See below explanatory Note 1. This model should be linked with/or can be part of the BRRM (Recommendation 2).
4. Develop plan for rehabilitation and reconstruction of the damaged area for effective and timely reconstruction process with special emphasize on social and economic recovery and rehabilitation process.
5. Develop preparation plan for the use of the GIS, remote sensing, Drones or Unmanned Aerial Systems (UAS); as well as social networking system (See Note 2) for post disaster response and recovery.

Table 7-2 Identification the Pre disaster Need identification and gap identification based on the existing capacity.

Pre-Disaster Needs for:	Existing Capacities	Required Based on BRRM	Gaps	Timeline to Supply
Search and Rescue				
Medical Relief and facilities				
Temporary Shelter				
Service Restoration				
Physical Recovery				
Socio-economic recovery				
Reconstruction				

Table 7-3 Minimum Quantities of Requirements for 1000 People in Earthquake Disasters

Standards Related to the Development of Health Centers (Beds/1000 People)		
In most of countries	1.9 – 2.6	
Proposed for Bangladesh	1.7	
Minimum Required Shelter Space (square meters per 1000 People)		
Shelter Space	3500 square meters	
Minimum Water Quantities (liters/1000 People/Day)		
Surviving Needs: Water Intake (drinking and food)	2500-3000	
Basic Hygiene Practices	2000-6000	
Basic Cooking Needs	3000-6000	
Total	7500-15000	
Minimum Food Quantities (KCal /1000 People/Day)		
Minimum Nutritional Requirements	2100	
Minimum Numbers of Toilets/1000 People		
Period	Short- term	Long- term
Community	20	50

Note 1: The Post-Disaster Needs Assessment (PDNA) is a methodology developed by WB-GFDRR for estimating the physical damages, economic losses, and recovery costs following natural disasters. According to PDNA, government, international organizations, and assistant agencies can formulate recovery and rehabilitation frameworks and plans, identify appropriate projects, and arrange financing. The PDNA process initiates coordination of recovery efforts. Under the leadership of GoB, various stakeholders, such as assistance agencies, international organizations, and civil society organizations, can share the common information using PDNA model. The following sectors should be covered by B-PDNA:

- Social: Housing, education, health, culture, gender and religious practice;
- Infrastructure and services: Water and sanitation, community infrastructure, energy and electricity, transport, and telecommunications;
- Productive: Agriculture, livestock and fisheries, commerce and industry, and tourism;
- Macro-economy: GDP, fiscal deficit and balance of trade;
- Finance: Banks and non-banking financial institutions, insurance, etc.;
- Cross-cutting themes: Governance, disaster risk reduction, employment and livelihoods, environment, and gender;
- Human development: Poverty and human development.

Training and assessment should be conducted to build the capacity of experts at normal times; for an effective use the B-PDNA model after a disaster

Note 2: The use of Social Networking System (SNS) in DRR has changed the way people perceive and respond to disaster information and even to decision-making processes by government or other organizations working in disaster management. In most disasters, the first responders are the public, who then gather social capital, either directly or through SNS, in the form of the mobilization of skills, leadership, networks, and support systems. Data obtained through social media can be collected and analyzed by researchers for education and decision-making purposes. On the negative side, is the spread of false information from government/authorities were scarce, rumors circulated about an impending earthquake and tsunami. In Indonesia and Italy, scientists had trouble with the authorities as the information they gave were used and quoted inappropriately, which lead to chaos and insecurity among people.

7.3.7. Recommendation 7: Avoid Creating New Risk

Avoid creating new risks through safe and resilient planning, design, construction and maintenance Comprehensive and Integrated Capacity Building

The most effective approach for risk reduction and prevention in urban and rural areas is to stop new risk to be created by allowing the improper urban development and unsafe construction continues. The implementation of this recommendation requires a strong decision by the governance system of Bangladesh to avoid creating new risk by effective implementation and enforcement of rules and regulations that relates to safe and resilient planning, design and constructions of buildings, lifelines and infrastructures; in order to reduce earthquake risk and increasing the safety and quality of all new developments through the following actions:

1. Development and use of hazard and risk sensitive urban and rural land-use planning for buildings and infrastructures. This process has been started in Dhaka under the WB-URP and under NRP for small cities.
2. Improving the quality of city planning and management and enhancing the governance.

3. Improving technical capacity of engineers, foreman and labors and enhancing the technical capacity of engineering and labor organizations. This is also part of Recommendation 4.
4. Adopt the latest version of the BNBC, as well as to develop simplified building code for low income and rural housing that are compatible with local condition and easy to understand and implementable. Any delay in Gazetting the BNCB 2017, is adding to the building vulnerability and risk of Bangladesh.
5. Develop special seismic design guidelines for special structures, lifelines and infrastructures.
6. Initiate safe school and hospital campaign and pass the required legislation in the Parliament. For this initiative special guidelines for "Safe and Resilient School Planning, Design, Construction and Maintenance for Multi-hazard" and "Safe and Resilient Hospital Planning, Design, Construction and Maintenance for Multi-hazard" should be developed with high priority for their development. Iran successful experience can be used toward implantation of this task.
7. Effective prohibition and prevention of poor-engineering and unsafe construction, and making sure that all structures are build safer by full implementation of building codes. Establishment of e-permitting systems helps to avoid additional informal settlements and improper construction and code violation.
8. Enforcement of mandatory use of insurance, guarantee and liability system for all constructions. Builders should insure their products. See Recommendation 9 as well.
9. Enforcement of standardized and quality controlled construction materials and promoting the production of the resilient building material.
10. Establishing the legal framework that severe building violation would be treated as criminal act and not simple a civil violation.
11. Provide necessary support legal environment to make sure that code would not be violated, as detailed out in Figure 7-10.
12. Provide quality assurance systems and regulatory process for the whole building life cycle as explained in Figure 7-11.

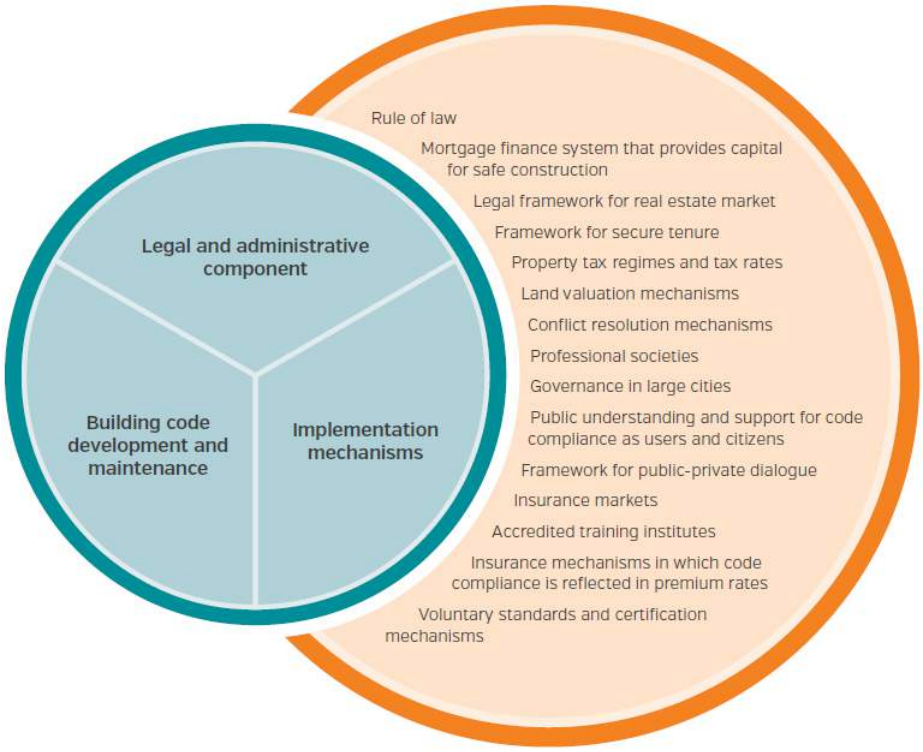


Figure 7-10 Legal and administrative environment for safe and resilience urban development [Ref. WB-GFDRR Build Back Better].

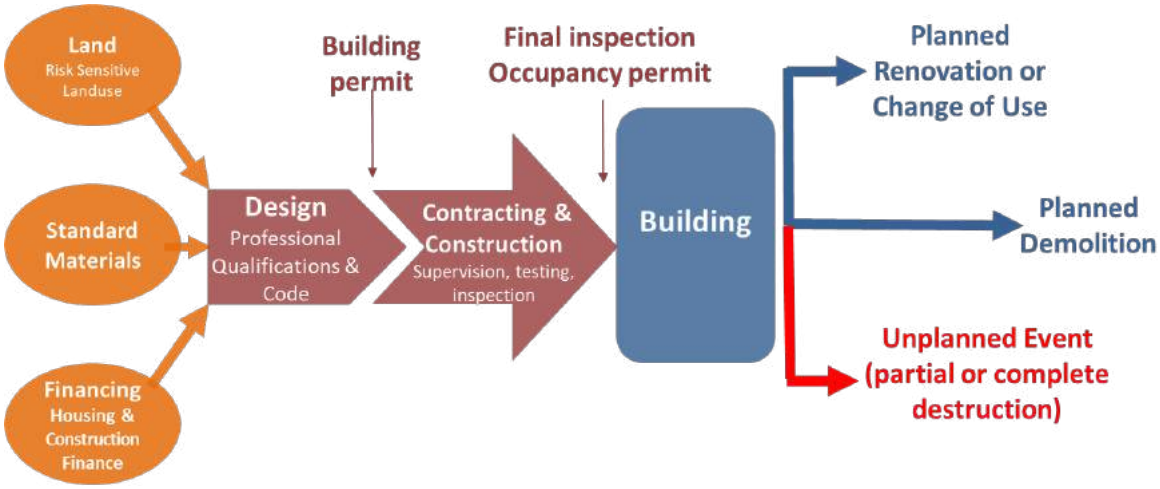


Figure 7-11 Legal and administrative environment for safe and resilience urban development and constructions [Ref. WB-GFDRR Build Back Better]

7.3.8. Recommendation 8: Gradual Reduction of Existing Risk

Considering the high urban vulnerability of Bangladesh; the importance of this recommendation in saving human lives should be realized by all stake holders and existing risk reduction should be done on gradual basis. Thus the substantial risk and vulnerability reduction of existing (mainly public and important) structures should be done with the main objective of saving human lives and providing effective disaster response through:

1. Define risk-based strengthening and improving safety program for each cities and identify the important public buildings, lifelines and infrastructures that need to strengthen.

2. Retrofitting and seismic rehabilitation of important public buildings, lifelines and infrastructures (for example) within next 20 years.
3. Initiate Safe and Resilient School and make sure all schools will be safe by next 10 years.
4. Providing special loan and financial incentive (tax credit, insurance, etc.) for the strengthening of the private residential, commercial and service buildings and facilities.
5. Structural and Non-Structural Health Monitoring of important and vital infrastructures such as bridges, power plants, etc.

7.3.9. Recommendation 9: Design, Develop and implement Disaster Risk Finance/Insurance

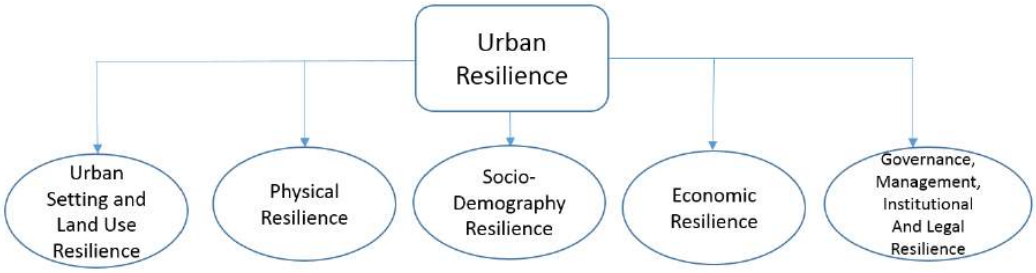
Design and development of an effective financial system for recovery, reconstruction and compensation through either or all of the methods such as: 1) Disaster Risk Insurance (DRI) which provides an effective tool to deal with increasing disaster losses, strengthen resilience to external shocks, and reduce future expenditure in case of a disaster, and can forms a safety net for vulnerable countries and its citizen; and 2) Disaster Insurance Pool which provides a basic affordable natural disaster insurance for all home owners with joint financial contribution of people and government. There are other mechanism such as Catastrophic Bonds, InsuResilience, Resilience Bonds, etc. which are not recommended at this stage.

The following actions need to be implemented with high priority for integrating insurance as part of the DRM of Bangladesh:

1. Design risk-based earthquake insurance plan for buildings and infrastructure with the cooperation of the Bangladesh Insurance Authority.
2. Design Bangladesh Disaster Insurance Pool with the cooperation of the Bangladesh Insurance Authority.
3. Implement and enforce mandatory disaster insurance for all important private business and factories, infrastructures, private hospitals, etc.
4. City Corporation Authorities should design a strategy for providing financial Incentives for safe design and construction of new buildings, such as reducing the building permit fees, reducing annual building tax; as well as in cooperation with banking system provide special loan for better construction.
5. Granting discount or eliminate tax for certain periods for strengthening of existing private buildings.
6. Private sector financial institutions need to integrate DRM into their business models and practices through disaster risk-informed investments.

7.3.10. Recommendation 10: Continuous Monitoring of Urban Risk and Resilience

Finally, to evaluate the progress and achievement on how the implementation of all of the ongoing programs and above mentioned recommendations improve the resiliency of the urban areas; an index based monitoring system has been proposed based on the pertinent parts of Sendai Framework for Disaster Risk Reduction (2015-2030) – as the newest adopted international strategy for disaster risk reduction – as well as other proposed indicator system for urban resilience. Indicator system has a hierarchical structure and has been extended according to a rational lookout to cover all involved parts of a city. Based on the main contribution parameters as shown in Figure 7-12. The detail description of the Urban Resilience Monitoring system has been given in Appendix III.



Sectors	Weight Factors	Thematic areas	Weight Factors	Indicators	Weight Factors
Urban setting and Land use Resilience R_F	**W_F**	Risk Sensitive Urban Development **R_{F1}**	**W_{F1}**	I_{F1} = Compatibility of development and construction with hazard level	
				I_{F2} = Comprehensive urban development plan	
		Form and Overall Structure of the City **R_{F2}**	**W_{F2}**	I_{F3} = Building height vs. street width	
				I_{F4} = Building access to outdoor	
				I_{F5} =Availability of Open Space, Parks	
				I_{F6} = City pattern or texture	
				I_{F7} = Time-worn urban textures	
Physical Resilience R_P	**W_P**	Buildings **R_{P1}**	**W_{P1}**	I_{P1} = Structural vulnerability	
				I_{P2}= Usage	
		Required Infrastructures for DRM and Response **R_{P2}**	**W_{P2}**	I_{P3}= Fire stations	
				I_{P4}= Hospitals	
				I_{P5}= Rescuers access	
		Urban Lifeline and Infrastructures **R_{P3}**	**W_{P3}**	I_{P6}= Water distribution network	
				I_{P7}= Gas distribution network	
				I_{P8}= Electricity Distribution network	
				I_{P9}= Communication and IT network	
				I_{P10}= Road and Transportation network	
Socio–demography Resilience R_S	**W_S**	Understanding Risk, Awareness and Preparedness **R_{S1}**	**W_{S1}**	I_{S1} = Level of people's awareness and sensitivity	
				I_{S2} = People preparedness and response to disaster and emergencies	
		Human Development Components **R_{S2}**	**W_{S2}**	I_{S3} = People trust on laws, officials and experts	
				I_{S4} = Level of health	
				I_{S5} = Level of education and training	
				I_{S6} = Age	
				I_{S7} = Social welfare and people's hope to life	
				I_{S8} = Migration (Daily, Monthly and Seasonal)	
		Social Contribution **R_{S3}**	**W_{S3}**	I_{S9} = Collaboration and Partnership	
				I_{S10} = Existence and activities of related NGOs	
				I_{S11} = Participation in community activities/drill	
		Human Vulnerability **R_{S4}**	**W_{S4}**	I_{S12} = Population vulnerability to disasters	
				I_{S13} = Population density	
Economic Resilience R_E	**W_E**	Economic Potential/Resources **R_{E1}**	**W_{E1}**	I_{E1} = Financial capacity to implement policies and responding to the effects of the crisis	
				I_{E2} = Ability to physical and economic recovery and reconstruction	
				I_{E3} = Job	
		Income **R_{E2}**	**W_{E2}**	I_{E4} = Economic welfare	
				I_{E5} = GDP and Income per capita	
Governance Management, Institutional and Legal Resilience R_M	**W_M**	Governance and Legal Capacities of City= **R_{M1}**	**W_{M1}**	I_{M1} = Existence of DRM and DRR related regulations	
				I_{M2} = Enforcement and Implementation of laws,...	
				I_{M3} = Existence of DRM system & Institution	
		Emergency Management **R_{M2}**	**W_{M2}**	I_{M4} = Early warning systems	
				I_{M5} =Capacity and ability to disaster response	
				I_{M6} =Capacity and ability to Recovery & Recons	

Figure 7-12 Main Component of Urban Resilience

8. REFERENCES

Base Documents

1. Bangladesh National Plan for Disaster Management (2016-2020), Building Resilience for Sustainable Human Development, Ministry of Disaster Management and Relief of Bangladesh, March 2017.
2. Bangladesh Disaster Risk Management Status Report 2016, Ministry of Disaster Management and Relief (MoDMR), Government of the People's Republic of Bangladesh, June 2009.
3. Standing Orders on Disasters, Ministry of Food and Disaster Management, Government of the People's Republic of Bangladesh, 2010
4. Standing Orders on Disasters, Ministry of Disaster Management and Relief, Government of the People's Republic of Bangladesh, 2018
5. Building Code (BNBC), (2010). Housing and Building Research Institute and Bangladesh Standard and Testing Institute, Bangladesh
6. Bangladesh National Progress Report on Implementation of Hyogo Framework for Action (2011-2013), Ministry of Disaster Management and Relief of Bangladesh, April 2013
7. Bangladesh Plan of Action to Implement SFDRR (2015-2030), Ministry of Disaster Management and Relief of Bangladesh, April 2016.
8. Earthquake Vulnerability Assessment of Dhaka, Chottogram and Sylhet City Corporation Area, CDMP; Ministry of Disaster Management and Relief (MoDMR), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh; June 2009.
9. Earthquake Risk Assessment of Dhaka, Chottogram and Sylhet City Corporation Area, CDMP; Ministry of Disaster Management and Relief (MoDMR), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh; June 2009.
10. National Earthquake Contingency Plan, Disaster Management Bureau (DMB) and Ministry of food and disaster management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
11. Earthquake Contingency Plan for Dhaka City, Disaster Management Bureau (DMB) and Ministry of Food and Disaster Management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
12. Earthquake Contingency Plan for Chottogram City, Disaster Management Bureau (DMB) and Ministry of food and disaster management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
13. Contingency Plan for Earthquake Hazard for Dhaka Power Distribution Company Limited (DPDC-CDMP), Ministry of Food and Disaster Management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
14. Contingency Plan for Earthquake Hazard for Directorate of Fire Service and Civil Defense (FSCD-CDMP, Ministry of Food and Disaster Management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
15. Contingency Plan for Earthquake Hazard for Directorate of Relief and Rehabilitation (DRR-CDMP), Ministry of Food and Disaster Management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

16. Contingency Plan for Earthquake Hazard for Directorate of Water Supply and Sewerage Authority (DWSSA-CDMP), Ministry of Food and Disaster Management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
17. Contingency Plan for Earthquake Hazard for Directorate of Titas Gas Transmission & Distribution Company Limited (TGTDCL-CDMP), Ministry of Food and Disaster Management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
18. Scenario based Ward level Spatial Contingency Plan, Ward No. 01 to (CCC01-4) Chottogram City Corporation, Ministry of Disaster Management and Relief of Bangladesh, 2014
19. Scenario based Ward level Spatial Contingency Plan, Ward No. 01 to 31 (DNCC 01-31) Dhaka North City Corporation, Ministry of Disaster Management and Relief of Bangladesh, 2014
20. Scenario based Ward level Spatial Contingency Plan, Ward No. 31 to 51 (DSCC 01-31) Dhaka South City Corporation, Ministry of Disaster Management and Relief of Bangladesh, 2014
21. Scenario based Earthquake Contingency Plan of Tangail Pourashava Area, Ministry of Disaster Management and Relief of Bangladesh, November 2014
22. Scenario based Earthquake Contingency Plan of Rangpur Corporation Area, Ministry of Disaster Management and Relief of Bangladesh, November 2014
23. BIGD, 2014. State of Cities: Governance for a Livable Chottogram. BRAC Institute of Governance and Development, BRAC University, Dhaka.
24. Government of Bangladesh. 2016. Draft National Land Policy
25. Comprehensive Disaster Management Programme (CDMP), (2009a). Seismic Hazard Assessment of Dhaka, Chottogram & Sylhet city corporation area. Ministry of food and disaster management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
26. Comprehensive Disaster Management Programme (CDMP), (2009b). Time-predictable fault modeling of Bangladesh. Ministry of food and disaster management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
27. Comprehensive Disaster Management Programme (CDMP), Terminal Evaluation 2009, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. November 2009
28. Urban Risk Assessment Guideline-My City is getting Ready-CDMPII, Ministry of Disaster Management (MoDMR), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh, 2014
29. Housing and Building Research Institute. 2015. Bangladesh National Building Code
30. Comprehensive Disaster Management Programme (CDMP), (2009a). Seismic Hazard Assessment of Dhaka, Chottogram & Sylhet city corporation area. Ministry of food and disaster management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
31. Comprehensive Disaster Management Programme (CDMP), (2009b). Time-predictable fault modeling of Bangladesh. Ministry of food and disaster management (MoFDM), Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
32. Comprehensive Disaster Management Programme (CDMP), Terminal Evaluation 2009, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. November 2009.

33. Urban Risk Assessment Guideline-My City is getting Ready-CDMPII, Ministry of Disaster Management (MoDMR), Government of the People's Republic of Bangladesh, 2014.

Technical and Non-Governmental Related Documents

34. Ali, M.H., Choudhury, J.R., (2001). Assessment of seismic hazard in Bangladesh. In: Nizamuddin K. (ed) Disaster in Bangladesh: selected readings. Disaster Research Training and Management Centre, University of Dhaka, Bangladesh, P. 197.
35. Ansary M.A and Horecritical R. (200); Review of the Standing Orders on Disaster Management of Bangladesh; New Technologies for Urban Safety of Mega Cities in Asia, 2009; https://www.researchgate.net/publication/327557981
36. Ansary, M.A., Meguro, K., (2003). Economic consequences of large earthquakes for Dhaka, Bangladesh. Bulletin ERS, Vol. 36, P. 177-193.
37. Ansary, M. and K. Meguro (2003). "A study on damage scenarios for buildings in Dhaka, Bangladesh." Natural Hazards (under review).
38. Ansary, M. A., (2019): Assessment of predominant frequencies in Dhaka city, Bangladesh using ambient vibration, First south Asia conference on earthquake engineering (SACEE'19), Karachi, Pakistan.
39. Atrachali, M., Ghafory-Ashtiany, M., Amini-Hosseini, Arian-Moghaddam; (2019) Toward quantification of seismic resilience in Iran: Developing an integrated indicator system; Int. Journal of Disaster Risk Reduction; Vol 30; https://doi.org/10.1016/j.ijdrr.2019.10123.
40. Bothara J., Ingham J., and Dizhur D., (2018), Earthquake Risk Reduction Efforts in Nepal; https://www.researchgate.net/publication/325187332
41. Earthquake and M. Initiative (2014). Bangladesh Urban Earthquake Resilience Project–Dhaka Earthquake Risk Guidebook, EMI Report, BUERP-PD-06-2014.
42. EMI. 2014. Risk Sensitive Land Use Planning Guidebook- Bangladesh Urban Earthquake Resilience Project
43. Global Assessment Report on Disaster Risk Reduction; (2019); United Nations Office for Disaster Risk Reduction; Swiss; https://gar.unisdr.org; eISBN: 978-92-1-004180-5
44. Global Earthquake Model; (2018) Bangladesh hazard and Risk report; https://downloads.openquake.org/countryprofiles/BGD.pdf
45. Ghafory-Ashtiany, M.; (2009); The Islamic View of Earthquakes, Human Vitality and Disaster; International Journal of Disaster Prevention and Management; Vol. 18,, pp218-232; DOI: 10.1108/09653560910965600015.
46. Ghafory-Ashtiany, M., (2015); View of Abrahamic Religions on Natural Disaster Risk Reduction; Chapter 21 of Book on Hazards, Risks, and Disasters in Society; ISBN: 978-0-12-396451-9; Elsevier.
47. Ghafory-Ashtiany, M., (2014); Earthquake Risk of and Risk Reduction Capacity Building in Iran; Chapter 20: Extreme Natural Hazards, Disaster Risks and Societal Implications; Cambridge University Press.
48. Ghafory-Ashtiany, M.; (2008); Iran Earthquake Risk Reduction Strategy and IIEES"; Global Risk Forum, Davos, Geneva.
49. Ghafory-Ashtiany, M., and Naser-Asadi, K.;(2014); Earthquake Insurance in Iran; Proceedings of GRF 2014; Paper 2896; Davos, Swiss.

50. Ghafory-Ashtiany, M. and Arghavani, M; (2016); Quantification of Resilience in Earthquake Engineering"; Proceeding of UNISDR Science and Technology Conference, Implementation of SFDRR; 27-29; Geneva, Switzerland.
51. Global Resilience Partnership (2014); Global Resilience Challenge for Building Resilience to Acute Shocks and Chronic Stresses in the Sahel, Horn of Africa, and South and Southeast Asia; http://www.globalresiliencepartnership.org
52. Grubinger, V (2012) Resilience and sustainability in the food system. Accessed April 2015.http://learn.uvm.edu/foodsystemsblog/2012/10/22/resilience-and-sustainability-in-the-food-system/
53. Japan International Cooperation Agency (JICA), (2015). Data Collection Survey on Urban Building Safety in the People's Republic of Bangladesh.
54. Maksud Kamal, A.S.M., (2013). Earthquake Risk and Reduction Approaches in Bangladesh. In: Disaster Risk Reduction Approaches in Bangladesh, Eds.: Shaw, R., Mallick, F., Islam A., Springer Japan, P. 103-130, DOI: 10.1007/978-4-431-54252-6.
55. Nepal P., Khanal N.R.; Pangali Sharma B.P., (2018); Policies and institutions for disaster risk management in Nepal: A review; The Geographical Journal of Nepal; Vol. 11: 1-24; Central Department of Geography, Tribhuvan University, Kathmandu, Nepal
56. National Infrastructure Advisory Council (NIAC) (2010) A framework for establishing critical infrastructure resilience goals. Final report and recommendations by the council. Washington DC.
57. National Institute of Standards and Technology-NIST, (2013) Developing Guidelines and Standards for Disaster Resilience of the Built Environment: A Research Needs Assessment. U.S. Department of Commerce.
58. Parsizadeh, F. and Ghafory-Ashtiany, M.; (2010); Iran Public Education and Awareness Program and its Achievements"; International Journal of Disaster Management, Vol.19, No.1.
59. Raihanul Islam, Md. Nazrul Islam and M. Nazrul Islam; (2016); Earthquake Risks In Bangladesh: Causes, Vulnerability, Preparedness And Strategies For Mitigation; Asian Research Publishing Network (ARPN) Journal of Earth Sciences; Vol. 5, No. 2, ISSN 2305-493X
60. Rana MMP (2011) Urbanization and sustainability: challenges and strategies for sustainable urban development in Bangladesh. Environmental Development Sustain 13(1):237–256
61. Risk INFORM (2019); EU Commission-Disaster Risk Management Knowledge Centre-INFORM;https://drmkc.jrc.ec.europa.eu/inform-index/Countries/Country-Profile-Map
62. Sendai Framework for Disaster Risk Reduction, 2015-2030;
63. Tsunami Hazard and Vulnerability-Training Material for Decision Makers/Planners and Managers of Coastal Infrastructure, Ministry of Disaster Management and Relief of Bangladesh, ADPC
64. World Bank and EMI (Earthquakes and Megacities Initiative, Inc.), (2014). Dhaka Profile and Earthquake Risk Atlas- the Bangladesh Urban Earthquake Resilience Project (BUERP).
65. The World Risk Report, World Risk Index 2019 Overview; Institute for International Law of Peace and Armed Conflict (IFHV) of Ruhr University Bochum (RUB) and United Nations University Institute for Environment and Human Security, Germany, ISBN 978-3-946785-08-8

I. Appendix I: Bangladesh in View of International Risk Ranking

Many seismic risk analysis and risk indexing has been done at national and international level for Bangladesh. World Risk Index quantitatively ranks all countries based on their level of hazard, exposure, vulnerability and coping and adoptive capacity. The results for Bangladesh are shown in Figure I-2 and Table I-1.

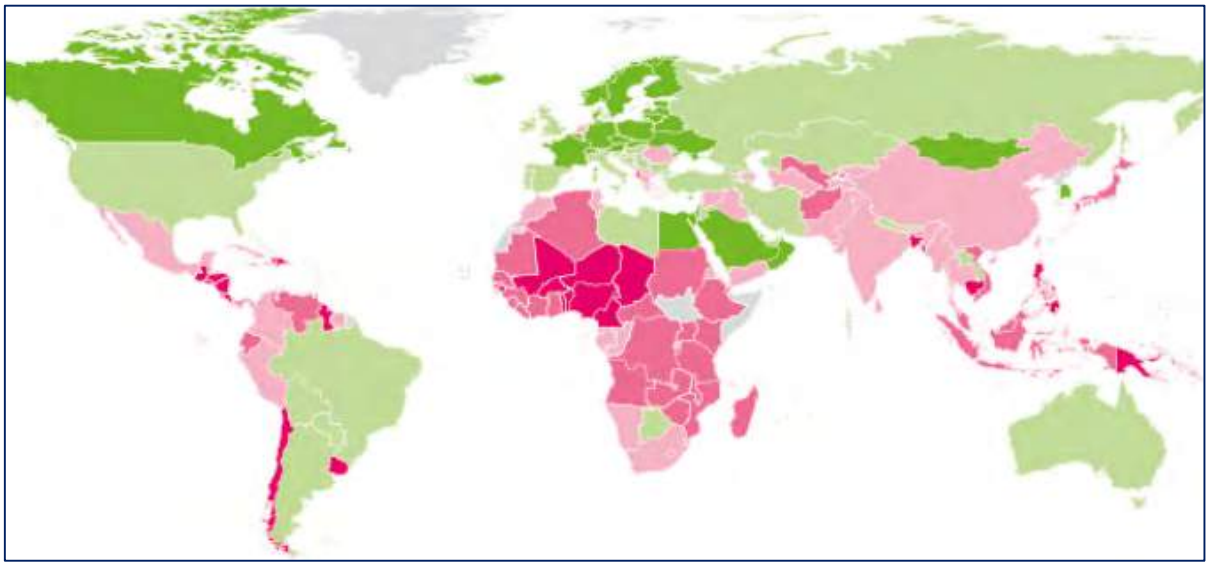


Figure I-1 World Risk Map indicating very high Natural Disaster Risk of the Bangladesh (Rank 10 in 2019). [Ref. 65, *World Risk Index*, United Nations University Institute for Environment and Human Security.]

WorldRiskIndex 2019 Overview

Classification	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
very low	0.31 - 3.29	0.90 - 9.59	21.11 - 33.08	8.75 - 16.50	36.44 - 58.83	11.16 - 22.73
low	3.30 - 5.49	9.60 - 12.30	33.09 - 42.10	16.51 - 20.65	58.84 - 71.95	22.74 - 32.26
medium	5.50 - 7.51	12.31 - 14.73	42.11 - 47.91	20.66 - 28.43	71.96 - 78.62	32.27 - 38.94
high	7.52 - 10.61	14.74 - 19.61	47.92 - 61.79	28.44 - 45.05	78.63 - 84.65	38.95 - 51.52
very high	10.62 - 56.71	19.62 - 99.88	61.80 - 76.13	45.06 - 70.46	84.66 - 94.14	51.53 - 68.95

Max. value = 100, Classification according to the quantile method

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
1.	Vanuatu	56.71	99.88	56.78	35.32	84.36	50.66
2.	Antigua and Barbuda	30.80	69.95	44.03	23.38	76.65	32.05
3.	Tonga	29.39	61.41	47.86	28.19	79.92	35.47
4.	Solomon Islands	29.36	48.31	60.77	46.37	80.95	55.00
5.	Guyana	22.87	44.98	50.84	26.41	79.68	46.44
6.	Papua New Guinea	22.18	32.54	68.18	55.45	86.21	62.88
7.	Brunei Darussalam	21.68	57.62	37.62	15.26	67.14	30.45
8.	Guatemala	20.69	38.56	53.65	32.19	83.96	44.80
9.	Philippines	20.69	41.93	49.34	28.86	80.98	38.17
10.	Bangladesh	18.78	32.48	57.83	32.93	86.13	54.44
11.	Cape Verde	18.02	38.26	47.10	31.13	67.63	42.54
12.	Fiji	17.83	38.43	46.41	21.54	78.76	38.93

Figure I-2 Rankings of the Bangladesh by Natural Disaster Risk based on the Vulnerability, Susceptibility, Lack of coping and adoptive Capacities. [Ref. 65, *World Risk Index*, United Nations University Institute for Environment and Human Security.]

Table I-1 Rankings of the countries by Natural Disaster Risk [Ref. 30, *World Risk Index*, United Nations University Institute for Environment and Human Security

Rank	Country	2019	2017	2013	2012	2011
1	Vanuatu	56.71%	36.28%	36.43%	36.31%	32.00%
2	Antigua and Barbuda	30.80%	-	-	-	-
3	Tonga	29.39%	29.33%	28.23%	28.62%	29.08%
4	Solomon Islands	29.36%	19.14%	18.11%	18.15%	23.51%
5	Guyana	22.87%	11.39%	11.65%	11.77%	9.02%
6	Papua New Guinea	22.18%	16.43%	15.90%	15.81%	15.45%
7	Brunei	21.68%	17.00%	15.58%	15.92%	14.08%
8	Guatemala	20.69%	19.88%	20.88%	20.75%	20.88%
9	Philippines	20.69%	26.70%	27.52%	27.98%	24.32%
10	**Bangladesh**	**18.78%**	**19.17%**	**19.81%**	**20.22%**	**17.45%**
11	Cape Verde	18.02%	10.39%	10.80%	10.88%	9.47%
12	Fiji	17.83%	13.15%	14.10%	13.53%	11.13%
37	Indonesia	10.58%	10.24%	10.54%	10.74%	11.69%
40	Vietnam	10.31%	12.53%	12.81%	12.88%	11.21%
54	Japan	9.19%	12.99%	13.56%	13.69%	13.57%
55	Malawi	8.94%	7.98%	8.02%	8.18%	8.99%
67	Mauritania	7.72%	7.95%	8.26%	8.43%	9.70%
71	Malaysia	7.61%	6.39%	6.45%	6.53%	6.69%
73	Sri Lanka	7.50%	7.32%	7.67%	7.79%	7.84%
78	Kyrgyzstan	7.28%	7.86%	8.43%	8.50%	8.48%
80	Pakistan	7.08%	6.96%	7.21%	7.25%	7.84%
85	India	6.77%	6.64%	7.17%	7.28%	7.68%
91	Thailand	6.48%	6.19%	6.34%	6.44%	6.86%
98	China	6.39%	6.39%	6.97%	7.04%	6.90%
106	Turkmenistan	5.69%	6.44%	6.57%	6.64%	7.18%
113	Turkey	5.06%	5.20%	5.52%	5.68%	5.38%
114	Hungary	4.94%	5.32%	5.69%	5.87%	5.49%
115	Iran	4.92%	4.73%	4.92%	4.98%	5.11%
116	Nepal	4.92%	5.12%	5.53%	5.69%	6.15%
124	Australia	4.49%	4.22%	4.51%	4.57%	4.28%
143	Butan	4.22%	4.22%	4.43%	4.56%	4.08%
149	Mongolia	3.00%	3.08%	3.10%	3.24%	3.43%
161	Singapore	2.51%	2.27%	2.49%	2.54%	2.85%
3	Grenada	0.80%	1.42%	1.44%	1.46%	2.29%
2	Malta	0.54%	0.60%	0.61%	0.61%	0.72%
1	Qatar	0.31%	0.74%	0.11%	0.10%	0.02%

Another commonly used risk management index is INFORM (EU-Disaster Risk Management Knowledge Centre-INFORM report 2019). As shown in Figure I-3, based on INFORM assessment, Bangladesh has the highest physical exposure to flood score (10) and earthquake score (9.2) and with total score of 6, ranks 22 in all 191 countries against this risk which highlights the increased need for understanding of risk patterns and trends in the country.

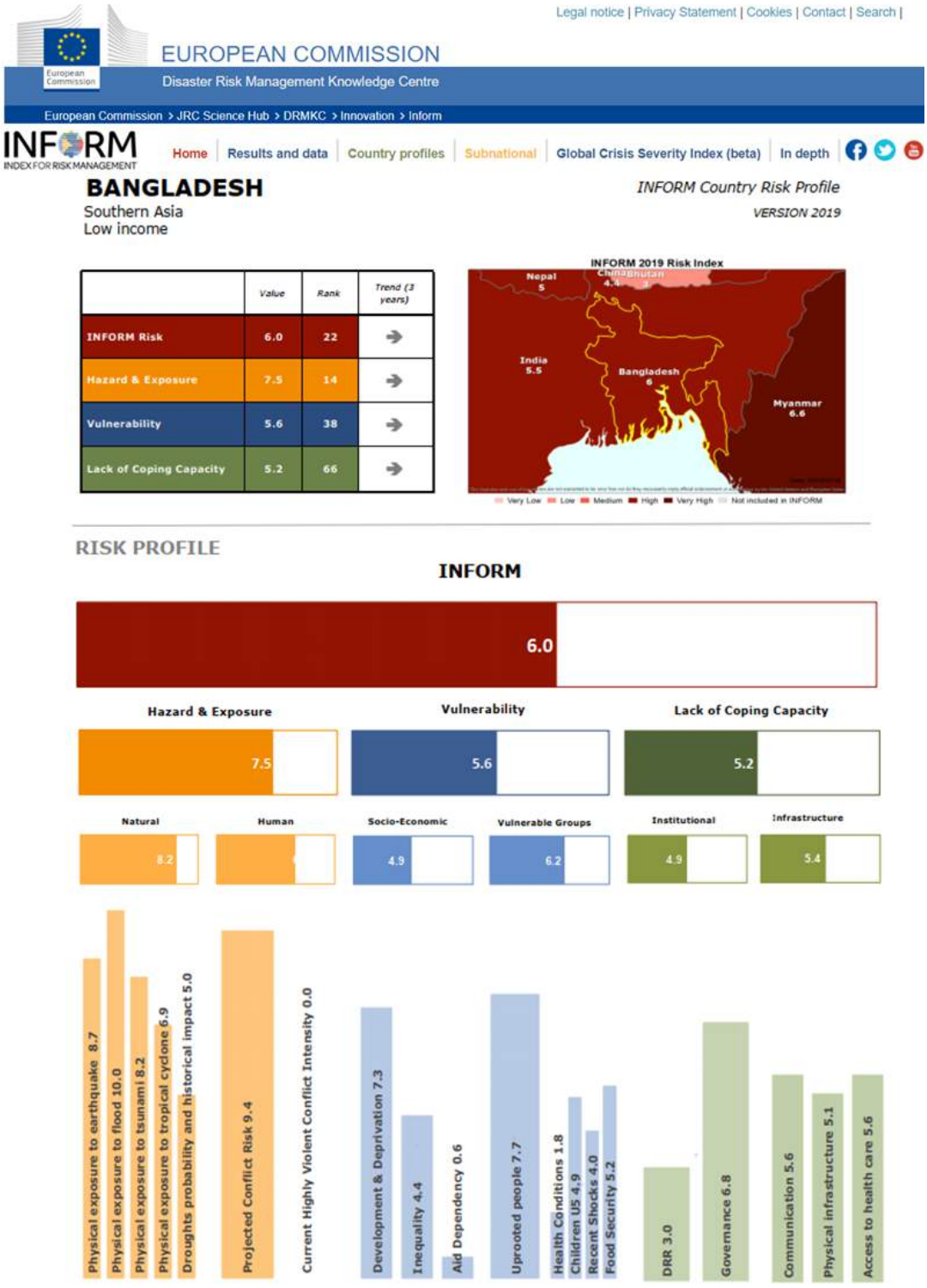


Figure I-3 Bangladesh Risk Profile [Ref.61, Risk INFORM]

II. APPENDIX II: Tables and Figures Related to Bangladesh DRM System

II.1: Key Stakeholders in Bangladesh DRM.

Table II-1 shows the list of the institution and committees for related to earthquake disaster risk management at national and sub-national level.

Table II-1 List of the institutions and committees for disaster risk management at national and sub-national level

Level	Summary
National Level Bodies	**National Disaster Management Council (NDMC)** headed by the Prime Minister for formulates and review the disaster management policies and issue directives.
	Inter-Ministerial Disaster Management Co-ordination Committee (IMDMCC) headed by the Minister in charge of the Ministry of Disaster Management and Relief (MoDMR) to implement disaster management policies and decisions of NDMC / Government.
	National Disaster Management Advisory Committee (NDMAC) headed by Chairman, Standing Committee for Ministry of Disaster Management and Relief
	National Platform for Disaster Risk Reduction (NPDRR) headed by Secretary, Ministry of Disaster Management and Relief (MoDMR) and DG, DDM functions as the member secretary. This platform shall coordinate and provide necessary facilitation to the relevant stakeholders
	Earthquake Preparedness and Awareness Committee (EPAC) headed by minister for MoDMR and Additional Secretary, MoDMR act as member secretary
	Disaster Management Training and Public Awareness Building Task Force (DMTATF) headed by the Director General of Department of Disaster Management (DDM) to coordinate the disaster related training and public awareness activities of the Government, NGOs and other organizations.
	Focal Point Operational Coordination Group of Disaster Management (FPOCG) headed by the Director General of DDM to review and coordinate the activities of various National Plan for DM of departments/agencies in the group related to disaster management and also to review the Contingency Plan prepared by concerned departments
	NGO Coordination Committee on Disaster Management (NGOCC) headed by the Secretary of MoDMR to review and coordinate the activities of concerned NGOs.
Sub-national Level Bodies	**Divisional Disaster Management Committee headed by Divisional Commissioner**
	District Disaster Management Committee (DDMC) headed by the Deputy Commissioner (DC) to coordinate and review the disaster management activities at the District level.
	Upazilla Disaster Management Committee (UZDMC) headed by the Upazila Chairman and Cocjair is the Upazilla Nirbahi Officer (UNO) to coordinate and review the disaster management activities at the Upazilla level
	Union Disaster Management Committee (UDMC) headed by the Chairman of the Union Parishad to coordinate, review and implement the disaster management activities of the concerned Union
	Pourashava Disaster Management Committee (PDMC) headed by Mayor of Pourashava (municipality) to coordinate, review and implement the disaster management activities within its area of jurisdiction
	City Corporation Disaster Management Committee (CCDMC) headed by the Mayor of City Corporations

II.2 Staanding Order on Disasters, 2019

II.2.1 Earthquake Preparedness and Awareness Committee (EPAC)

Following the verdict of High Court Division of Supreme Court, dated 29.07.2009, in order to prepare the nation for earthquake risk management, the EPAC was formed with 39 members. In SOD 2019, the number of members became 75 as shown in Table II-2. Quick observation indicates that considering that all of the agencies and members should work toward risk reduction, creating collaboration and cooperation among them would be a difficult task. Based on the SOD, the committee should held two meeting every year with minimum of one-third of members. However, it is foreseen that sub committees may be formed for contingency planning and aspect of earthquake risk reduction. Coordination for an important task of creating earthquake resilient Bangladesh as it has been outlined in next section.

Table II-2 Earthquake Preparedness and Awareness Committee

1	Minister, Ministry of Disaster Management and Relief	Chairperson
2	Secretary, Ministry of Disaster Management and Relief	Vice- Chair
3	Secretary, Ministry of Public Administration	Member
4	Secretary, Ministry of Agriculture	Member
5	Secretary, Finance Division, Ministry of Finance	Member
6	Secretary, Economic Relations Division	Member
7	Secretary, Ministry of Housing and Public Works	Member
8	Secretary, Energy and Mineral Resources Division	Member
9	Secretary, Ministry of Information	Member
10	Secretary, Ministry of Foreign Affairs	Member
11	Secretary, Ministry of Defense	Member
12	Secretary, Ministry of Primary and Mass Education	Member
13	Secretary, Secondary and Higher Education Division	Member
14	Secretary, Technical and Madrasa Education Division	Member
15	Secretary, Power Division	Member
16	Secretary, Railways Division	Member
17	Secretary, Roads and Highways Department	Member
18	Secretary, Bridges Division	Member
19	Secretary, Ministry of Social Welfare	Member
20	Secretary, Ministry of Women and Children Affairs	Member
21	Secretary, Security Services Division	Member
22	Secretary, Public Security Division	Member
23	Secretary, Local Government Division	Member
24	Secretary, Health Services	Member
25	Secretary, Ministry of Health and Family Planning Affairs	Member
26	Representative, Cabinet Division	Member
27	Director General, Department of Disaster Management	Member
28	Director General, Health Services	Member
29	Director General, Fire Services and Civil Defense Department	Member
30	Director General, GSB	Member
31	Director General, NGO Affairs Bureau	Member
32	Director General, Department of Women Affairs	Member
33	Managing Director, National Foundation for Development of the Disabled Persons	Member
34	Chairman, RAJUK	Member
35	Divisional Commissioner, DHAKA	Member
36	Divisional Commissioner, CHOTTOGRAM	Member

37	Divisional Commissioner, RAJSHAHI	Member
38	Divisional Commissioner, KHULNA	Member
39	Divisional Commissioner, BARISAL	Member
40	Divisional Commissioner, SYLHET	Member
41	Divisional Commissioner, RANGPUR	Member
42	Divisional Commissioner, MYMENSINGH	Member
43	Joint Secretary, (Field Administration) Cabinet Division	Member
44	Joint Secretary, (Disaster Management), Ministry of Disaster Management and Relief	Member
45	Chief Executive Officer, Dhaka North City Corporation	Member
46	Chief Executive Officer, Dhaka South City Corporation	Member
47	Managing Director, Dhaka WASA	Member
48	Chief Engineer, Public Works Department	Member
49	Chief Engineer, Roads and Highways Department	Member
50	Chief Engineer, Local Government Engineering Department	Member
51	Chief Engineer, Engineering Education Department	Member
52	Chief Engineer, Dhaka Electric Supply Company Limited (DESCO)	Member
53	Chief Engineer, Dhaka Power Distribution Company Limited (DPDC)	Member
54	Director, Housing and Building Research Institute (HBRI)	Member
55	Chairman, Disaster Science and Management, University of Dhaka	Member
56	Chairman, Department of Geology, University of Dhaka	Member
57	Chairman, Bangladesh Red Crescent Societies (BDRCS)	Member
58	Representative, National Forum of organization	Member
59	Representative, Hazrat Shahajalal International Airport, Dhaka	Member
60	Representative, Urban Development Directorate (UDD)	Member
61	Representative, Civil Engineering Department, BUET	Member
62	Representative, Department of Geography and Environment, University of Chottogram	Member
63	Representative, Department of Regional and Urban Planning, Jahangirnagar University	Member
64	Representative, Department of Civil and Environmental Engineering, SUST	Member
65	National Commissioner, Bangladesh Scouts	Member
66	Representative, Department of Armed Forces	Member
67	Representative, Bangladesh Police	Member
68	Representative, RAB	Member
69	Managing Director, Nuclear Power Plant Company Bangladesh Lmt.	Member
70	Director, Department of Weather	Member
71	Representative, Organizations Helping in Development (Nominated by the Government)	Member
72	Representative, Nominated by UNRC	Member
73	3 Rep. from NGO, active on a National level, Nominated by MoDMR	Member
74	2 Rep. from NGO, active on an International level, Nominated by MoDMR	Member
75	Additional Secretary/ Joint Secretary (Disaster Management), MoDMR	Member- Secretary

Responsibilities in Raising Earthquake Awareness Committee

1. Review programs for earthquake preparedness and awareness and provide recommendations for the concerned organizations;
2. Provide advice on earthquake preparedness, search and rescue, determining strategies to enhance the capacity to reformation of the organization;
3. Prepare and recommend a list of equipment for earthquake risk reduction and search and rescue programs after an earthquake;
4. Provide advice on the development of the capacity of the primary and secondary responding person/ organization;

5. To make necessary recommendations on the things to be done for earthquake-north reconstruction and rehabilitation activities;
6. Following the Bangladesh National Building Code and take up advocacy for the construction of houses and buildings;
7. Providing advice on disaster-relief for emergency service deployment and supply systems;
8. Necessary advice for preparing emergency plans and conducting trials
9. Provide recommendations for the formation of multiple sub-committees as needed to reduce, prepare for and respond to earthquakes;
10. Provide Recommendations for educational institutes for awareness activities on “things to do during an Earthquake”;
11. Provide recommendations for preparedness activities and regular earthquake trials in homes, workplaces, home centers and educational institutions;
12. Provide recommendations for communications during emergency situations with mobile number, email id, database creation, updating and dissemination of the person responsible for educational institutes, offices, business centers;
13. Utilization and collection of foreign experiences on earthquake;
14. The construction of buildings must be in compliance with Bangladesh National Building Code;
15. Mobile courts are conducted on a regular basis with the help from representatives of different ministries;
16. Ensuring maximum percentage of emergency drainage system for construction of multistoried buildings;
17. Conduct trials to deal with any accidents in various educational institutes and offices, every three months or intervals of time.

II.2.2 Risk Reduction Responsibilities of the City Corporation DM Committee:

1. Arrange regular training and workshops on disaster management especially on earthquake issues by keeping the DMB informed.
2. Hold a hazard, vulnerability and risk analysis at City Corporation level and prepare contingency plan for earthquake and other natural and human induced disasters e.g. for fire, flood etc. Ensure that all life line support agencies e.g. WASA, DESA, Gas companies, T&T have their own agency contingency plan for earth quake, fire and subsequent mass causality management
3. Identify community at risk based on age, sex, physical fitness, social status, profession and economic condition.
4. Prepare short, medium and long-term vulnerability reduction and capacity building action plan for the high-risk people with the active participation of the community at risk.
5. Organize regular meetings on developmental issues with organizations working at City Corporation level who have development programs and who are providing services to take decisions for the implementation of short, medium and long term action plans and to review the progress.
6. Establish effective coordination with utility services for immediate restoration of lifeline services and manage local fund for the implementation of risk reduction action plans.

7. Inform the DMB on the progress of implementation of the action plans.
8. Prepare a comprehensive disaster management action plan, which will enable the local community, authority of the City Corporation and local organizations to support the poor and vulnerable community for increasing their income and other abilities for risk reduction and for taking necessary security measures against any impending warnings and disaster.
9. Ensure that the local people are kept informed and capable of taking practical measures for the reduction of risk at household and community levels and also disseminate widely the success stories among the local people about reducing risks at household and community levels.
10. Arrange speedy and effective dissemination of forecasts relating to disasters (cyclone, tidal surge, tsunami, heavy rainfall, flood, water logging, high tide, cold wave, etc.) among individuals, volunteers and target organizations and make them able to take effective roles to save their lives and property during disaster.
11. Build the capacity of local institution, volunteers, and the community to adopt disaster (cyclone, tidal surge, tsunami, earthquake, tornado, flood, water logging, salinity, high tide, cold wave) resistant housing features.
12. Build the capacity of the local institution, earthquake volunteers, and the community to adapt with disaster resistant agriculture and other livelihood options. Institutionalize the training for mason and bar binders on earthquake resilient structure constructions.
13. Determine specific safe center/shelter where the people of particular area will go at the time of disaster and assign responsibilities to different individuals and organizations – for providing various services and securities at the shelters.
14. Ensure supply of safe drinking water and if necessary, other services from specific points near the shelter/center.
15. Train the students, youth, local club members and volunteers on community based water purification techniques so that during disaster, they can supply safe drinking water in their own community during emergencies.
16. Identify open space at city corporations to establish field hospitals & medical operations for mass causalities management. Keep stocks of emergency lifesaving drugs and other support facilities at City Corporation and Ward level for use during disaster.
17. Prepare relevant preparedness plans for search & rescue, primary relief operation, and local arrangement for rehabilitation of severely affected families.
18. Arrange for rehearsals or drills on the dissemination of warnings/forecasts, evacuation, rescue and primary relief operations (if necessary, committee can seek assistance from DMB).

II.3 CDMP DRM Program

List of universities in Bangladesh that help creating an enabling atmosphere for generating disaster management professionals, Table II-3.

Table II-3 Universities and related agencies offering disaster management courses

1	Inst. of Disaster Management and Vulnerability Studies (IDMVS), Univ. of Dhaka
2	Department of Disaster Science and Management (DSM), University of Dhaka
3	University of Rajshahi (RU), Rajshahi.
4	Jahangirnagar University (JU), Dhaka.
5	Bangladesh Agricultural University (BAU), Mymensingh.
6	Khulna University (KU), Khulna.
7	Patukhali Science and Technology University (PSTU), Patuakhali.
8	Mawlana Bhashani Science and Technology University (MBSTU), Tangail.
9	Shahjalal University of Science and Technology (SUST), Sylhet.
10	Chottogram University of Engineering and Technology (CUET), Chottogram.
11	Rajshahi University of Engineering and Technology (RUET)
12	Khulna University of Engineering and Technology (KUET)
13	Independent University Bangladesh (IUB), Dhaka.
14	BRAC University (BRAC-U), Dhaka.
15	North South University, Dhaka.
16	National Curriculum and Text Book Board (NCTB), Ministry of Education, Dhaka.
17	Faculty of Disaster Management, Begum Rokeya University, Rangpur
18	Bangladesh University of Professional (BUP)

II.4 JICA Urban Safety Projects in Bangladesh

Japan International Cooperation Agency (JICA) has implemented several project toward increasing the earthquake safety in Bangladesh as shown in Table II-4.

Table II-4 List of the JICA projects in Bangladesh with its objective and expected results.

SL	Project Name	Objective	Expected Results
1	The Project for Capacity Development on natural Disaster Resistant Techniques of Construction and Retrofitting for Public Buildings (CNCRP)	The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters is developed.	1. The capacity to do inventory, vulnerability assessment (seismic evaluation) of the existing public buildings is developed. 2. The design methods for new building designing as well as retrofitting the public buildings against natural disasters are established. 3. Quality control process is developed. 4. The technologies on construction and retrofitting for new building design and retrofitting design of public buildings 5. The technologies on construction and retrofitting for new building design and retrofitting design of public buildings.
2	Urban Building Safety Project"	To enhance the building safety in Dhaka and Chottogram by financing loans for building safety for private buildings through Participating Financial Institutions and by improving the building safety situation for public/Gov. buildings.	1. Establish Technical financing mechanism for strengthening the private buildings 2. Strengthening the public buildings (Infrastructure and equipment) for better response capacity 3. Promote Building Regulatory Authority through Technical Review panel (TRP)

3	Project on Capacity Building for Community- based DRR in Urban Areas of Bangladesh	To build up a system in which the communities in Dhaka North city can implement DRR activities in a continuous manner.	1. Training human resources for the promotion of community based DRR 2. Building three models of DRR community 3. Establishment of a system in which the model of practicing DRR community can be widely expanded and disseminated 4. Meaning of community DRR are widely shared and understood
4	The Project for Technical Development to Upgrade Structural Integrity of Buildings in Densely Populated Urban Areas and its Strategic Implementation towards Resilient Cities	Technologies for enhancing structural resilience of buildings and their effective implementation schemes in Dhaka are proposed through technical capacity and research resources development of relevant institutes.	1. Building characteristics governing its performance are identified, and research target areas and buildings are determined. 2. Performance evaluation methodology against collapse is established and applied to pilot buildings. 3. Retrofit schemes for buildings with low performance are established and applied to pilot buildings. 4. Efficient and effective urban planning strategies for resilient city against disasters are established and promoted.
5	Building Safety Promotion Project	Capacity of implementation for promoting seismic buildings safety in public sector of urban area is enhanced	1. Human resource development system for seismic building safety is enhanced. 2. Manuals/handbooks prepared to promote the seismic related technique are applied into actual implementation of seismic evaluation, seismic design, retrofitting design and construction supervision of public buildings in urban area.
6	RAJUK Capacity Building on Construction Monitoring	Building Design and Construction Quality for resilience of newly constructed private buildings approved by RAJUK in Dhaka Metropolitan Area is improved.	1. RAJUK process to validate the structure of the newly designed and applied private buildings in collaboration with third party is established and the capacity of RAJUK officers engaged in the process is strengthened 2. Inspection and monitoring processes for the newly constructed buildings in RAJUK and by Certified Professionals and IAB/IEB are improved and the capacity of RAJUK officers engaged in the process is strengthened 3. The awareness of the measures to improve building resilience among stakeholders will be increased
7	Disaster Risk Management Enhancement Project	To enhance comprehensive DRM of GoB by recovering and rehabilitating infrastructures at high risk for natural disasters, providing equipment for emergency comm. and relief, and establishing disaster recovery and rehabilitation scheme.	1. FSCD will be able conduct better search and rescue operation 2. Emergency recovery funding mechanism will be established

III. Appendix III: Urban Resilience Monitoring

Based on the definition of the resilience given in the introductory section 1.3, and for implementation of the Recommendation 10, an urban resilience indicator system composed of many parameters have been presented based on the urban condition of the Bangladesh.

III.1 Urban Resilience Indicator System

The proposed indicator system has been developed based on the pertinent parts of Sendai Framework for Disaster Risk Reduction (2015-2030) – as the newest adopted international strategy for disaster risk reduction – as well as other proposed indicator system for urban resilience. Indicator system has a hierarchical structure and has been extended according to a rational lookout to cover all involved parts of a city. To achieve this goal, major parts of the city has been divided into five sections, that are called hereafter "Sectors"; then for each sector, some smaller portions have been provided, namely "Thematic areas" to cover all possible aspects of each sector, precisely. As the final step, for each thematic area, relevant "Indicators" have been presented as the smallest characteristics of the system that operates in a city.

The process of "indicator selection" has been done with high care, because each selected indicator should be quantifiable and the required data for quantification should be accessible. Another challenge in this path is the provision of the logical relationship of each indicator with urban resilience. It should be mentioned that the proposed indicator system looks at the whole city generally and does not go into the detail of the components (Ghafory-Ashtiany and Atrachali 2016, Atrachali and Ghafory-Ashtiany 2018). By a critical review in the literature to find parameters contributing to the seismic resilience, a long list of around 100 indices have been identified. After preliminary consultation with experts this long list has been shortened with the consideration of their importance and avoiding overlaps. The structure of the proposed resilience indicators is presented in Table III-1. It is clear that the index in this list can be further reduced or increased, in other word the urban resilience is not limited to these indicators and can be improved in the future based on the results of its applications in Bangladesh.

Urban resiliency composed of many parameters, some can be measured and quantified and some cannot. In context of urban resilience, the important resiliency parameter that can be quantified and defined in terms of urban structure, physical, socio-human, economic, and governance are shown in Figure III-1 and Table III-1. This table follows the logic given the in the risk formula.

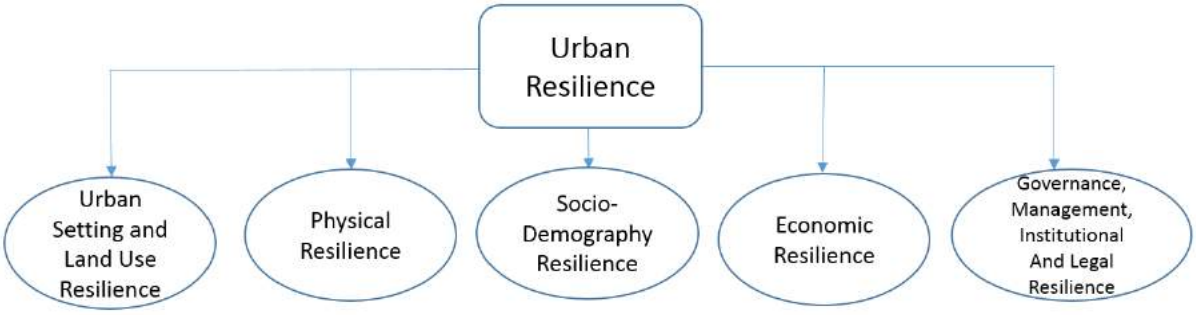


Figure III-1 Main Component of Urban Resilience

Table III-1 Urban resilience indicator system

Sectors	Weight Factors	Thematic areas	Weight Factors	Indicators	Weight Factors
Urban setting and Land use Resilience R_F	**W_F**	Risk Sensitive Urban Development **R_{F1}**	**W_{F1}**	I_{F1} = Compatibility of development and construction with hazard level	
				I_{F2} = Comprehensive urban development plan	
		Form and Overall Structure of the City **R_{F2}**	**W_{F2}**	I_{F3} = Building height vs. street width	
				I_{F4} = Building access to outdoor	
				I_{F5} =Availability of Open Space, Parks	
				I_{F6} = City pattern or texture	
				I_{F7} = Time-worn urban textures	
Physical Resilience R_P	**W_P**	Buildings **R_{P1}**	**W_{P1}**	I_{P1} = Structural vulnerability	
				I_{P2}= Usage	
		Required Infrastructures for DRM and Response **R_{P2}**	**W_{P2}**	I_{P3}= Fire stations	
				I_{P4}= Hospitals	
				I_{P5}= Rescuers access	
		Urban Lifeline and Infrastructures **R_{P3}**	**W_{P3}**	I_{P6}= Water distribution network	
				I_{P7}= Gas distribution network	
				I_{P8}= Electricity Distribution network	
				I_{P9}= Communication and IT network	
				I_{P10}= Road and Transportation network	
Socio–demography Resilience R_S	**W_S**	Understanding Risk, Awareness and Preparedness **R_{S1}**	**W_{S1}**	I_{S1} = Level of people's awareness and sensitivity	
				I_{S2} = People preparedness and response to disaster and emergencies	
		Human Development Components **R_{S2}**	**W_{S2}**	I_{S3} = People trust on laws, officials and experts	
				I_{S4} = Level of health	
				I_{S5} = Level of education and training	
				I_{S6} = Age	
				I_{S7} = Social welfare and people's hope to life	
				I_{S8} = Migration (Daily, Monthly and Seasonal)	
		Social Contribution **R_{S3}**	**W_{S3}**	I_{S9} = Collaboration and Partnership	
				I_{S10} = Existence and activities of related NGOs	
				I_{S11} = Participation in community activities/drill	
		Human Vulnerability **R_{S4}**	**W_{S4}**	I_{S12} = Population vulnerability to disasters	
				I_{S13} = Population density	
Economic Resilience R_E	**W_E**	Economic Potential/Resources **R_{E1}**	**W_{E1}**	I_{E1} = Financial capacity to implement policies and responding to the effects of the crisis	
				I_{E2} = Ability to physical and economic recovery and reconstruction	
				I_{E3} = Job	
		Income **R_{E2}**	**W_{E2}**	I_{E4} = Economic welfare	
				I_{E5} = GDP and Income per capita	
Governance Management, Institutional and Legal Resilience R_M	**W_M**	Governance and Legal Capacities of City= **R_{M1}**	**W_{M1}**	I_{M1} = Existence of DRM and DRR related regulation	
				I_{M2} = Enforcement and Implementation of laws,...	
				I_{M3} = Existence of DRM system & Institution	
		Emergency Management **R_{M2}**	**W_{M2}**	I_{M4} = Early warning systems	
				I_{M5} =Capacity and ability to disaster response	
				I_{M6} =Capacity and ability to Recovery & Recons	

III.2 Components of the Resilience Indicator System

The following criteria play an important role to urban resilience:

1. Urban structure and setting resilience: One of the sectors that play an important role in increasing the resilience of the city is urban shape. This important factor has been considered as the “urban structure and setting resilience”. In fact, the first sector of the proposed resilience indicator system looks at the general structure of a city from urban design and setting; considering the development of the city and its level of compatibility to the distribution seismic hazard as well. Thus, a city with a development plan and also compatible construction with the level of hazard, can be more ready for incoming disasters. Meanwhile, the provision of wide traffic lifelines and appropriate accessibility to open and safe spaces, would facilitate recovery process after occurrence of an earthquake.
2. Physical resilience which contains buildings and infrastructures. The existence of earthquake resistant buildings is a vital need to reduce the destructiveness effects of seismic events and infrastructures play a supportive role in pre, during and post disaster activities. In order to cover all aspects related to the infrastructures, this part has been divided into two different parts, namely: “disaster management related infrastructures” and “urban infrastructure”. The reason behind such division is to make a distinction between available infrastructures in terms of their functionality. The disaster management related infrastructures have been proposed in the sector of physical resilience to investigate the structures and facilities owned by the responsible organizations for disaster management and emergency response. The urban infrastructure is composed of the five basic facilities in a city that shall operate well in abnormal situations. The thematic area of “buildings” is one of the most critical part of the indicator system, because lots of the post event activities may not be necessary in case of having earthquake resistant buildings. Therefore, this section has been provided to assess vulnerability and the type of utility as two most affecting factors on the physical resilience.
3. Socio-human components of a city which has been widely emphasized as a priority for action in Sendai framework for disaster risk reduction. A city with aware and sensitive people to hazards will be more ready for confronting an earthquake in order to reduce the possible consequences. Developed cities with high quality lifestyle are more resilient against natural hazards, especially, earthquakes. So, the development index is added to the indicator system. Social contribution assesses the social connectivity and group activities of different communities in a city; hence, it considers the cooperation of them within a city as well as the level of citizens in terms of required skill and training for facing natural hazards. The last thematic area of this sector elaborates on the vulnerability of the people and the population density as one of the most important indicators in the context of socio-human resilience.
4. Economic resilience, which contains economic potential and income as two thematic areas. Economic capacity plays an important role in the pre and post disasters activities; thus, financial capability for the implementation of policies and effective recovery has been considered for the first thematic area as well as the ability to create jobs. A community with higher financial welfare will respond better to disasters and it can bounce back earlier to the original situation.

5. Managerial, institutional and legal resilience that is composed of a thematic area for existence and enforcement of laws, while another thematic area deals with management of emergency situation. The existence and enforcement of laws is a necessity for a resilient city and lack of them, results in poor performance in legal and managerial sectors. Early warning systems are considered to be in this sectors, because they are a kind of preventive tools can reduce both the primary and secondary impacts of an earthquake. During a disaster, it is vital to establish an organized process in order to deliver essential assistance to vulnerable people. So, an indicator is provided to quantify that.

Table III-2 Proposed weighting factor Scales

Value	Description
0.2	There is very little awareness about the importance of the indicator among officials and stakeholders, so, any special effort has not made to promote the value of the indicator in the city. Different parts of the city are not ready in the domain of the indicator and high level of vulnerability as well as low level of resilience can be seen.
0.4	The relative importance of the indicator is somewhat perceived by citizens and officials, therefore, some efforts have been done to improve it, but, those are not enough. A safe performance of the city against an earthquake is not expected.
0.6	The importance of the resilience indicator has been determined, but the mechanisms and procedures to attain high resilience level have not been fully established yet. The functional level of the city against natural disasters is in a medium level and plenty of preventive tasks in order to reduce the impacts of an earthquake are required.
0.8	The importance of the indicator has largely been determined, but the implementation procedures have not been fully developed. An acceptable performance of the city against an earthquake is expected, but this performance can be improved to achieve ultimate goal of a resilient city.
1	The importance of the indicator has been fully determined by citizens, officials and decision makers. Illustrative procedures have been conducted to attain the best level of the indicator and there is a full integration between the responsible organizations to do their duties. It should be noted that although the city is resilient, further effort is required to achieve higher level of safety and resilience.

III.3 Resilience AHP Questionnaire

AHP (Analytical Hierarchy Process) is a type of empirical methods that are developed based on the expert judgment. It can prioritize alternatives by making pairwise comparison via expert opinions. AHP illustrates the privilege of each options by every decision maker and displays the most important alternative as well. It is better to extend the number of interviews to cover a variety of opinions from almost all individuals from relevant expertise in Bangladesh. Based on the AHP method, there is a comparative scale between two items which should be prioritized by expert opinions in a scale among 1 (equal importance) to 9 (full superiority). The standard AHP questionnaire has been designed as table 3. The questionnaire is used for weight assigning to each indicator and thematic area as well as resilience sector. When all the expert opinions have been gathered, the eigenvector for each matrix should be calculated to assign a weight to each indicator. By conducting an AHP method the relative importance of each indicator, thematic area and sector would be available and this weight factor can be utilized for urban resilience quantification or decision-making process. The

pairwise comparison is used to express the importance of one element to another. The AHP questionnaire explanation is as follow:

Table III-3 AHP Score Comparison Scales

Explanation	Numeric Value
If option A and option B are equally important: mark →	1
If option A is moderately more important than option B: mark →	3
If option A is strongly more important than option B: mark →	5
If option A is very strongly more important than option B: mark →	7
If option A is extremely more important than option B: mark →	9

Given Options A and B you can judge their relative importance as shown below example:

Table III-4 Example of How to Complete the AHP Forms

Options A	Extremely	Very Strongly	Strongly	Moderately	Equally	Moderately	Strongly	Very Strongly	Extremely	Options B
Governance and Legal Capacities of City	9	✓	5	3	1	3	5	7	9	Emergency Management
Buildings	9	7	5	3	1	3	✓	7	9	Urban infrastructures

Table III-5 AHP Questionnaire for Resilience Indicator System

Sector 1: Urban Setting and land use Resilience										
Thematic Area 1: Risk Sensitive Urban Development										
Compatibility of Development and Construction with Hazard Level	9	7	5	3	1	3	5	7	9	Comprehensive Urban Development Plan

Thematic Area 2: Form and Overall Structure of the City										
Buildings Height Vs. Street Width	9	7	5	3	1	3	5	7	9	Building Access to Outdoor
Buildings Height Vs. Street Width	9	7	5	3	1	3	5	7	9	Availability of Open Space, Parks
Buildings Height Vs. Street Width	9	7	5	3	1	3	5	7	9	City Pattern or Texture
Buildings Height Vs. Street Width	9	7	5	3	1	3	5	7	9	Time-Worn Urban Textures
Building Access to Outdoor	9	7	5	3	1	3	5	7	9	Availability of Open Space, Parks
Building Access to Outdoor	9	7	5	3	1	3	5	7	9	City Pattern or Texture
Building Access to Outdoor	9	7	5	3	1	3	5	7	9	Time-Worn Urban Textures
Availability of Open Space, Parks	9	7	5	3	1	3	5	7	9	City Pattern or Texture
Availability of Open Space, Parks	9	7	5	3	1	3	5	7	9	Time-Worn Urban Textures
City Pattern or Texture	9	7	5	3	1	3	5	7	9	Time-Worn Urban Textures

Comparison Between Thematic Areas 1 and 2										
Risk Sensitive Urban Development	9	7	5	3	1	3	5	7	9	Form and Overall Structure of the City
Sector 2: Physical Resilience										

Thematic Area 3: Buildings										
Structural Vulnerability	9	7	5	3	1	3	5	7	9	Usage

Thematic Area 4: Required Infrastructures for DRM Response										
Fire Stations	9	7	5	3	1	3	5	7	9	Hospitals
Fire Stations	9	7	5	3	1	3	5	7	9	Rescuers Access
Hospitals	9	7	5	3	1	3	5	7	9	Rescuers Access

Thematic Area 5: Urban lifeline and Infrastructures										
Water Distribution Network	9	7	5	3	1	3	5	7	9	Gas Distribution Network
Water Distribution Network	9	7	5	3	1	3	5	7	9	Electricity Distribution Network
Water Distribution Network	9	7	5	3	1	3	5	7	9	Communication and IT Network
Water Distribution Network	9	7	5	3	1	3	5	7	9	Road and Transportation Network
Gas Distribution Network	9	7	5	3	1	3	5	7	9	Electricity Distribution Network
Gas Distribution Network	9	7	5	3	1	3	5	7	9	Communication and IT Network
Gas Distribution Network	9	7	5	3	1	3	5	7	9	Road and Transportation Network
Electricity Distribution Network	9	7	5	3	1	3	5	7	9	Communication and IT Network
Electricity Distribution Network	9	7	5	3	1	3	5	7	9	Road and Transportation Network
Communication and IT Network	9	7	5	3	1	3	5	7	9	Road and Transportation Network

Comparison Among Thematic Areas 3, 4 and 5										
Buildings	9	7	5	3	1	3	5	7	9	Required Infrastructures for DRM Response
Buildings	9	7	5	3	1	3	5	7	9	Urban lifeline and Infrastructures
Required Infrastructures for DRM Response	9	7	5	3	1	3	5	7	9	Urban lifeline and Infrastructures

Sector 3: Socio-Demography Resilience										
Thematic Area 6: Understanding Risk, Awareness and Preparedness										
Level of People's Awareness and Sensitivity	9	7	5	3	1	3	5	7	9	People Preparedness and Response to Disaster and Emergencies

Thematic Area 7: Human Development Components										
People Trust on Laws, Officials and Experts	9	7	5	3	1	3	5	7	9	Level of Health
People Trust on Laws, Officials and Experts	9	7	5	3	1	3	5	7	9	Level of Education And Training
People Trust on Laws, Officials and Experts	9	7	5	3	1	3	5	7	9	Age
People Trust on Laws, Officials and Experts	9	7	5	3	1	3	5	7	9	Social Welfare, and People's hope to life
People Trust on Laws, Officials and Experts	9	7	5	3	1	3	5	7	9	Migration (Daily, Monthly and Seasonal)
Level of Health	9	7	5	3	1	3	5	7	9	Level of Education And Training
Level of Health	9	7	5	3	1	3	5	7	9	Age
Level of Health	9	7	5	3	1	3	5	7	9	Social Welfare and People's hope to life
Level of Health	9	7	5	3	1	3	5	7	9	Migration (Daily, Monthly and Seasonal)
Level of Education And Training	9	7	5	3	1	3	5	7	9	Age
Level of Education And Training	9	7	5	3	1	3	5	7	9	Social Welfare and People's hope to life
Level of Education And Training	9	7	5	3	1	3	5	7	9	Migration (Daily, Monthly and Seasonal)
Age	9	7	5	3	1	3	5	7	9	Social Welfare and People's hope to life
Age	9	7	5	3	1	3	5	7	9	Migration (Daily, Monthly and Seasonal)
Social Welfare and People's hope to life	9	7	5	3	1	3	5	7	9	Migration (Daily, Monthly and Seasonal)

Thematic Area 8: Social Contribution										
Collaboration and Partnership	9	7	5	3	1	3	5	7	9	Existence and Activities of Related NGOs
Collaboration and Partnership	9	7	5	3	1	3	5	7	9	Participation in Community Activities/Drills
Existence and Activities of Related NGOs	9	7	5	3	1	3	5	7	9	Participation in Community Activities/Drills

Thematic Area 9: Human Vulnerability										
Population Vulnerability to Disasters	9	7	5	3	1	3	5	7	9	Population Density

Comparison Among Thematic Areas 6, 7, 8 and 9										
Understanding Risk, Awareness and Preparedness	9	7	5	3	1	3	5	7	9	Human Development Components
Understanding Risk, Awareness and Preparedness	9	7	5	3	1	3	5	7	9	Social Contribution
Understanding Risk, Awareness and Preparedness	9	7	5	3	1	3	5	7	9	Human Vulnerability
Human Development Components	9	7	5	3	1	3	5	7	9	Social Contribution
Human Development Components	9	7	5	3	1	3	5	7	9	Human Vulnerability
Social Contribution	9	7	5	3	1	3	5	7	9	Human Vulnerability

Sector 4: Economic Resilience										
Thematic Area 10: Economic Potential/Resources										
Financial Capacity to Implement Policies and Responding to the Effects of the Crisis	9	7	5	3	1	3	5	7	9	Ability to Physical and Economic Recovery and Reconstruction
Financial Capacity to Implement Policies and Responding to the Effects of the Crisis	9	7	5	3	1	3	5	7	9	Job
Ability to Physical and Economic Recovery and Reconstruction	9	7	5	3	1	3	5	7	9	Job

Thematic Area 11: Income										
Economic Welfare	9	7	5	3	1	3	5	7	9	GDP and Income per capita

Comparison Between Thematic Areas 10 and 11										
Economic potential/Resources	9	7	5	3	1	3	5	7	9	Income

Sector 5: Governance, Management, Institutional and Legal Resilience										
Thematic Area 12: Governance and Legal Capacities of City										
Existence of DRM and DRR Related Regulations	9	7	5	3	1	3	5	7	9	Enforcement and Implementation of Laws
Existence of DRM and DRR Related Regulations	9	7	5	3	1	3	5	7	9	Existence of DRM System and Institution
Enforcement and Implementation of Laws	9	7	5	3	1	3	5	7	9	Existence of DRM System and Institution

Thematic Area 13: Emergency Management										
Early Warning Systems	9	7	5	3	1	3	5	7	9	Capacity and Ability to Disaster Response
Early Warning Systems	9	7	5	3	1	3	5	7	9	Capacity and Ability to Recovery and Reconstruction
Capacity and Ability to Disaster Response	9	7	5	3	1	3	5	7	9	Capacity and Ability to Recovery and Reconstruction

Comparison Between Thematic Areas 12 and 13										
Governance and Legal Capacities of City	9	7	5	3	1	3	5	7	9	Emergency Management

Comparison Among Different Sectors 1 to 5 of Urban Resilience										
Urban Setting and Land Use Resilience	9	7	5	3	1	3	5	7	9	Physical Resilience
Urban Setting and Land Use Resilience	9	7	5	3	1	3	5	7	9	Socio – Demography Resilience
Urban Setting and Land Use Resilience	9	7	5	3	1	3	5	7	9	Economic Resilience
Urban Setting and Land Use Resilience	9	7	5	3	1	3	5	7	9	Governance, Management, Institutional and Legal Resilience
Physical Resilience	9	7	5	3	1	3	5	7	9	Socio – Demography Resilience
Physical Resilience	9	7	5	3	1	3	5	7	9	Economic Resilience
Physical Resilience	9	7	5	3	1	3	5	7	9	Governance, Management, Institutional and Legal Resilience
Socio – Demography Resilience	9	7	5	3	1	3	5	7	9	Economic Resilience
Socio – Demography Resilience	9	7	5	3	1	3	5	7	9	Governance, Management, Institutional and Legal Resilience
Economic Resilience	9	7	5	3	1	3	5	7	9	Governance, Management, Institutional and Legal Resilience

IV. Appendix IV: Stake Holder Meetings

IV.1 Meeting with DG of DDM-MoMDR

Stakeholder meeting were held on 26th of February 2020 with the Director General of Department of Disaster Management (DDM), Mr. Md. Mohsin and other officials of DDM and 20 of DDM experts; with the presence of Mr. Arif Abdullah Khan, Mr. Kamal Hossain and Mr. Palash Mon from UNDP-NRP.

The DG of DDM expressed the strong will of the GoB for having an effective and prepared DRM, and what they expect from NRP and this gap analysis.

The Consultant presented: 1) An overview on the existing Bangladesh DRM systems, 2) Situation analysis of GoB DRM, 3) Gap Analysis; 4) Strategy toward improving the present situation and fill the existing gap; and finally 5) 10 key Recommendations that are essential and are complementary for Safe and Resilience Bangladesh.

The DG-DDM expressed his appreciation and emphasized that the recommendation should be implementable and compatible with the local condition of Bangladesh.

IV.2 Stakeholder Meeting with Rangpur Mayor

IV.2.1 Meeting at Rangpur City Corporation

Stakeholder meeting were held on 8th of March 2020 with the Mayor of Rangpur City Corporation, Mr. Mostafizar Rahman and 20 of Rangpur City Corporation official; with the presence of Mr. Palash Mondal from UNDP-NRP.

The Mayor presented the city programs and activities for DRM, improving building quality, city corporation structure, building permits, high vulnerability and risk of Rangapur; as well as their challenges for improving disaster response with the limited technical, human and financial resources. He further stated that:

1. 30-year master plan of Rangpur has been developed with the objective of achieving planned, safe and clean city. The approval and adaptation is pending by the Ministry of Local Government. This situation creates an environment for improper and vulnerable development of the city.
2. No Rangpur master plan, no suitable organogram, no technical engineer, no tools to monitor BNBC implementation.
3. City Corporation does not have enough technical staff to approve the design and monitor the building code implementation. In other word, the code enforcement by the existing technical capacity is impossible.
4. Mayor has limited authority to create coordination between all stakeholders in the city
5. Based on the SOD, Mayor is the commander of the disaster response. But other do not obey the rule and coordinator role of the Mayor.
6. The university civil engineering curriculum are not compatible with the need of the city.
7. The earthquake risk in Rangpur has become so complex and Mayor cannot do much to either avoid the risk, or reduce the risk. We need integration, coordination, cooperation and working together in order to reduce the risk.

The Consultant presented his finding on the present situation of DRM systems in Bangladesh and his overall assessment of Rangpur vulnerability to earthquake. He further explained that each city requires special tailored risk reduction and disaster response plan of actions which are compatible with the socio-economic and cultural condition of the people; as well as we should learn from world experience and built own capacity. The high importance for local engineering capacity building to avoid the risk and put a stop on bad construction. Every bad construction increases the dependency of the city to the post disaster response. Finally, the consultant discussed the ten key Recommendations that are essential and are complementary for Safe and Resilience Bangladesh; and asked the Mayor's comments and view. The Mayor said that he thinks these are the most important actions that are needed to be done and addresses the key issues in Bangladesh.

IV.2.2 Meeting at Rangpur with Government Official

Mr. Akhtar Jamal, Director of DDM of Rangpur Government office stated the following points: The city follows the SOD 2019 guidelines for DRM in Rangpur, and has implemented its recommendation to best it could be done with limited technical, human and financial resources:

1. Main disasters in Rangpur are: Fire, Flood, Cyclone and Earthquake.

2. 2 to 5 fires occur per day. Due to limited capacity to cope with fire, usually the fire service arrives after the fire is over. Fires can be easily reduced through education.
3. Flood: Usually 15 days before flood season, people are warned to evacuate the flood hazard zone. City has 22 shelters, 6 boats, 500 tents and limited food supply. For a city of one million, the available supply is very limited.
4. Earthquake: Considering that city has not experienced any large earthquake, we are not prepared for earthquake. CDMP recommendation for Rangpur has not been implemented and it is only on the paper. Best way is to protect the building, and our building are not safe for earthquake.
5. Hospitals are not prepared for earthquake and are totally unaware of the earthquake disaster impact on the medical system. Moreover; most of the hospitals are located in one area of the city. Based on the overall assessment of the visited public and private hospital; the consultant found that hospital are at high risk and the are not expected to remain functional after the mid-intensity earthquake. The city is very religious and religious incentive is very helpful toward people awareness.

He believes the following actions need to be taken to improve the safety of city against earthquake disasters:

1. Government should inform the people about their risk
2. Develop and implement a realistic contingency plan based on the vulnerability and expected losses. Building need to be safe and design good. Code violation is a major issues and it needs to be stopped.
3. Our information about the soil condition is very low. No geotechnical issues are considered for the building construction
4. Very limited expert engineering is available to design and construct seismically safe building.
5. City needs to build its technical capacity both for purpose of code enforcement and code implementation.

Observation: The consultant overall assessment from his interview with government official, is that existing DRM understanding and response in Rangpur is far from the existing policies and regulations. DRM is not a priority in Rangpur.

IV.2.3 Visiting Rangpur Fire Service and Civil Defence

The Rangpur Fire Service and Civil Defence building and all type their facilities and equipment were visited and based on the discussion with the FSCD Chief and staff, their capacity to response to disaster has been evaluated. The most important challenge is the existence of only one FSCD for the whole city of around one million population. With the consideration of incompatibility of the existing capacity, narrow road, heavy traffic, and unsafe buildings; their response is limited to clean up the situation after the fires finishes. Unless the fire occur near the FSCD station, they cannot extinguished the fire in a way that prevent major losses.

IV.2.4 DRM Program at University

Meeting was held with Prof. Emdadul Haque from Bezum Rokeya University in Rangpur (only DRM faculty in Rangpur) to understand his perspective on the existing natural hazard risk in Bangladesh. The main threatening disasters in Rangpur are: Flood, Drought, Tornado, Fire and

cyclone which occurs on yearly basis. Even-though, he did not feel earthquake is a major treat and have not experience any major shaking; but we need to make the building safe, public should become more concern and aware, and more important invest on technical capacity building. He under CDMP project, has established DRM program at his university.

Upon his request, I attended his DRM class, and shared some part of my finding that has been outlined in this report with his students. It was interesting that students with lots of positive energy and hope for future, were concerned about the natural disaster risk in their country. They knew what are the basic actions that need to be done; but they felt there is no infrastructure that their thought could be implemented. They thought the biggest challenges toward risk reduction is the risk governance. The most parameters that made their city vulnerable are poor governance, low code and regulatory enforcement, low capacity and building violations.

Finally, the following points are Prof. Haque view on the DRM challenges in Bangladesh:

1. All policies and rule do not cover the same messages, they are contradictory and lots of duplications without an infrastructure for its implementation.
2. No cooperative or integrated research. They are mainly done in Dhaka and no support is provided for small universities or institutions outside Dhaka.
3. No awareness on rules and regulations. Most government officials do not know what technical capacity they need and what should be done technically.
4. Bangladesh tries to follow other countries. They need to define their own issues and try to find local solutions.
5. We need Bangladesh model of development and we need to have an integrated master DRR plan.


Meeting with Mayor and City Officials
Meeting and Visiting FSCD Operation
Meeting with DM
Responsible Officer
Visiting University and Talking with DRM Students

IV.3 NRP Stakeholders Consultation Meeting

On 3rd of March 2020, a meeting was held with DRM experts from BUET, Dhaka University, UN agencies, and JICA to discuss the finding of the studies.

The Consultant presented: 1) An overview on the existing Bangladesh DRM systems, 2) Situation analysis of GoB DRM, 3) Gap Analysis; 4) Strategy toward improving the present situation and fill the existing gap; and finally 5) detail description of the 10 key Recommendations that are essential and are complementary for Seismically Safe Bangladesh.

All of the attendee expressed their appreciation and found the recommendation very useful and highly needed. The consultant appreciated the valuable comments and the information that was provided during the meeting. Prof. Raquib from BUET said he has 100% agreement to all of recommendation and advised the UNDP for its implementation. Prof. Sakhavat and Zillur Rahman from Dhaka University emphasized the need for institutional capacity building. Mr. Chowdhury from JICA provided the JICA related activities.

IV.4 List of the Consulted Experts

No.	Name of the Experts	Organization
1	Mr. Arif Abdullah Khan	UNDP
2	Mr. Kamal Hossain	NRP, UNDP
3	Mr. Palash Mondal	NRP, UNDP
4	Ms. Saudia Anwe	UNDP
5	Ms. Tahmina Tamanna	UNDP
6	Prof. Raquib Ahsan	BUET
7	Prof. Zillur Rahman	Dhaka University
8	Prof. Hossain Sekhavat	Dhaka University
9	Prof. Taufique Utpal	UDD, MoHPW
10	Prof. Emdadul Haque	Bezum Rokeya University
11	Mr. Abdul Latif Helaly	RAJUK, PD of URP
12	Mr. Aminur	RAJUK, DPD of URP
13	Prof. M.R. Rahmani	URP-Urban Planner
14	Engr. A.T.M. Akhtaruzzaman	Rangpur District Relief and Rehabilitation
15	Prof. Mehdi Ansary	BUET
16	Mr. Mostafizar Rahman	Mayor of Rangpur City Corporation
17	Major General AbuSyeed Masud	Retired Army Corp of Engr.
18	Prof. Tawhid Islam	Dir., Inst. of Remote Sensing Jahangirnagar Univ.
19	Mr. Malik Kabir	WFB
20	Ms. Kazi Shahidur Rahman	Humanitarian Affair Specialist, UN Bangladesh
21	Mr. Md. Anisuzzaman Chowdhury	Program Manager, Social Develop Center, JICA
22	Mr. Md. AbuSadegh	Ex Director of HBRC
23	Mr. Rahman Shah	
24	Prof. Hassan Hamidul	CEO of Smart Development Engr., Dhaka
25	Dr. Mehmet Emin Akdogan	International Consultant for WB-URP
26	Mr. Shamaun Al.Noor	Urban Expert, URP-RSLUP
27	Mr. Abbas FathiAzar	Structural Engr., URP-RSLUP
28	Mr. Samrat	Structural Engr.
29	Mr. Shaber Ahmad Hossain	Geotechnical Engr., Islamic Univ. of Technology
30	Mr. Tauhidul Islam Akanda Tonmy	Geotechnical Engr.,
31	Mr. Saiful Alam	Independent Urban expert
32	Mr. Glenn Whaley	TL of URP, RTI, USA
33	Prof. Abdolreza Sarvghad Moghaddam	TL of S4, URP, Iran
34	Mr. Moinul Islam Majumder	ADC Engineering Consultant
35	Prof. Jahangir Alam	BUET
36	Mr. Akhtar Jamal	Rangpur City Corp, Urban Specialist
37	Engr. Samiul Islam	Project Manager,
38	Ms. Ismat Shorna	Business, URP
39	DRM Students	Bezum Rokeya University
40	Ms. Tasnia Rahman Chowdhury	Urban and GIS Engr., URP

V. Appendix V: About International Consultant: Prof. Mohsen Ghafory-Ashtiany

Professor Mohsen Ghafory-Ashtiany is the distinguished professor of earthquake engineering and risk management at International Institute of Earthquake Engineering and Seismology (IIEES), Associate member of Iran Academy of Science, Affiliate faculty of Va. Tech-GFURR, Chairman of BoD of SP Insurance Risk Management Institute (SPRMI); and have worked with UNESCO, UNDRR, UN-HABITAT, UNESCAP, UNDP, WB-GFDRR, WHO, Global Alliance of Disaster Risk Institutes (GADRI), International Institute of Applied System Analysis (IIASA) and Inter-Academy on risk and resilience. He has been appointed as the Team Leader for Dhaka Risk Sensitive Land-use Planning (WB-URP-RSLUP). He has been the founder of the IIEES in Iran in 1989 and was its president until 2007. He is the author of more than 300 papers, 5 books and 70 research reports in the field of random vibration, earthquake engineering, seismic hazard and risk analysis, risk management, urban resilience, and risk reduction policy development. He is Editor of Journal of Seismology and Earthquake Engineering; Co-editor of Integrated Disaster Risk Management (IDRiM) Journal, and member of Editorial Board of many other journals. He is founder and now President of Iranian Earthquake Engineering Association (IEEA), and a pioneer in Risk mitigation activities in Iran. He has served as member of Iran's Natural Disaster Prevention and Management Headquarter, Iran's Risk Reduction Commission, Iran Scientific Research Council, National Building Code Council, Risk Management Advisor of Iran Ministry of Energy, etc. He is also member of many scientific associations such as: International Association of Earthquake Engineering, European Earthquake Engineering, UNESCO Scientific Board of the International Geoscience Program, International Union of Geology and Geophysics-GEORisk, IUGG-IASPEI, ex-member of UNISDR-STC, ex-chairman of IASPE commission of SGM, Hazard and Risk, ex-director of World Seismic Safety Initiative, etc.

Finally, he has more than 35 years of professional experience in project management, program director, institutional building, policy development, at national and international levels.

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