

COMPARATIVE ANALYSIS OF DISASTER RISK MANAGEMENT PRACTICES IN SEVEN MEGACITIES

Jeannette Fernandez, Fouad Bendimerad, Shirley Mattingly, Jim Buika

ABSTRACT: The results of a comparative analysis of disaster risk management (DRM) practices in seven large cities in developing countries are presented. The cities are Metropolitan Manila, Mumbai and Kathmandu in Asia; Bogotá and Quito in the Americas; and Tehran and Istanbul in the Euro-Mediterranean region. The objective is to identify parameters of sound practice and assess impediments to the implementation of DRM in complex urban areas (i.e. megacities). Because they are most relevant to the city-level conditions, three thematic areas out of five suggested in the ISDR¹ approach were used in this study. These are: Political Commitment, Risk identification and Institutions, and Knowledge Management. The analysis shows that all seven cities have expended considerable effort in risk analysis, particularly earthquake risk. However, serious limitations in comprehensive DRM implementation in the other two areas were identified. The authors also offer alternatives drawn from existing practices collected through the implementation of the EMI's Cross-Cutting Capacity Development (3cd)² Program that can improve DRM efforts if adapted to specific needs and culture of the cities.

KEYWORDS: megacities; disaster risk management; sound practices; EMI; 3cd Program

1. INTRODUCTION

Population growth linked to rapid urbanization is one of the major concerns worldwide, particularly in developing countries. By year 2015³, twenty-nine cities in the world will have populations over 8 million. Ten of the world's 16 largest cities will be in developing countries in Asia, 5 in America and 1 in Africa. . The average size of the world's largest cities increased from 2.1 millions inhabitants in 1950 to 5.1 millions inhabitants in 1990. In developing countries, the number of cities with more than 1 million has increased six times since 1950; nine hundred of them will be in Asia in the next decade.

High population density, proximity and heterogeneity are some of the characteristics of these megacities, which pose serious challenges related to meeting the demands for collective urban services, keeping a sound natural environment, and reducing physical, social and institutional vulnerabilities. Other very specific challenges have to do with safety against natural and man made hazards.

The expansion of cities to accommodate rapid population increase is largely unplanned and unaware of the increasing exposure to disaster risk. In a survey undertaken by EMI, informal construction and unplanned urbanization was listed as the number one concern of megacities managers⁴. For example, officials in Mumbai estimate the number of the city's inhabitants living in informal settlements to be between 50 and 60% of the total city population⁵. According to the 1991 census in Greater Mumbai, the demographic features observed showed 74% of the population living in slums⁶. Officials from Quito estimate 60% of the total buildings built without municipal permits⁷.

The management and reduction of disaster risk in megacities has notoriously been neglected. Megacities disaster risk management has not been addressed in the past for a number of reasons,

including the complexity of their risks, their policy-setting environment, and an erroneous assumption that large cities have the capacity to address risk on their own. If action is taken at all, megacities' policy makers tend to see their mandate and responsibility as limited solely to emergency response activities. This is a logical and understandable position, as most megacities in developing countries are struggling with the lack of resources and vital demands from their citizenry. Current legal and institutional arrangements typically inhibit local action, despite decentralization processes being initiated in most countries.

In the recent years, the Earthquakes and Megacities Initiative, **EMI**¹, has undertaken concrete actions to address disaster risk management in megacities and other complex urban centers. The EMI's Cluster Cities Project (**CCP**) brings together a formal and active partnership of local governments of 20 megacities grouped in five regional clusters. The Cross-Cutting Capacity Development Program (**3cd Program**) builds on six years of experience of the CCP Project, it works one-on-one with megacities' institutions and other stakeholders in helping them integrate disaster risk reduction within their development planning and in sustainability mechanisms. Both directly address the integration of disaster risk reduction within sustainable development policies and practice.

2. BACKGROUND

2.1. The 3cd Program

The goal of the 3cd Program is to develop sound practices and policies focused on the complexities of these mega environments, through researching existing disaster risk management knowledge, practices and implementation mechanisms in the world's megacities.

The 3cd Program has four major components: **Component 1** helps the research team setting the context in each city; it focuses on understanding how disaster risk management is organized and delivered, including sound practices to be shared with others. Field investigation and literature search are used to identify gaps, needs and impediments to risk reduction and to document City Profiles and Sound Practices. **Component 2** ensures knowledge building, capacity development, institutional strengthening, and sustainability to support the implementation of a DRMMP. **Component 3** incorporates disaster risk assessment and effective options for risk communication to decision makers, planners, educators, community leaders, and the general public. **Component 4** is centered on providing technical and logistical support to develop and implement a consensus DRMMP in the city.

This paper is based on the information collected in seven megacities integrating the EMI network, as part of the specific activities undertaken under component 1 which leads to one of the major

¹ EMI is an international not for profit scientific NGO dedicated to reducing human, economic and environmental losses from earthquakes and other disasters in large cities around the world, for more information see www.earthquakesandmegacities.org

outputs of the 3rd Program, the Megacity Disaster Risk Management Knowledge Base (MDRM-KB).

2.2. ISDR's draft framework for disaster risk reduction

Recently, several organizations and researchers have focused their interest in developing standardized tools to assist governments and related stakeholders in understanding, guiding, monitoring and setting some kind of indicators and benchmarks for disaster risk reduction, among them Mattingly (2004)⁸, Cardona (2004)⁹, Mitchell (2003)¹⁰ and other organizations such as the UNDP and the World Bank.

The World Conference on Disaster Reduction held in January 2005 in Kobe, Hyogo-Japan, adopted a "Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters" commonly known as the Hyogo Framework for Action - HFA¹¹. This framework incorporates five thematic areas that set an initial core of principles and goals, each one of them comprising several key components that need to be looked at. The five priorities for action are:

1. **Political Commitment and Institutional Development (Governance)**, to ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.
2. **Risk Identification**, to identify, assess and monitor disaster risks and enhance early warning.
3. **Knowledge Management** including use of knowledge, innovation and education to build a culture of safety and resilience at all levels.
4. **Risk Management Applications** to reduce the underlying risk factors, and
5. **Preparedness and Emergency Management**, to strengthen disaster preparedness for effective response at all levels

Three priorities for action out of the five proposed as very relevant for a comprehensive DRM process and implementation were considered in this study. First, Political Commitment and Institutional Development, second, Risk Identification, and finally, Knowledge Management. For each one of these three priorities for action, the methodology has identified key activities which are summarized on tables 1 to 3 in this paper.

3. DATA COLLECTION AND ANALYSIS

The information was collected in each of the cities via a survey and interviews of local officials and other stakeholders. The objective was to identify parameters of sound practice and also impediments to the implementation of DRM in complex urban areas.

Through the survey the research team attempted to identify how cities are organized and which is their relationship with the national government and other local government units. What is in place to facilitate risk reduction actions, in terms of laws, regulations, institutions, resources? What is impeding effective DRM; is it the lack of resources, and which Sound Practices are available? All the information collected has been integrated in an electronic disaster risk management knowledge base system that utilizes the internet platform to provide access to

different interested parties to the DRM city profiles, Sound Practices, a DRM specialized library and a contact directory in each one of the participating cities.

The information collected was then translated to three disaster risk management matrixes, one for each one of the thematic areas, its components and the seven selected cities. In addition, a fourth matrix was constructed based on what city managers have identified as the major issues or roadblocks for a more effective risk reduction strategy.

A specific table to describe the characteristics of the three priority areas for action included in this report and its respective key components have been reproduced from the UN/ISDR 2004 publication, *Living with Risk* and are used in the comparative charts for the seven cities included in this report.

3.1. Political Commitment and Institutional Development

Good governance is seen in the ISDR framework as a key area to promote sustained risk reduction efforts. If local governments and municipalities can count on appropriate legal frameworks that embrace options for prevention and mitigation; if a strong organizational structure is set with appropriate staff and resources for DRM delivery; and if the integration of all the stakeholders in the cities, such as the scientific and the private sector, the civil society and other sectors of the economy is promoted, then prospects for a greater capacity to handle risks are increased. Table I includes a suggested list of key activities to progressively ensure that disaster risk reduction is a priority that counts on a strong institutional bases for implementation.

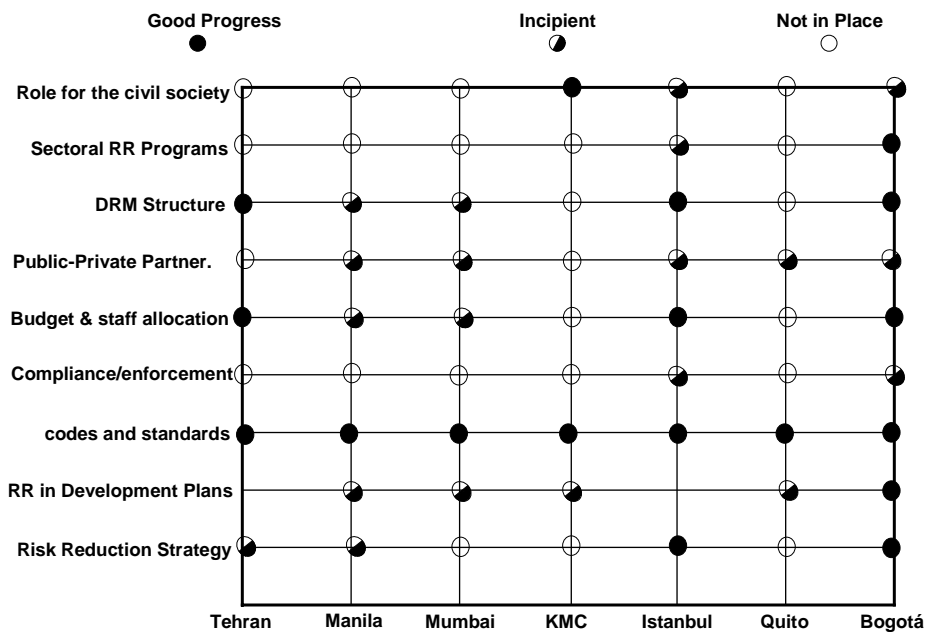
Table I. A framework to guide and monitor Disaster Risk Reduction
Thematic area 1: Political Commitment and Institutional Development (Governance)
 Source¹²: ISDR (2004), *Living with Risk*, A global review of disaster reduction initiatives

Thematic areas/ Components	Characteristics	Criteria for benchmarks (adapted to megacities context)
Policy and planning	<ul style="list-style-type: none"> • Risk reduction as a policy priority • Risk reduction incorporated into post disaster reconstruction • Integration of risk reduction in development planning and sectoral policies (poverty eradication, social protection, sustainable development, climate change adaptation, desertification, energy, natural resource management, etc) 	<ul style="list-style-type: none"> • Megacity wide risk reduction strategy • Disaster reduction in poverty reduction strategy papers • Participation in regional and international activities, programmes, networks and structures (including major conventions)
Legal and regulatory framework	<ul style="list-style-type: none"> • Laws, acts and regulations • Codes, standards • Compliance and enforcement • Accountability 	<ul style="list-style-type: none"> • Requirement of compliance by law • Existence and update of codes and standards • Existence of systems to ensure compliance and enforcement
Resources	<ul style="list-style-type: none"> • Resource mobilization and allocation: financial (innovative and alternative funding, taxes, incentives), human, technical, material 	<ul style="list-style-type: none"> • Evidence of budget allocation • Staffing allocation • Public-private partnerships

Organizational structures	<ul style="list-style-type: none"> • Interministerial, multidisciplinary & multisectoral approaches • Implementing and coordinating mechanisms • Decentralization, civil society and community participation, local institutions 	<ul style="list-style-type: none"> • Existence of an administrative structure responsible for disaster reduction • Sectoral Programs • Consultation with and role for civil society, NGOs, private sector and communities • Existence of ‘watchdog’ groups
---------------------------	---	--

Figure 1 summarizes the results of the survey undertaken in the seven megacities related to the existing organization, political commitment and its legal and institutional support. The availability of a risk reduction strategy for the city and how risk reduction concepts have been introduced or not in current development plans are investigated to better understand policy and planning perspectives. How is the DRM legal and regulatory systems working, if there are available building/construction codes and standards and the mechanisms for its enforcement and compliance are some of the important aspects considered. The availability of human and financial resources to keep risk reduction activities in the agenda and what is the organizational structure supporting these process, are also examined.

Figure 1. Summary of current DRM status in seven megacities
Thematic area 1: Political Commitment and Institutional Development



Five of the seven cities investigated count on newly developed plans that lay down a more comprehensive approach to DRM, most of them produced in partnership with international research organizations. Actually four of them have been produced with the assistance of the Government of Japan through its International Cooperation Agency (JICA), and they are Metropolitan Manila, Kathmandu, Istanbul and Tehran. In all the cases, the constitution of local advisory groups and the integration of other city stakeholders coming from the academia, the private sector, the NGOs and the community are observed. The so called “JICA studies” provide

the cities with a detailed study on hazards, vulnerabilities and a suite of earthquake scenarios useful for planning and emergency response purposes. In addition, mechanisms for institutional strengthening, capacity building, operation and coordination for disaster risk management are provided. The fifth city, Bogotá, has developed its own research program to put in place a city-wide risk reduction strategy. Funding has come mainly from the national and municipal governments, and some international cooperation agencies.

Despite the good quality of the available studies, the implementation phase has not been addressed with the same sense of urgency in all the cities. The perception that earthquakes are not so frequent, the daily demands of their constituencies for basic amenities provision and limited human and economic resources have not provided enough incentives to city administrators to invest more in prevention and mitigation activities, thus a strong tradition that looks more into the response side still has to be surmounted. Risk reduction criteria have not been incorporated in the regular processes for urban land use and planning nor have they been introduced through sectoral development policies, or they are in its very preliminary stages.

If we look into their legal and regulatory framework, most of the cities count on rather old pieces of legislation that prevent them from having more dynamic settings which include complex and vertical structures with resources that are usually allocated only after the disaster has been declared. It is interesting to notice that most of these cities have undertaken decentralization processes or count on special status related to their metropolitan condition that allows them to put in place specific ordinances to deal with risk reduction, although apparently little has been done in this regard.

Figure 1 also shows the existence of construction codes, standards and regulations in every city part of this study, most of them reflecting state of the art literature. But the same figure shows that more than the 70% of this sample do not count on valid mechanisms to ensure compliance and code enforcement. This process requires decision-making, leadership, time, funding and particularly buy-in from end users in order to set up the appropriate machinery and overcome the natural resistance from the construction sector and building owners.

In regard to the organizational structure, only 3 of the 7 cities investigated have put in place a specific Disaster Risk Management System that counts on budgetary funding and enough human resources to undertake the challenge of reducing risk in the cities. Bogotá counts on the Metropolitan System for Prevention and Emergency Attention (DPA) under the local government and headed by the mayor of the city. The Istanbul Metropolitan Municipality recently established its Disaster Coordination Center (AKOM) to improve preparedness and look for mitigation and prevention options. Finally, the municipality of Tehran established in 2003 the Disaster Mitigation and Management Center (TDMMC) which falls under the direct control and guidance of the city's mayor; despite its broad mandate, its vision is still very response focused.

Quito, Kathmandu and Mumbai count on small offices under one of the line departments of the municipality, with limited personnel and resources allocation. In the case of Metro Manila, the Metro Manila Disaster Coordination Council (MMDCC) under the regional development authority (MMDA) coordinates disaster response activities for the Local DCCs in the 17 cities and municipalities comprising Metro Manila still has a strong focus on the emergency side.

The role of the civil society and building additional partnerships with the private sector has still a long way to go in most of the cities as can be drawn from Figure 1 which shows incipient efforts in this regard in most of the investigated cities.

3.2. Risk Identification and Assessment

Hazards, vulnerabilities and risk identification are the starting point for any disaster risk reduction process. This is an area that has been extensively developed by multi-disciplinary teams that include both the so called hard sciences and those more linked to the social and economic aspects. The possibility of monitoring and forecasting is also considered under this thematic area. By assessing losses in a systematic manner and keeping track of the social and economic impact of disasters, it will be easier to understand where changes for improvement are needed.

Table II shows the characteristics and criteria for benchmarking linked to the identification of risk and its assessment.

Table II. A framework to guide and monitor Disaster Risk Reduction
Thematic area 2: Risk Identification and Assessment
 Source: ISDR (2004), *Living with Risk, A global review of disaster reduction initiatives*

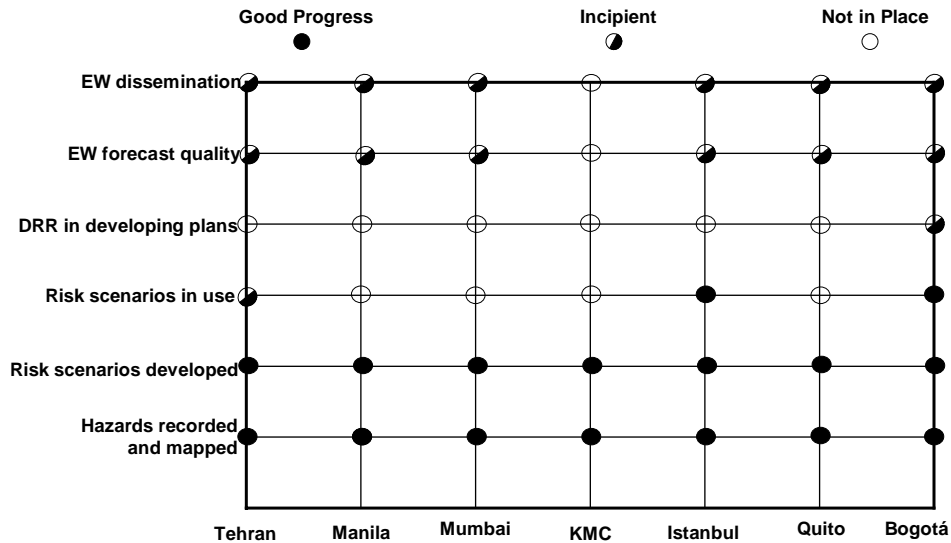
Thematic areas/ Components	Characteristics	Criteria for benchmarks (adapted to megacities context)
Risk assessment and data quality	<ul style="list-style-type: none"> • Hazard analysis: characteristics, impacts, historical and spatial distribution, multi-hazard assessments, hazard monitoring including of emerging hazards • Vulnerability and capacity assessment: social, economic, physical and environmental, political, cultural factors • Risk monitoring capabilities, risk maps, risk scenarios 	<ul style="list-style-type: none"> • Hazards recorded and mapped. Vulnerability and capacity indicators developed and systematically mapped and recorded. • Risk scenarios developed and used • Systematic assessment of disaster risks in development programming
Early warning systems	<ul style="list-style-type: none"> • Forecast and prediction • Warning processing and dissemination • Response 	<ul style="list-style-type: none"> • Use effectiveness indicators developed by IATF WG2 (to be available in October 2003)

Through the survey questionnaires, the seven megacities provided information about the level of understanding they have related to the hazards they phase, the socio-political and economic vulnerabilities identified and an overall knowledge of the associated risks through scenarios, maps and any other existing option. Also the availability of any early warning systems, its use and the involvement of the community were additional aspects explored.

Figure 2 attempts to summarize this information for each one of the selected cities. A brief analysis shows that six out of the seven cities investigated have conducted detailed seismic risk assessments and count on sophisticated GIS based maps to represent seismic damage scenarios, building inventory, soils with liquefaction potential, slope susceptibility maps and other elements that constitute important planning tools if used properly. The seventh city, Mumbai, used expert evaluation methods to combine seismic hazard and vulnerability assessment, mainly of the

building stock, to estimate expected levels of damage and numbers of casualties. Local efforts to produce these studies have been teamed up with international groups that provided technical and financial support and promoted capacity building and knowledge transfer as already describe in the preceding section.

Figure 2. Summary of current DRM status in seven megacities
Thematic area 2: Risk Identification and Assessment



Only two of the selected cities are making use of this information for planning purposes, retrofitting, urban renovation or legislation through specific ordinances that make use of sophisticated studies such as seismic microzonation. The cities of Istanbul and Bogotá are actually the ones leading these processes. The remaining cities are not making significant practical use of the recommendations of those state of the art studies, confirming the weak links between research and practice.

In most of the cases, the end users do not really know how to apply the results of the research or perceive the possibility of misuse or misinterpretation, thus limiting the information to a reduced circle of academicians and high level authorities. This way, valuable time to actually start taking some preventive actions is lost. Other causes for little implementation relates to the overwhelming need to take action in several fronts at the same time. Since most of these studies provide long lists of concrete action items, each one looking more important than the other, often times decision makers find themselves puzzled as to where to allocate scarce resources.

Initiatives like EMI and its 3cd Program can certainly facilitate a consensus-building process among different city stakeholders as to decide on a road map for implementation based on perceived priorities and resources availability, such as the process being undertaken in Metro Manila with the leadership of the Metropolitan Manila Development Authority (MMDA), the

Philippine Institute for Volcanology and Seismology (PHIVOLCS) and the three pilot cities, Quezon, Makati and Marikina.

Keeping track of natural or manmade hazards and their impacts is not part of the practice of any of the cities, cost-loss estimates are not done systematically, and there are no natural disaster observatories that could assist the cities with basic statistics to measure either improvement or setbacks. Three of the seven cities in the sample show a common interest in making use of software developed by LA RED called DESINVENTAR for a systematic disaster impact data collection. Perhaps this initiative could provide the foundation for a standardized process of data collection in megacities around the world.

Forecasting and early warning systems are not readily available tools for earthquakes; some important efforts have been done towards flooding and volcanic eruption in Metro Manila, Mumbai and Quito.

3.3. Knowledge Management

Improving and managing communication for risk reduction through capacity building at different levels and raising awareness or incorporating the community in information and dissemination campaigns can certainly impact the way people face an emergency, get prepared or better take a proactive role towards risk reduction.

Formal education for professionals and capacity building or training for other target groups are explored here as a means for disaster risk reduction.

Current mechanisms of knowledge transfer between researchers and end-users are too inefficient to adequately disseminate knowledge to policy-makers and practitioners and have kept knowledge limited to a few connoisseurs. Political will, community involvement and good technical capabilities to understand hazards and risk mitigation seem to be a better approach to reducing the impacts of natural disasters in the long run. A strong participation of the community, NGO's and the private sector, along with the use of appropriate and accessible technologies through non-expensive means such as the Internet or cellular phones, is a challenge still to be addressed.

**Table III. A framework to guide and monitor DRR
Thematic area 3: Knowledge Management**

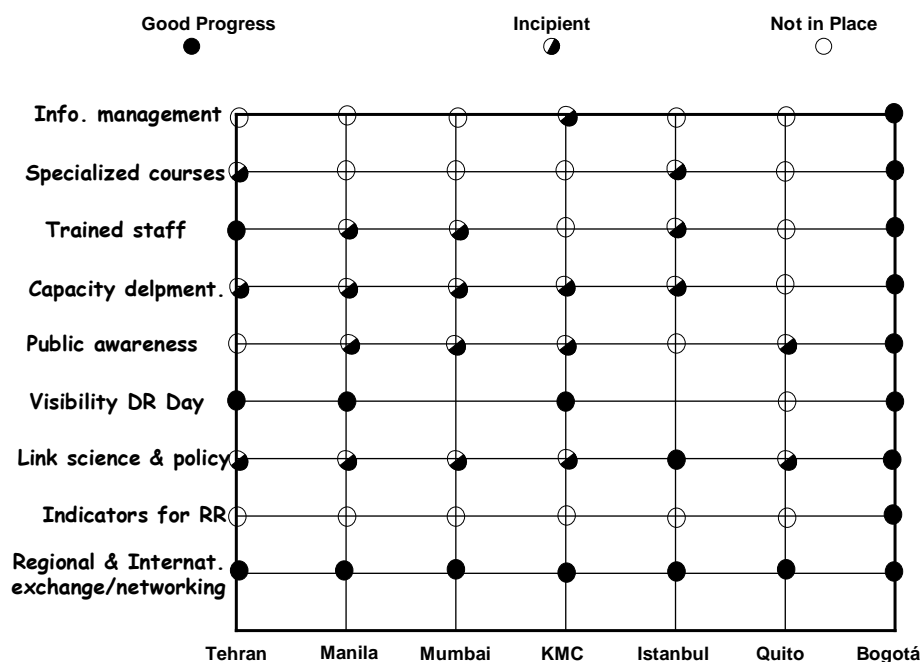
Source: ISDR (2004), *Living with Risk, A global review of disaster reduction initiatives*

Thematic areas/ Components	Characteristics	Criteria for benchmarks (adapted to megacities context)
Information management and communication	<ul style="list-style-type: none"> Information and dissemination programmes and channels Public and private information systems (including disaster, hazard and risk databases & websites) Networks for disaster risk management (scientific, technical and applied information, traditional knowledge) 	<ul style="list-style-type: none"> Documentation and databases on disasters Professionals and public networks Dissemination and use of traditional /local knowledge and practice Resource centres and networks, in particular education facilities

Education and training	<ul style="list-style-type: none"> • Inclusion of disaster reduction from basic to higher education (curricula, educational material), training of trainers programs • Vocational training • Dissemination and use of traditional/ local knowledge. • Community training programmes. 	<ul style="list-style-type: none"> • Educational material and references on disasters and disaster reduction • Specialized courses and institutions • Trained staff • Evidence of systematic capacity development programs
Public awareness	<ul style="list-style-type: none"> • Public awareness policy, programmes and materials • Media involvement in communicating risk and awareness raising 	<ul style="list-style-type: none"> • Coverage of disaster reduction related activities by media • Public aware and informed • Visibility of disaster reduction day
Research	<ul style="list-style-type: none"> • Research programs and institutions for risk reduction • Evaluation and feedback • National, regional and international cooperation in research, science and technology development. 	<ul style="list-style-type: none"> • Existence of a link between science and policy (evidence-based policy and policy oriented research) • Indicators, standards and methodologies established for risk identification • Regional an international exchange and networking

Figure 3 summarizes current status of disaster risk management in the cities of Tehran, Istanbul, Kathmandu, Mumbai, Metro Manila, Quito and Bogota when looking at the third priority of action: Knowledge Management.

**Figure 3. Summary of current DRM status in seven megacities
Thematic area 3: Knowledge Management**



The seven cities in the sample report good and periodic information sharing through regional and international exchange, so they are perfectly aware of international campaigns and frameworks available to boost Disaster Risk Reduction. In particular these cities benefit from the annual

cluster cities meeting organized through EMI in each one of its five clusters and a biannual integrated meeting with the 20 cities which form part of its network.

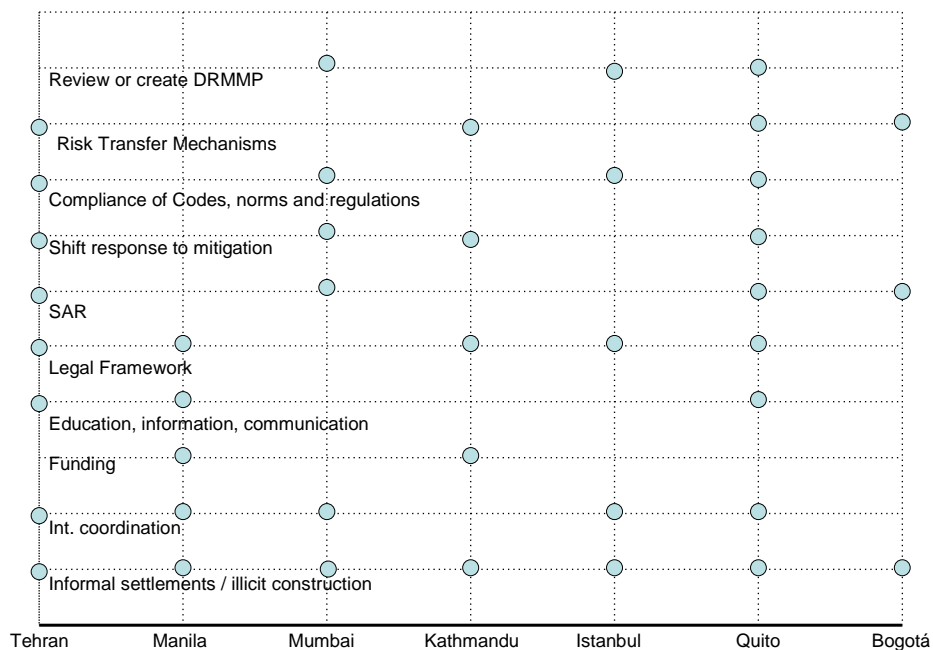
Disaster information management and communication are incipient or have not even started in a systematic and organized manner in most of the cities. There is a need for specialized formal courses and training on disaster risk management at all levels. This is a challenge for the universities and research centers to carry on training and capacity building needs assessment and design attractive courses at different levels to promote understanding and provide qualified staff to handle DRM activities at the local and municipal level.

A dialogue between education providers and researchers needs to take place on a regular basis so as to improve the links between science and policy. It is necessary to gain understanding on the specific needs of end users while at the same time building trust and confidence for both sectors to work together in an effort to advance disaster risk management and risk reduction practices.

The use of indicators to monitor and guide areas of improvement has not been yet undertaken by any of those cities in the sample, except for Bogotá. Again, an opportunity is sought to make use of recent developments in this regard, to adapt the proposed methodologies to the megacity context. The availability of enough technical/social/economic information makes it possible to apply such methods in any of the seven cities in this sample.

On the other hand, city administrators were asked to express their major concerns and impediments to improve risk reduction mechanisms in their respective cities. Figure 4 shows the results of this consultation.

Figure 4. Summary of current DRM status in seven megacities
Major Impediments to DRM in megacities



Every city administrator pointed out the fast growing populations living in informal settlements and the yearly increase of illicit construction. Likewise, they referred to weak legal frameworks and lack of strong institutions to support and carry on the DRMMP implementation processes. The lack of compliance and proved enforcement mechanisms confirmed the need of strong institutions and coordination among them. The traditional vision of emergency response continues to be a serious impediment and the lack of risk transfer mechanisms is seen as a priority in the process.

Funding is not considered to be a major problem; maybe because once the demand is created and local authorities see the potential benefits of a new preventive approach, then it becomes part of their regular job to seek appropriate mechanisms to budget specific activities related to risk reduction.

4. MULTI-DISCIPLINARY OPTIONS TO IMPROVE DRM

The Megacity Disaster Risk Management Knowledge Base (MDRM-KB) currently being compiled and implemented by EMI and its partners through the 3cd Program offers a wide variety of options for cities to look up and consider when deciding on concrete risk reduction actions. For illustrative purposes, the authors would like to cite a few examples that could represent options that the seven cities of this sample could start looking at to improve risk reduction and risk management.

Bogotá and Istanbul are certainly ahead on the process of implementing their disaster risk management master plans. For those interested, insights from the process and content of the earthquake master plan developed for Istanbul can be gained by reading this documented Sound Practice, which reflects the efforts made by the city to count on a strategic document. To initiate concrete actions for reducing physical, social and institutional vulnerability, the Istanbul Metropolitan Municipality (IMM), asked four leading technical universities: Bogazici, Istanbul, Middle East and Yildiz Technical Universities, to prepare an Earthquake Master Plan for Istanbul. For the implementation process the city has decided to focus on urban renovation options, retrofitting of selected structures, enforcement of building codes and universal insurance against earthquakes for general use buildings.

Bogotá has introduced a disaster management indicator system. This is a multi-disciplinary approach that takes into account the expected physical damage, the number and type of casualties or the economic losses, but also social, organizational and institutional factors, such as social fragility and the lack of resilience of the exposed community. Damage scenarios previously developed for the city are used in conjunction with a set of indicators to develop this urban approach as part of the IADB-IDEA Indicators for Disaster Risk Management Project.

In addition to the urban indicators system, the city's Directorate for Preparedness and Emergency Attention, DPAE-Bogotá, promotes the use of an integrated information system to facilitate access to risk management information and emergency attention. SIRE is an information system composed of several elements: Equipment (hardware), Programs (software) and essentially Information (data).

The school earthquake seismic safety program designed and developed in Katmandu has also influenced its neighboring Indian cities. The program evolved from a simple school retrofit to a comprehensive program of earthquake safety involving the entire community. SESP includes a survey and vulnerability assessment of public school buildings through school headmasters; retrofitting and reconstruction of schools; local masons' training on earthquake resistant construction; a participatory community-based approach to earthquake mitigation; awareness raising and education on earthquake safety for teachers, school children and parents; empowerment of communities and general improvement of safety and livelihood; and institutionalizing SESP in local government.

A sustained process to identify squatter colonies and the families residing in the areas, conduct a city wide registration and continued census, and produce an inventory of all possible land in the city for resettlement was initiated in Marikina City. Resources and policies for sustainability were provided. Political, legal and organizational-managerial capabilities were exercised by local authorities to regularize land tenure and improve quality of living in informal settlements.

Tehran contributes to this knowledge base with one but very important document related to a recently developed program for land use and planning based on seismic hazard evaluation.

Currently the MDRM-KB hosted by the Pacific Disaster Center in Maui, Hawaii, counts on nearly 30 identified sound practices for consultation by interested megacities.

5. CONCLUSIONS AND RECOMMENDATIONS

1. The ISDR framework is a useful, clear and easy to use tool that allows an initial approach to understanding current DRM condition and where the city should be looking in a macro scale, through a set of tentative benchmarks. Nevertheless, it needs to be combined with a more detailed indicators system to allow monitoring of specific actions implemented, both qualitatively and quantitatively. Combining the ISDR framework with other proposed methodologies such as those already tested in Latin America and the Caribbean, promoted by the Inter American Development Bank, IADB-UNC/IDEA, "Indicators of Disaster Risk and Risk Management"¹³, would result in a more practical procedure to motivate concrete action.
2. The first and foremost need of megacities relates to informal settlements and illicit construction. Research programs and risk reduction frameworks need to address this issue and provide a suite of sound practices that can be progressively implemented. Concrete action has been taken by EMI through its 3cd Program by exposing heads of land use and planning offices in local governments to available practical tools for urban risk reduction through planning. A pilot program will be started soon in Metropolitan Manila, which will help to set an agenda and decide on a basic curriculum to be further implemented in other megacities.
3. Risk analysis and evaluation, particularly of earthquake risk, seems not to be the problem in the studied megacities. All of the cities in the sample have a good understanding of the hazards they face, and major social and structural vulnerabilities have been identified;

consequently, their associated risks are pretty much known and have been accurately mapped. However, serious limitations related to governance and knowledge management surfaced in most of the cities. Appropriate legal and regulatory frameworks and strong institutions and coordination need to be examined.

4. Creative DRM communications tools are needed to further promote understanding, awareness and mainly motivate action from local officials and the general public in risk reduction activities. Strengthening existing DRM knowledge systems and promoting their use at all levels can certainly contribute in this regard. Initiatives such as the one being promoted by EMI and its partners through the 3cd Program that uses internet based Map Viewers and a Megacity Disaster Risk Management Knowledge Base (MDRM-KB) should be emphasized as means to make accessible and facilitate exchange of information.
5. The use of Sound Practices for risk reduction turns out to be a good option to learn from others' experience, avoid repeating the same mistakes and choosing from a number of options that have been already tested elsewhere, consequently improving the use of valuable time and other resources.

ABOUT THE AUTHORS

Jeannette Fernandez is the 3cd Program Component 1 coordinator, currently working as a consultant for the Pacific Disaster Center. Phone: +1-808-8917935, Email: jfernandez@pdc.org

Fouad Bendimerad is the chairman of the board of the Earthquakes and Megacities Initiative (EMI), currently visiting professor at Kobe University in Japan. Phone: +1-408-768 8987, Email: fouadmail@sbcglobal.net

Shirley Mattingly is the EMI 3cd Program Director, former FEMA Region IX director and Los Angeles City Emergency Management Director, currently advisor on urban disaster risk management for Asian and Latin American countries. Email: abovethebay@earthlink.net

Jim Buika is the PDC's 3cd Project Manager and a Senior Manager at the Pacific Disaster Center in Maui, Hawaii. Phone: +1-808-8917913, Email: jbuika@pdc.org

ACKNOWLEDGEMENTS

The authors would like to acknowledge Dr. Allen Clark and the PDC staff for contributing to the development of this investigation. Also to Dr. Neil Britton and Dr. Antonio Fernandez from EdM-Team-4 in Kobe, Japan and our colleagues in the seven cities all of whom assisted the 3cd Program Implementation Team in collecting and analyzing valuable information pertaining to Disaster Risk Management in those megacities.

Attachment Ia. DRM Assessment Matrix - Political Commitment and Institutional Aspects

	MANILA	MUMBAI	KATHMANDU	ISTANBUL	QUITO	BOGOTA
Policy and Planning	<ul style="list-style-type: none"> - OCD submits yearly a ND and Calamity Preparedness Plan for presidential approval - Emergency Preparedness Plan and master plan for Eq. impact reduction (MMEIRS-2004) initial phase of implementation. 	<ul style="list-style-type: none"> - Maharashtra DM project –2000 - Mumbai's DMP mostly focused on response. - Comprehensive National Disaster Framework is being adopted by every state. 	<ul style="list-style-type: none"> - KV counts on the Earthquake Disaster Mitigation Plan developed by MOHA in cooperation with JICA-2002, which has not been implemented. It has an integral perspective to address DRM. 	<ul style="list-style-type: none"> -New DRMMP designed (2000-2004) under the leadership of the IMM with the support of 4 technical local universities has just started its implementation phase. 	<ul style="list-style-type: none"> - No specific plans for DRR available at national or city level. - Emergency response plans have been prepared considering volcanic eruption, given recent episodes in the city. 	<ul style="list-style-type: none"> - National Plan for disaster prevention and attention available, it has cascaded to the city, localities and sectoral levels, through a set of guidelines to produce specific mitigation and emergency plans.
Legislation	<ul style="list-style-type: none"> -Presidential Decree No. 1566 - 1978 creates the NDCC -PD 474-1974 provides for a 2% Calamity Fund -Special PD 824-1975 to create MMDA as a public corporation -Local Government Code 1991 	<ul style="list-style-type: none"> -High Powered Commission on Disaster Management 1999 -Government rules, 2002 transfers DRM responsibilities from MOA (Agriculture) to MOHA (Home) -District Disaster Officer for Greater Mumbai, 1994 	<ul style="list-style-type: none"> -Natural Calamity Relief Act, 1982. -Local Administration Act, 1971 -Local Self Governance Act, 1999 -KV Town Development Act, 2000 -Building Act, 1998 	<ul style="list-style-type: none"> -Disaster Law -Civil Defense Law -Development Law -Law of Municipalities (1958) provides for DRM at the municipal level -Building supervision Law (4708) -Compulsory Eq. Insurance PD -Building Const. Supervision PD 	<ul style="list-style-type: none"> -Law for National Security, norms of 1976, law passed on 1991 -Law for the creation of Quito Metropolitan District, 1999 	<ul style="list-style-type: none"> -Executive Decree 919 of 1989 at the national level -1991 constitution establishing a decentralized model for the country -Specific Law for Bogotá Capital District 1993
Resources	<ul style="list-style-type: none"> -2% allocated for the National Calamity Fund -5% of estimated revenues shall be set aside by the local governments to address calamities, funds are released 24 hours after disaster declaration. Focused on post event relief. 	<ul style="list-style-type: none"> -A calamity relief fund is set up in each state, 75% the Government and 25% the state to a total amount fixed by the National Finance Commission. -Government manages its own National Calamity Contingency Fund. Both are focused on post event relief. 	<ul style="list-style-type: none"> -A Central Natural Disaster Aid Fund releases budget to the District Natural Disaster Aid Fund according to specific needs to face emergencies. 	<ul style="list-style-type: none"> -Not clear if calamity funds or annual budgets for DRR are available. There seems to be a fund allocated from the national budget to be used in DRR activities. -Compulsory Earthquake insurance for risk transfer adopted at the national and city levels. 	<ul style="list-style-type: none"> -The Community Safety Department counts on a the Safety Tax charged to the residents in Quito, a small percentage is assigned to the DRM unit, which has 2 full time staffs. 	<ul style="list-style-type: none"> -FOPAE, city's fund for prevention and attention nurtured by the 0.5% of all taxes collected by the city. -Additional funds are allocated for specific programs to the institutions in charge of the execution.

Attachment Ib. DRM Assessment Matrix - Political Commitment and Institutional Aspects

	MANILA	MUMBAI	KATHMANDU	ISTANBUL	QUITO	BOGOTA
Organizational Structures	<p>-The National Disaster Coordination Center is the focal inter-inst. Org. for DRM, it plays an advisory role to local DCCs through the Civil Defense</p> <p>-The Metropolitan Manila Development Authority MMDA through the MM Council and more specifically the MM Disaster Coordination Council MMDCC</p> <p>-Efforts to established LDCC at the Municipal level and Barangay. Municipal or city mayor chairs the LDCC</p>	<p>-MOHA, nodal organization for DM, the (CRC) central relief commissioner coordinates actions with appropriate ministers in case of emergency.</p> <p>-Departments of relief and rehabilitation act at the state level through the state crisis management committee.</p> <p>-The DM Department is in charge Greater Mumbai, two district collectors assist the Municipal Commissioner.</p> <p>-District Disaster Management Committees also available.</p>	<p>-The Ministry of Home Affairs through its department of narcotics, drug control and disaster management, is the national body in charge of DRM.</p> <p>-The Central Disaster Relief Committee CDRC is in charge of response in the country.</p> <p>-At the city level, the DM Section of the Department of Social Welfare has the responsibility.</p> <p>-Efforts at the ward level to establish disaster management committees.</p>	<p>-The Ministry of Public Works and Settlements, the Directorate of Civil Defense under the Ministry of Internal Affairs and the Turkish Emergency Management Directorate (TAY) integrate a highly complicated DRM structure at the national level.</p> <p>-The Istanbul Governorship established the Council of Disaster Management Center (AYM) and the Istanbul Metropolitan Municipality instituted the Disaster Coordination Center (AKOM)</p>	<p>-The Civil Defense in charge, with a responsive vision, under the National Security Council, part of the Presidency of the Republic. It counts on juntas cantonales to address local events.</p> <p>-The Municipality has two units to address DRR, the Community Safety Department with the DRM unit and a unit for Special Studies under the Planning Department.</p> <p>-Roles and responsibilities not clear and overlapping</p>	<p>-National System for Prevention and Attention, under the Ministry of the Interior and Justice (Government) – DGPAD-</p> <p>-Distrital System for Emergency Prevention and Attention -DPAE- under the Mayor's office.</p>

	MANILA	MUMBAI	KATHMANDU	ISTANBUL	QUITO	BOGOTA
Normative Framework	<p>-MMC issues building clearances as prerequisite for building permits. No enforcement mechanisms</p> <p>-Comprehensive Land Use Plans required by the Housing and Land Use regulatory Board for each municipality. No compliance</p>	<p>-Lack of implementation of National Building Code & Indian Standards on hazard safety measures.</p> <p>-Building construction is regulated by the Town and Country Panning Acts and Building regulations, but in many cases building regulations do not incorporate BIS codes.</p>	<p>-The National Building Code was launched in 1994, not yet effectively implemented.</p> <p>-In 2003 the Council of Ministers decree makes it obligatory for all government-building constructions and urges municipal authorities to make code compliance obligatory by every one, appropriate mechanisms not yet in place.</p>	<p>-The earthquake design code is a law in the country, last edition of the code dates 1997 with some revisions on the 98.</p> <p>-Deficiencies in the control and code enforcement are noticeable.</p>	<p>-General plan for land use and development (PGDT in Spanish)</p> <p>-The municipality issues building permits, blueprints require a registered architect or engineer's signature</p> <p>-Seismic Code revised and updated (2001) for Ecuador, adopted by the municipality, has incorporated a Microzonation study for the city.</p> <p>No mechanisms for compliance.</p>	<p>-Territorial Development Plan that incorporates hazards for land use and planning purposes.</p> <p>-Revised and updated construction code, special normative for compliance and independent supervision in place.</p> <p>-Still difficulties to reach full compliance.</p>

Attachment II. DRM Assessment Matrix - Risk Identification and Assessment

	MANILA	MUMBAI	KATHMANDU	ISTANBUL	QUITO	BOGOTA
Risk Assessment	<p>-Mapping of Earthquake related hazards, ground shaking, liquefaction and tsunami in 500 m grid GIS based</p> <p>-Earthquake damage scenarios for buildings, infrastructure and lifelines</p> <p>-Death toll and fire damage estimates available.</p> <p>-Studies on physical and social vulnerability available through MMEIRS - 2004</p>	<p>-Expert Evaluation Method was used to combine seismic hazard and vulnerability assessment to determine the seismic risk in Mumbai and estimate the damage of buildings and casualties. Not GIS option.</p> <p>-These studies are based on historical seismology, no instrumentation available.</p>	<p>-Mapping of Earthquake related hazards, ground shaking, liquefaction and tsunami in 500 m grid</p> <p>-Earthquake damage scenarios</p> <p>-Death toll and fire damage estimates available.</p> <p>-Studies on physical and social vulnerability available through the MOHA-JICA study 2002-GIS based</p>	<p>-Detailed studies on vulnerability and risk assessment including loss estimates for each one of the districts based on different earthquake scenarios are available. GIS based</p> <p>-Special interest has been given to detailed vulnerability studies of the building stock to prioritize intervention either by retrofitting, strengthening or replacing existing buildings.</p>	<p>-Risk maps for seismic and volcanic activity. GIS based</p> <p>-General physical, social and economic vulnerability assessment available for different sectors of the economy. Detailed for hospitals, schools, bridges, historical areas.</p> <p>-Historical records & catalogues for Earthquakes and Eruptions.</p>	<p>-Risk maps for earthquakes, flooding, landslides, fires, technological hazards available. GIS based</p> <p>-Vulnerability assessment for general building stock, hospitals, schools</p> <p>-Detailed risk indicators for each one of the 20 locations comprising Bogotá.</p>
Early Warning	<p>-PHIVOLCS manages a good network to monitor seismic and volcanic activity.</p> <p>-PAGASA in charge of flooding forecasting</p> <p>-LDCC, should organize warning services. Warning devices are maintained and operated when needed.</p>	<p>-A Flood Forecasting Network managed by the Central Water Commission manages a forecasting and warning system, it covers 14 states, among them Maharashtra with 7 stations.</p> <p>-The Indian Meteorological Dept. (IMD) monitors and gives warnings regarding Tropical Cyclone</p>	<p>-The Department of Mining and Geology operates the 17-instrument Nepalese Seismological Network, information is transmitted and managed by the National Seismological Center in KMC</p>	<p>-A seismological and accelerographic network is maintained and monitored by specialized institutions, the IMM runs it self 8 seismic stations and monitors meteorological data related to flooding and heavy snow.</p> <p>-Istanbul Government and IMM are implementing an Eq. Early warning system that also aims at preventing secondary effects such as fire, gas and electricity cuts.</p>	<p>-A limited number of seismometric, accelerographic, pluviometer and air quality measuring instruments are available in the city.</p> <p>-Early warning systems for volcanic eruption are under design and some are available for mud flows and flooding in the Pichincha slopes.</p>	<p>-Good instrumentation available in the city to monitor seismic activity.</p>

Attachment IIIa. DRM Assessment Matrix - Knowledge Management

	MANILA	MUMBAI	KATHMANDU	ISTANBUL	QUITO	BOGOTA
Information Management	<p>-DROMIC maintains a data bank of disaster incidents and related information Nation Wide, -There is not a systematic record of hazard impacts nor associated losses at the city (whole MM) or individual cities' level.</p>	<p>-A Natural Disaster Knowledge Network is planned as a "network of networks". A platform to facilitate a dialogue among all players dealing with DRM in India and abroad. -There is not a similar policy or communication strategy at the city level.</p>	<p>-Water Induced Disaster Preparedness of the Ministry of Water Resources implements a GIS based information system for DRM -The DM section of KMC through the information and communication department undertakes public awareness. Lack of resources and manpower does not allow to fully accommodate the responsibility.</p>	<p>-Efforts are made to develop and implement a National Disaster Information Systems at the Ministry of Public Affairs and Settlements. -There is not a similar policy or communication strategy at the city level.</p>	<p>-Communication mechanisms and information dissemination was upgraded on the eve of recent eruptive episodes in the city. Some technical groups have gained extensive credibility and trust from the authorities and community. -No formal DRM information system available.</p>	<p>-SIRE an integral system for Disaster Management and Emergency Response to facilitate accesses to detailed information and from different actors ranging from general public to key word controlled for selected staff and authorities.</p>
Education and Training	<p>-Disaster awareness is taught under Science in public schools, it has been suggested to review the content and extend it to private schools too. -Formal training at the under graduate or graduate levels are inexistent.</p>	<p>-The National Institute for Disaster Management develops training modules at different levels, undertakes training to trainers and provides consultancy to the states. -DM elements are taught under Social Sciences from grade VIII. -Earthquake engineering is not part of curricula in the undergraduate levels at engineering colleges.</p>	<p>-No sustained efforts to address DRM aspects through school curricula or formal education at the universities. -A survey conducted by the MOHA /JICA project shows that the 93% of the residents think that education on Earthquake Mitigation is should be included in the school curricula.</p>	<p>-General aspects related to Earthquake risks is offered in primary and high schools -No systematic education programs related to natural disasters for the general public. -The city counts on a number of universities and research institutes where aspects related to DRM are formally taught through regular and specialized training.</p>	<p>-Little training or formal education on DRM issues. Most universities offer a very technical and specific oriented vision such as civil engineering schools, for example.</p>	<p>-Training and formal education on DRM available through DPAE and other research and education centers.</p>

Attachment IIIb. DRM Assessment Matrix - Knowledge Management

	MANILA	MUMBAI	KATHMANDU	ISTANBUL	QUITO	BOGOTA
Information Management	<p>-Proclamation 296-88 and Executive Order 137-99 declare July as the month for Natural Disaster consciousness. National and local government agencies develop interesting related campaigns.</p> <p>-The private sector through CNDR corporate network for DR and other active NGOS work on mitigation, preparedness, relief and rehabilitation</p>	<p>-Even if community participation in mitigation and emergency preparedness is promoted through media coverage oriented to preparedness, opinion programs and NGOs and the Private Sector participate in dissemination activities, there is a need to design and implement more public awareness activities.</p>	<p>-Starting in 1998, every year on January 15, Nepal commemorates the Earthquake Safety Day as an effort to raise awareness in the community, many activities in Kathmandu, including a shaking table demonstration.</p> <p>-A number of interesting community based experiences such as the school safety program that includes teachers, students, masons and the neighbors of the target building.</p>	<p>-Education of the public for disaster preparedness and mitigation has been under the central government responsibility (Civil Defense and Dept. of Education).</p> <p>-Local governments and NGOs are not given a strong role in these issues</p> <p>-Efforts to incorporate press, radio and TV coverage oriented to preparedness seem to be limited.</p>	<p>-The reactivation of several volcanoes in the country since 1999, has put disaster issues in the public and community agendas, nevertheless this is not always the case. Good opportunity to enhance DRM performance and delivery.</p>	<p>-Sustained campaigns aiming at community involvement and learning process.</p> <p>-Specific programs for school teachers and students,</p> <p>-Manuals, brochures and visual aids with mitigation options in easy to understand language.</p> <p>-Monthly on-line newsletter to inform on DRM activities, programs and projects executed locally and abroad.</p>
Research	<p>-Currently academic and research communities have a limited role in DRR*</p> <p>-PHIVOLCS, PAGASA and MGB count on strong groups working on hazards</p> <p>*ISDR-Country Report</p>	<p>-The Indian Institute of Technology, IIT-Powai is engaged in some research initiatives through its Masters and PHD programs in Civil Engineering.</p> <p>-Few programs looking at the holistic DRM picture.</p>	<p>-Limited research capacity, NSET as a not-for-profit organization has lead some applied research projects. Other Public Departments such as DWIDP and ICIMOD look for means to fill this gap locally and regionally.</p>	<p>-Strong research groups at the universities and research institutes country-wide and particularly in Istanbul.</p> <p>-Major focus so far has been the physical vulnerability of buildings, other aspects of the overall DRM concept need to be addressed.</p>	<p>-Mainly technical research addressed to construction, hazards monitoring, but very little on the broader side of DRM.</p>	<p>-Comprehensive research agenda for risk evaluation and mitigation.</p> <p>-Important international support for applied research looking for easy to implement alternatives.</p>

REFERENCES

- ¹ ISDR (2003), **A draft framework to guide and monitor Disaster Risk Reduction**, www.unisdr.org/dialogue/basicdocument/htm
- ² EMI (2004), **The Cross Cutting Capacity Development (3cd) Program: Program Definition and Implementation Plan**, www.earthquakesandmegacities.org
- ³ Urban Agglomerations (2001), United Nations Population Division, Department of Economics and Social Affairs
- ⁴ Fernandez J., Mattingly S., (2005), **EMI Contribution to the World Conference on Disaster Risk Reduction**, www.earthquakesandmegacities.org.
- ⁵ Singh S.K., (2004), **Disaster Management in Mumbai**, First coordination workshop of EMI's 3cd Program, Seeheim, Germany, June 26-27
- ⁶ Mumbai Disaster Management Plan (1999), Government of Maharashtra
- ⁷ Carrion D., (2005), **Dealing with illicit construction in Quito**, ISDR World Conference on Disaster Risk Reduction, Kobe, January 2005
- ⁸ Mattingly S., (2004), **Input on Key Attribute for Sound Practices in Disaster Risk Management**, unpublished
- ⁹ Cardona et al, (2004), **Programa de Indicadores para la Gestión del Riesgo en América Latina y el Caribe**, progress report
- ¹⁰ Mitchell T., (2003), **An Operational Framework for Mainstreaming Disaster Risk Reduction**, Benfield Hazard Research Centre, Disaster Studies, Working Paper 8, November 2003
- ¹¹ ISDR (2005), Report of the World Conference on Disaster Reduction, Kobe, Hyogo-Japan, 18-22, January 2005
- ¹² ISDR (2004), **Living with Risk: A global review of disaster reduction initiatives**, available on line http://www.unisdr.org/eng/about_isdr/bd-lwr-2004-eng.htm
- ¹³ IADB, Universidad Nacional de Colombia-IDEA (2005), **Indicators of Disaster Risk and Risk Management**, Manizales, Colombia, 2005