State of Disaster Risk Reduction at the Local Level

A report on the Patterns of Disaster Risk Reduction Actions at Local Level

Sound Practices of Local Disaster Risk Reduction (DRR)

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1.0 Introduction

Disaster risk reduction (DRR) is an important component for achieving sustainable development of cities, in particular when the world is steadily becoming more urban. Fast growing cities and urban areas of the world increase disaster risk due to economic growth and fast population expansion. With local governments increasingly taking an important role in the sustainable development, the need for globally comparable knowledge of disasters risks has even become greater. Sound practices that have been tested and implemented by different cities around the world aid knowledge sharing opportunities for future disaster risk reduction. A sound practice can be considered as anything that has been tried and shown to work in some way—whether fully or in part but with at least some evidence of effectiveness—and that may have implications for practice at any level elsewhere. It is intended to improve the knowledge sharing opportunities between cities by reporting practices that have been already tested and implemented by one city and that can be successfully adapted by another. The intent is to provide local governments and other institutions learn from one another by effectively facilitating the sharing of sound practices and disseminating these established sound practices in risk reduction.

United Nations Office for Disaster Risk Reduction with the support of the Making Cities Resilient Campaign commissioned this report on state of DRR at the local level with the intention of consolidating available knowledge on the patterns of disaster risk reduction actions, and analyses of what enables successful practices at the local level. In particular, this chapter focuses on reported sound practices of local DRR and aims to provide a collection of sound practices on DRR actions at the local level and what needs to be done to reduce future disaster risks. This document uses the ten essentials identified in the United Nations International Strategy for Disaster Reduction (UNISDR) making cities resilient ten-point checklist to illustrate some of the risk reduction work that has been undertaken across the world. The material contained herein is intended for public dissemination to all sectors and practitioners involved in DRR including international organisations, national and local government agencies, non-governmental organisations, the private sector and academia.

2.0 Concepts and Principles

Natural disasters are becoming more frequent causing widespread damage to human and property. Indian Ocean tsunami in 2004, hurricane Katrina in 2005, Haiti earthquake in 2010, New Zealand earthquake in 2011, Japan earthquake and tsunami in 2011, Typhoon Haiyan in 2013 and Nepal earthquake in 2015 are some of the major catastrophic disasters occurred over the past decade, causing devastating and long-term impacts to the affected communities, countries and to the entire nation. In historical times, disasters were seen as 'acts of god' and it was believed that nothing could be done to avoid the occurrences of disasters (Voogd, 2004). Later, disasters were increasingly seen as 'acts of nature' and in the late 20th century the view has shifted again to be considered as an 'act of society' or an 'act of human beings'. O'Keefe et al. (1976) were among the first to recognise disasters as a consequence of a vulnerability by identifying a disaster as an "interaction between extreme physical or natural phenomena and a vulnerable human group which result in general disruption and destruction, loss of life, and livelihood and injury" (Westgate and O'Keefe, 1976). Accordingly, it was argued that disaster risk arises when hazards interact with physical, social, economic and environmental vulnerabilities (UN-ISDR, 2005). Hence, in reducing disaster risks it is of paramount importance to concentrate on these vulnerabilities and to reduce disaster risks within them.

Cities and urban areas are growing very rapidly all over the world, particularly in developing countries (Sinha, 1999; UNFPA, 2007). It has been observed that urbanisation is very significant in low and middle-income nations as a result of population movement in response to better economic opportunities and lack of prospects in rural areas (Satterthwaite et al., 2007). As a result of rapid urbanisation, cities face many challenges. The major challenges for cities include, increased density which put pressure on land and services, unplanned and unauthorised settlements, settlements in hazard prone areas, lack of capacities and unclear mandates for DRR at local levels, weak local governance and lack of regulatory frameworks, inadequate water resource management, decline of eco systems, decaying infrastructure and unsafe building stocks, uncoordinated emergency services and adverse effects of climate change (UN-ISDR, 2012; Malalgoda, 2014). On the other hand, the main underlying cause for urbanisation is the concentration of new investment and economic opportunities in urban cities (Satterthwaite et al., 2007). It was further noted that by 2004, 97% of the world's GDP was generated by industry and services most of which were urban based enterprises. Consequently, it was realised that most of the world's largest cities are the world's largest economies (Satterthwaite et al., 2007). As such, disasters can cause major economic losses. For an instance, the economic losses recorded for disasters in 2011 amounted to US$ 366 billion; where the worst disasters for that year were two urban based disasters, the earthquake and

tsunami that hit Fukushima, Japan in March 2011 and the floods that hit Thailand from August to December (AFP, 2012). As such, the impacts of natural disasters to cities can be worse than in other environments (Wamsler, 2006; Vooged, 2004; Malalgoda et al., 2013). Thus, it is important to focus on reducing the risks associated with urban areas and to make necessary structures, systems and capacities at local level to withstand the disaster risks. Making cities resilient is a complex task, which require collaborative efforts of various stakeholders. UN-ISDR (2012) has identified national governments, local government associations, international, regional and civil society organizations, donors, the private sector, academia and professional associations and every citizen as main stakeholders of making a city resilient to disasters and has highlighted the role to be played by them to reduce the risk of disasters. As such, a multi-stakeholder engagement is a key to make a city resilient to disasters and a system need to be properly established to involve all stakeholders to create disaster resilient cities.

There are strong calls within literature and policy to institutionalise DRR at local level. The basic idea of decentralisation is that it brings governments closer to the local population and better reflects their needs in public policy making endeavours (Ahmed and Iqbal, 2009). This brings decision making closer to people and provides opportunities to design and deliver services, which can effectively address local needs. Accordingly, local governments are expected to play a key role in contributing to making cities resilient, as they are based at local level, where disasters happen (MacManus and Caruson, 2006; Kusumasari et al., 2010; Manyena, 2006; Malalgoda et al, 2013). Though there are strong calls to institutionalise DRR at local level, local organisations face a number of challenges in implementing DRR at local level. Some of the major challenges include, inadequate knowledge and capabilities in managing disasters (Kusumasari et al., 2010), financial and human resource scarcity (Pelling, 2003; Stren, 1989), inadequate urban planning and lack of monitoring and supervision of new developments (Voogd, 2004), unstable political systems (Manyena, 2006), lack of political will (Niekerk, 2007), inadequate legislative authority (Bendimerad, 2003), multi-layered governance arrangements and administrative weaknesses (Osei, 2007), relationship issues with the central government (Sabri and Jaber, 2007) and lack of community engagements (Sabri and Jaber, 2007; Pearce, 2003). Thus, it is very important to address these challenges in order to increase the local level contribution to make cities resilient to disasters.

Institutions such as UN-ISDR, the Red Cross, and ADPC, have also campaigned about the need for addressing issues related to local governance and urban risks. Due to this emerging need to encourage resilience at local levels, UN-ISDR has specifically addressed the 2010-2015 - world disaster risk reduction campaign to local governments under the theme of “Making Cities Resilient – My City is Getting Ready”. The campaign aims at achieving resilient and sustainable urban

communities and insists local governments to act effectively in order to reduce the risk of disasters to cities.

The campaign has developed ‘ten essentials’ for local governments to make their cities more disaster resilient and they are listed below (UN-ISDR, 2012).

- **Essential 1**: Institutional and Administrative Framework - Put in place organization and coordination to understand and reduce disaster risk, based on participation of citizen groups and civil society. Build local alliances. Ensure that all departments understand their role to disaster risk reduction and preparedness.
- **Essential 2:** Financing and Resources - Assign a budget for disaster risk reduction and provide incentives for homeowners, low-income families, communities, businesses and public sector to invest in reducing the risks they face.
- **Essential 3:** Multi-hazard Risk Assessment- Know your Risk - Maintain up-to-date data on hazards and vulnerabilities, prepare risk assessments and use these as the basis for urban development plans and decisions. Ensure that this information and the plans for your city's resilience are readily available to the public and fully are discussed with them.
- **Essential 4:** Infrastructure Protection, Upgrading and Resilience - Invest in and maintain critical infrastructure that reduces risks, such as flood drainage and adjusted them where needed to cope with climate change.
- Essential 5: Protect Vital Facilities: Education and Health - Assess the safety of all schools and health facilities and upgrade these as and when necessary.
- **Essential 6:** Building Regulations and Land Use Planning - Apply and enforce realistic, risk compliant building regulations and land use planning principles. Identify safe land for low-income citizens and develop upgrading of informal settlements, wherever feasible.
- **Essential 7:** Training, Education and Public Awareness - Ensure education programmes and training on disaster risk reduction are in place in schools and local communities.
- **Essential 8:** Environmental Protection and Strengthening of Ecosystems - Protect ecosystems and natural buffers to mitigate floods, storm surges and other hazards to which your city may be vulnerable. Adapt to climate change by building on good risk reduction practices.
- **Essential 9:** Effective Preparedness, Early Warning and Response - Install early warning systems and emergency management capacities in your city and hold regular public preparedness drills.
- **Essential 10:** Recovery and Rebuilding Communities - After any disaster, ensure that the needs of the survivors are placed at the centre of reconstruction with support for them and their community organizations to

design and help implement responses, including rebuilding homes and livelihoods.

As part of the campaign, a Local Government Self-Assessment Tool (LGSAT) has been prepared which provides key questions and measurements against the Ten Essentials for Making Cities Resilient (UN-ISDR, 2012). The campaign advises participating local governments to report progress on the ten essentials and many participating local governments have already reported their progress on ten essentials. Some of these identified good practices are provided in the section 4 of this chapter.

3.0 Methodology

This chapter on Sound Practices of Local DRR was developed through the review and analysis of a number of sources. It considered published literature and documentation on disaster risk reduction, risk classifications and their link to resilience. United Nations Office for Disaster Risk Reduction invited submission of original work, not published or considered for publication elsewhere that contribute to the themes of the State of Disaster Risk Reduction at the Local Level report. 12 papers were received for the 'Sound Practices of Local DRR' theme and 10 papers were accepted as input papers for this chapter. Input papers authored specifically to inform this chapter are listed in Section 6. Sound practices reported in these input papers were captured and presented according to UNISDR's 10 essentials for making cities resilient. In addition, papers submitted for the 'International Conference on Building Resilience: Individual, institutional and societal coping strategies to address the challenges associated with disaster risk' held in September 2013, and for the 4th International Conference on Building Resilience, Incorporating the 3rd Annual Meeting of the ANDROID Disaster Resilience Network, 8th - 11th September 2014, United Kingdom and the case studies published in the "Celebrating the success of HFA" at the UN World Conference on the Disaster Risk Reduction held in March 2015 were considered for any reported sound practices on disaster risk reduction.

4.0 Sound Practices

Essential 1: institutional and administrative framework

Case Study 1: Put in place the necessary organisations and systems to coordinate disaster management activities at national and local level
Location: Batticaloa, Sri Lanka

Context: Following the tsunami of 2004, the Sri Lankan government has taken various steps towards creating institutional arrangements for disaster management within the country. The country was able to approve and implement the Disaster Management Act in May 2005. In the same year, the Disaster Management Centre (DMC) was established under the National Council for Disaster Management (NCDM) with the mission to create a culture of safety among communities and the nation at large through systematic management of natural, technological and man-made disaster risks. As such, all disaster management activities are coordinated by the DMC, and its district level coordinators do coordinate the disaster management activities in each district with the support of all related government and non-government agencies.

Initiative: The District Disaster Management Coordinating Unit (DDMCU) of Batticaloa coordinates all disaster management activities through its Divisional Secretariats and “Grama Niladarie” divisions. Some of the initiatives include the formation of district, divisional and village level disaster management plans and committees, conducting training and awareness programmes for community and school children, mock drills, identifying safety locations and routes, early warning, search and rescue training, and livelihood support. A number of NGOs and INGOs are working closely with the DDMCU providing support in terms of finance, training, livelihood development, water and sanitation. The universities and research organisations also contribute by way of conducting workshops and training events for local officials and communities, and provide research support. In addition to the above, further collaboration exists with the local governments and other government agencies operating at the district level. Many of these organisations have district level offices in Batticaloa and work closely with the DDMCU in the city’s resilience-building activities.

Furthermore, Batticaloa is a participant city in the UN-ISDR campaign: ‘Making Cities Resilient – My City is Getting Ready’, and since joining the campaign the municipal council for the city has taken several initiatives towards risk reduction in the city. The council has established a Disaster Risk Reduction Unit within the council with the support from an Australian funded project "Disaster Resilient City Development Strategies for Sri Lankan Cities". The project was implemented by UN-Habitat in collaboration with the University of Moratuwa, Ministry of Disaster Management, Urban Development Authority and Local Authorities of the selected cities. Establishment of a disaster risk reduction unit for Batticaloa municipal council could be identified as one of the key milestones in the process of resilience-building. By establishing a DRR unit, it is expected to increase the municipal council’s contribution towards resilience-building activities in the city. The DRR unit is responsible for: implementation of the Batticaloa Disaster Preparedness Plan; supervision and monitoring of project implementation in consultation with the Technical Working Group established by the project; raising

community awareness and providing access to information on disaster resilient technologies; and providing guidance on DRR procedures to be adapted by relevant institutions.

Outcomes and Relevance to Practice: Institutional arrangements are now in place at local level to manage disaster related activities of the Batticaloa city. The disaster risk management initiatives of Batticaloa could be replicated in other cities and regions where local level organisational structures and networks could be created to coordinate the disaster risk management at local level. However, establishing such institutional structures would not itself be sufficient to ensure resilience of cities. It is important to lay down the roles and responsibilities of each stakeholder in disaster risk management and benchmarks need to be developed and agreed between stakeholders to measure the contribution and the success.

Case Study 2: Building local alliances in the Post-disaster reconstruction process
Location: Ache Province, Indonesia

Context: The Aceh province was heavily devastated by the Indian Ocean tsunami in 2004. The level of devastation was beyond the scope and the capacity of the existing disaster management agency, and resulted in the establishment of an ad-hoc body at the ministerial level to lead the post-disaster reconstruction initiatives. The agency was called the Rehabilitation and Reconstruction Agency for Aceh Nias – BRR.

Initiative: In order to accommodate the local aspirations, and at the same time helping to ensure the sustainability of the reconstructed assets through building a sense of ownership involving the local community and civil society were acknowledged as one of the utmost priorities. The participation of the local community and civil society was accordingly manifested in all phases of the reconstruction process, starting from the planning stage down to the project implementation. At the blue print preparation process, the local officials and the public figures were invited for comments and advise. At the implementation process, the local personnel dominated the BRR staff. Wherever possible, the local companies were given higher priorities in the bid tendering process, or encouraged to create a joint-venture with a bigger national level company. The involvement of the local components in the reconstruction process was also intensified by the establishment of the joint-secretariat at the regional level, consisting of representatives of the local governments in order to improve the coordination with the local governments and accelerate the reconstruction process.

Outcomes and Relevance to Practice: The importance of involving local community in all phases of reconstruction is a widely accepted phenomenon in literature, policy and practice. As such, the process adopted in Ache Province could be an example for other regions to determine how the community could be engaged in the reconstruction process. In addition, it is also important to develop mechanisms to increase the participation of marginalised population, as sometimes their needs are not adequately considered in the reconstruction processes.

Essential 2: financing and resources

Case study 3: The Great Hanshin-Awaji Earthquake Reconstruction Fund
Location: Hyogo Prefecture, Japan

Context: In the disaster recovery efforts, the Hyogo Prefectural Government was required to meet disaster victims' diverse needs promptly and flexibly. The local government's administrative system requires parliamentary decisions to obtain budgets for projects, which are normally unable to promptly resolve the challenges faced by the disaster victims. To make matters worse, the single-year-based budget accounting principles imposed constraints on its long-term perspective-based disaster recovery measures. Under such circumstances, the Great Hanshin-Awaji Earthquake Reconstruction Fund was established to implement projects to promptly meet the multifaceted needs of disaster victims over the long-term as well as on a stable and flexible basis. The Fund was established in April 1995 (with 900 billion yen in funds) to drive recovery for the disaster-affected areas. From its inception until 2007, this fund spent approximately 360 billion yen on projects to assist in housing, living, industry and education recovery in disaster-affected areas.

Initiative: To secure the budget to run the Fund, Hyogo and the Kobe City government decided to borrow a combined total of 880 billion yen from financial institutions and to provide interest-free financing to the Fund. This would enable it to complement the government's programmes to support disaster victims. In response to the effort by local governments to bear the interest payments for the Fund, the national Government provided an ordinary local grant tax to them to cover part of their interest burden. As a result, by the end of fiscal year 2013 (March 31, 2014), the Great Hanshin-Awaji Earthquake Reconstruction Fund had implemented a total of 116 supporting projects valued about 365 billion yen in the fields of housing, living, industry, education and others areas, thereby contributing greatly to the recovery from the Great Hanshin-Awaji Earthquake (GHAE).

Outcomes and Relevance to Practice: The Great Hanshin-Awaji Earthquake Reconstruction Fund complemented public funds in quantity by enabling the implementation of measures that were more rigorous than ordinary governmental programmes, and also carried out detailed projects that met the needs of disaster-affected people. While a significant amount of flexible budget is required for post-disaster recovery projects, the securing of such budgets is a major challenge for some national governments as the first step. Other countries and regions cannot necessarily use the reconstruction fund scheme employed in Japan after the Great Hanshin-Awaji Earthquake without significant changes. This is because each nation or region differs in terms of culture, approaches to the right to life, housing and life environment recovery, as well as with respect to societal and economic structures. It is thus essential to design a scheme befitting the circumstances of the disaster-affected country or region.

Essential 3: multi-hazard risk assessment – know your risk

Case Study 4: Remote sensing and GIS for flood hazard management: a case study from Sindh Province, Pakistan
Location: Sindh Province, Pakistan

Context: In Pakistan, floods have been recognized as a major natural hazard. The country has a long history of floods from the Indus River and its tributaries and the floods of 1928, 1929, 1955, 1957, 1959, 1973, 1976, 1988, 1992, 1995, 1996 1997 and 2010 attest to their destructive nature and adverse impact on lives and property in Pakistan.

Initiative: A number of initiatives have been implemented using remote sensing and GIS for flood hazard management. These initiatives include:

- Mapping of Pakistan 2010 floods, flood hazard assessment and proposed flood shelters.
- NASA-SERVIR Himalaya team was involved in the flood monitoring.
- Use of available cloud free data during the floods: MODIS data gave alternative images.
- Similar techniques can be replicated in other parts of Pakistan.
- GIS based proposed locations for building flood shelter was the first such initiative in Pakistan.

Outcomes and Relevance to Practice: The 2010 flood in Sindh province, Pakistan was described as the worst environmental disaster in Pakistan's history. The flood inundated a total area of 7,579 km^2 in Sindh province. The results indicated a very high hazard area (6,216 km^2) out of a total area of 46,138 km^2 in Sindh province. The published results are now hosted in many libraries including the World Meteorological Organization (WMO). The results were validated using the

Pakistan flood 2010 data. Some 1,363 km^2 were observed as less flood-prone and this can be attributed to human interventions, particularly infrastructure to regularly re-route water build-up from floods. Flood inundation mapping and the GIS based analysis for flood shelter suitability can be replicated anywhere in the world.

Case study 5: Building resilience in South Australia – A better understanding of risk
Location: South Australia

Context: Effective management of disaster risk is heavily reliant on accurate and accessible information about natural hazards. To improve the quality and accessibility of risk information, South Australia has developed the Zone Emergency Risk Management System (ZERMS) Project to assess disaster risk from multiple hazards.

Initiative: The project is being managed by the South Australian Fire and Emergency Services (SAFECOM). Utilising rigorous risk assessment methodology the project works collaboratively with key stakeholders to better understand risk and build resilience across the social, economic and environment sectors of the community. The project has addressed multiple hazards across the full prevention, preparedness, response and recovery (PPRR) spectrum across South Australia's eleven regions.

The core aim of the project is to better understand the risks South Australian communities face by conducting risk assessment workshops across ten different hazards, including bushfires, earthquakes and floods. The ZERMS Project uses the National Emergency Risk Assessment Guidelines (NERAG), adopted in 2011 as Australia's nationally agreed methodology for developing emergency risk assessments. The ZERMS project was the first instance when the NERAG methodology was rigorously applied in Australia at the regional level and the project team spent several months developing supporting tools – including templates, a workshop process and training programs - to apply NERAG at the regional level. The team has since shared this knowledge and tools with other Australian jurisdictions adopting the NERAG methodology. The project team worked with specialists in each hazard and key regional stakeholders, including local councils, to conduct the risk assessment process, including:

- understanding the demographic, social, economic and environmental characteristics of each region
- identifying the impacts of natural disasters in each region on people, the economy, infrastructure, public administration, community wellbeing, and the environment

- understanding the effectiveness of existing capabilities and systems for managing the risks across the PPRR spectrum
- identifying options for new risk reduction approaches.

Outcomes and Relevance to Practice: Key benefits from the overall process have included:

- a better understanding by the South Australian Government of disaster risks and existing systems for managing risk at the local, regional and state levels
- fostering better networks between the state and local governments
- better integration between state and local government emergency management planning
- building disaster resilience at the local level by supporting local governments to better understand and manage disaster risks to local communities

Reflecting the Australian National Strategy for Disaster Resilience, the target audience for participation in this project in each zone has been the emergency management community in the broader sense. To ensure the right stakeholders with the right knowledge participated in the process, stakeholder assessments were regularly conducted to identify the right people to engage across local and state governments, businesses, community leaders and the not-for-profit sector. Many of the people involved in the implementation of the project live and work in the zones and are part of the wider community.

Feedback, particularly from local government representatives, has consistently highlighted the benefit of the strong networks and partnerships that have been forged between local governments and state government agencies. Through the project, hundreds of members of South Australia's emergency management and broader community sectors have developed expertise in emergency risk assessment and a greater understanding of emergency management arrangements and capabilities across the state.

Essential 4: infrastructure protection, upgrading and resilience

Case Study 6: Building of a 2 km bund in the coastal village of Kumarakudi
Location: Kumarakurdi, Nagapattinam, Tamil Nadu, India

Context: The coastal village of Kumarakudi in Tamil Nadu is located 3 km from the seashore at the Bay of Bengal. The town has witnessed more storms over recent years causing salinization of lands and affecting the quality of ground

water. As supply of municipal piped water was irregular, drinking water became scarce.

Initiative: To protect the agriculture fields from salinization and improve the availability of clean water, 2 km bund was built around the agricultural fields. To ensure a high stability the bund was made of stiff clay, hard red earth and gravely soil. The vegetation on the bund walls prevents erosion. In addition, a shutter was placed where the fields' irrigation canal and the Manjal River join, to allow field drainage during the monsoon season. In addition, a pond renovation project which was proposed in early 2011 was accepted for funding by the Kumarakudi's Panchayat to complement the bund and shutter project. The pond was intended to provide the village with water for domestic usage.

Outcomes and Relevance to Practice: These measures protected the community's fields from flooding and salinization; increased the amount of harvest compared to the previous years - harvests are expected to double from 10 to 20 bags per acre and worth a total amount of INR 2 million; restored the quality of the groundwater; and the bund and shutter improved the quality and quantity of fresh water supply for the villagers. Furthermore, the constructed bund and shutter keep the village agriculture safe from storm surges and backwater flooding, which are projected to be worsened due to climate change. The technical measures also improve the cleanliness and structure of the fresh water pond for domestic consumption and irrigation. Accordingly, the project has been able to protect people's livelihoods and contribute to climate-proofing the development of Kumarakudi.

Case Study 7: Flood protection in Singapore
Location: Singapore

Context: Climate change brings risks and unprecedented vulnerabilities to cities. They include but are not limited to flood, heat stress, drought, loss of coastal land, loss of biodiversity, hurricane, etc. These risks and vulnerabilities press cities around the world to prepare adaptation plan and urban climate risk reduction (UCRR) projects to make cities more resilient. Implementation of these projects requires heavy investments, and operating them are often seen as liability for the city governments in the long-run. However, studying into some fruitful implemented climate risk reduction projects in Singapore has revealed that there are hidden opportunities in addition to reducing climate vulnerabilities. The opportunities lie in the fact that these adaptation projects can also serve as catalysts for the host cities to be resilient, innovative and progressive towards sustainable urban redevelopment, including environmental improvement, community bonding, job creation and economic growth.

Initiative: Initial findings by the National Environment Agency (2010) about climate change impacts to Singapore identified flooding as one of the possible risks to the city. In addressing the risk of flooding and fresh water shortage, the Marina Barrage project was implemented in Singapore Central Business District. The project involves in damming up the Marina Bay from the sea, converting the originally salt-water bay into a fresh water reservoir.

Outcomes and Relevance to Practice: This single project serves several important functions. The first one is mitigating flood by building the 350 m long dam with 9 giant steel crest gates to prevent flooding caused by high tide. The bay itself acts as a storm-water holding during downpour period. When a storm coincides with a high tide, the excess storm water can be flushed into the sea by 7 giant pumps, each with a capacity of 40 cubic metres per second. This endeavour contributes to reduce substantial flood prone area in Singapore (PUB, 2008). Secondly, the project also serves as a fresh water reservoir – the largest one in Singapore with a catchment area of 10,000 hectares (PUB, 2012). Thirdly, the dam serves as a pedestrian bridge with public resting facilities. The building roof-top, mostly greened with turf and shrub and with the beautiful city skyline as backdrop, has become one of the very popular urban green space and venue for various public entertainment and leisure activities. The building provides an ideal venue for public outreach and education for sustainable urban development and lifestyle. It also facilitates public art activities, and is a tourist destination boosting the tourism industry in the city.

Essential 5: protect vital facilities: education and health

Case Study 8: Safe schools and new disaster-prevention education
Location: Sendai City Elementary and Junior High Schools

Context: In Sendai City, where a large earthquake occurs every few decades, schools are important public facilities that are designated as evacuation centres in times of disaster. Before the Great East Japan Earthquake, disaster counter-measures had been implemented based on the lessons learned from the Miyagi Offshore Earthquake that occurs every few decades, including earthquake-proofing buildings and essential utilities. To ensure the safety of children and secure school buildings' function as evacuation centres in times of disaster, seismic diagnoses and seismic retrofitting were carried out. In 2011, 100% seismic retrofitting was achieved. Moreover, all elementary and junior high schools had created disaster response manuals and were carrying out evacuation drills twice a year. Joint disaster-prevention projects were also promoted between communities, schools and the government as well as creating community maps and community-based evacuation centre operation manuals.

Initiative: After the Great East Japan Earthquake, one junior high school in each ward and multiple elementary schools in the same district were designated as model schools. At these schools, lessons are conducted based on each school's master plan and yearly teaching plan, and progressive research carried out and practices implemented for collaboration with families and the community in times of disaster. The results are used to improve city-wide disaster-prevention education. Furthermore, a chief of disaster prevention has been established at every school and also created and implemented yearly teaching plans for disaster-prevention education, and disaster-prevention education through collaboration with the community and children's guardians has been undertaken. Sendai City has also distributed independent counter-measures to all elementary and junior high school students to be used in each subject area.

Outcomes and Relevance to Practice: During the Great East Japan Earthquake, the fruits of our previous disaster-prevention efforts were seen, including earthquake-proof buildings, disaster-prevention education evacuation drills working, as well as minimized damage to buildings. In addition, despite the damage from a tsunami of a scale beyond all expectations, the life of every child inside a school building was saved, including those of children at the three coastal schools. Students were able to calmly take action. Based on experiences and the lessons learned in the Great East Japan Earthquake, progressive disaster-prevention education has been implemented and created model projects and held disaster-prevention forums, training programmes for chiefs of disaster-prevention, and examples posted of the use of the supplemental readers on the website to increase public awareness. Since damage to buildings was minimized and there were no casualties at schools in the Great East Japan Earthquake, the disaster prevention efforts can be assessed thus far as having definite results. In order for the city to be prepared for disasters, it is believed vital to continue to plan safe school architecture and progress with new disaster-prevention education based on experiences and the lessons learned in the Great East Japan Earthquake. It is believed that it will have a great effect on the inheritance that bequeath to the next generation who have not experienced a disaster.

Case Study 9: Integration of Hospital Safety Index into Health System of Iran

Location: Iran - The Ministry of Health and Medical Education in collaboration with Health Emergency Working Group in the National Disaster Management Organization, and National Platform of Disaster Risk Reduction.

Context: Iran is a disaster prone country with over 900 hospitals. The adverse impacts of disasters on Iranian hospitals have been enormous. For example, in

the Bam earthquake (2003), almost all public and private hospitals collapsed. The Zarand earthquake (2005) led to non-functionality of the district hospital for about six hours due to non-structural damages and absence of staff. In the East Azarbaijan earthquake (2012), the district hospitals almost collapsed including one hospital that had opened one year before the earthquake. A fire in Tehran's Arg Mosque in 2006 led to more than 100 burn injuries and challenged Tehran's hospitals' surge capacity and their ability to manage burn victims. A similar problem was observed following a bomb explosion in Shiraz (2009) that left 202 injuries.

Initiative: In 2011, Iran's Ministry of Health and Medical Education (MoHME) in collaboration with Tehran University of Medical Sciences assembled a multi-disciplinary group of experts, including doctors, nurses, disaster managers and engineers to help develop an adapted version of HSI for Iran. The HSI was translated to Farsi and tested in pilot hospitals. The content validity of the tool was assessed based on opinions of subject experts, and face validity was assessed using views of the hospital personnel. The adopted tool was called Farsi Hospital Safety Index (FHSI). To be comparable with the assessments in other countries, in FHSI, Iran kept the structure of the tool and number of items similar to the original HSI version. Modifications, however, were made to the section on guides to evaluators whenever appropriate, and, the calculation method was modified. Three national training workshops were carried out to train the provincial assessors.

Outcomes and Relevance to Practice: In 2012, MoHME endorsed the FHSI and required all the Iran's hospitals to assess their safety using FHSI and report back to MoHME. By September 2013, 224 hospitals conducted their assessment. The results were as follow: functional capacity (27.3%), structural safety (36.0%), non-structural safety (36.0%), overall safety (32.4%), and safety level (4 out of 10).

The assessment results were used to advocate the importance of hospital safety to the relevant authorities. Advocacy finally led to the 2014 edition of Hospitals Accreditation Protocol, ratified by MoHME, which included FHSI conduct and reporting as annual accreditation criteria. Today, all Iranian hospitals are mandated to assess their disaster safety using FHSI to renew their annual license. The two main indicators to measure the success of this initiative are the number of hospitals that conduct safety assessment using FHSI; and whether the programme has been integrated into the health system. By the middle of the current Iranian year, 315 hospitals (1/3 of total hospitals) have conducted their assessment. Furthermore, hospital safety assessment using FHSI has been included among the criteria of hospitals' accreditation, endorsed by Iran's MoHME. The annual safety assessment using FHSI is the first step to provide updated information that can be potentially leveraged for policy-making, and

evidence-based resources allocation. However, it is important to plan and conduct appropriate measures accordingly to enhance the hospitals' safety and reduce disaster risks. MoHME is working with provincial health authorities and hospitals to ensure that the information from FHSI is being used in planning and risk reduction measures.

Essential 6: Building regulations and land use planning

Case Study 10: Mainstreaming Climate Change Adaptation and DRR in local planning

Location: Andhra Pradesh (AP), India

Context: India is highly vulnerable to natural and anthropogenic disasters on account of geo-climatic settings. The implications of climate change in the Indian sub-continent are expected to be severe. This include sea level rise and associated impacts (like coastal erosion, storm surges, inundation and related coastal hazards), changes to the nature and frequency of extreme events, threats to water resources and ultimately affecting food security of the nation.

Dealing with the diverse needs of coastal communities and cities in Andhra Pradesh (AP) and considering the existing urban-rural linkages, the AdaptCap project aimed at reducing the vulnerabilities to climate change by interlinking climate change adaptation (CCA), climate change mitigation (CCM) and disaster risk reduction (DRR) activities. The coastal Andhra Pradesh (AP) region is generally categorised as holding moderate to high disaster risk. The Buckingham Canal separates the village of RamudupalliPalem from coast of the Bay of Bengal, which is 1 km away. During rainy season and extreme weather events (e.g. Storms), heavy water flow in the Buckingham Canal obstructed people's free passage to the seafront. With their safety at risk, livelihood activities are hampered and approximately 75 working days per year were lost. Additionally during occurrence of cyclones, nets and boats were often washed out and villager faced unforeseeable investments and debts, putting their fragile livelihoods even more at risk.

Initiative: The key themes addressed include disaster and climate risks experienced by coastal communities (particularly related to cyclones, saltwater flooding, extreme heat and drought), the case for, status quo of and key challenges for integrating CCA into DRR policies and planning in India, and a practice-oriented approach for mainstreaming CRDRR in local planning processes, which has been applied in several districts in Andhra Pradesh. It consists of four components: 1) participatory climate change vulnerability and needs assessments in local communities, 2) integration of key risks into local

DRR strategies and plans, 3) pilot technical measures for CRDRR and 4) capacity development supporting all other components.
In order to improve the living condition, community built a sturdy and safe causeway over the canal to facilitate a year-round access to the seafront. Large pipes allow the canal water to flow freely underneath. The road is surfaced with gravel and dirt to match level with the rest of the road to the sea. Sand is deposited to provide a foundation under the large pipes, fixed by a 0.3 metres gravel layer. A metal layer on top provides the foundation for the road. The government has built other storm resistant sheds in the area which can be used as models.

Outcomes and Relevance to Practice: Participatory climate change vulnerability and needs assessments- The community members came to share a common understanding of the issues faced (Table 2). The process allowed community members to examine their experiences with climate change and disaster risks, and discuss the triggers and possible solutions to the difficulties at hand.
The interventions improve the climate-resilience of their livelihoods, safety, and income security of their fishermen and women
This case study presents an approach for integrating Climate Change Adaptation into local Disaster Risk Reduction planning processes, developed and implemented in coastal communities in Andhra Pradesh.

Community based adaptation measures, worldwide have been successful in demonstrating the resilience building at local levels. It is essential to enable national and local actors - policy makers and planners – to better understand how to support communities which are increasingly at risk of disasters. This should be facilitated by the growing recognition amongthe different communities of the added value of DRR, CCA and CCM, in particular in the context scarce financial resources. The DRR and humanitarian communities have agreed that, in order to be successful, activities should, to the extent possible, be climate-proof and, when possible and relevant, take into account the potential risks induced by a changing climate.

Case Study 11: Mainstreaming disaster risk reduction values through town planning by public-private partnership
Location: Sendai City, Japan

Context: Sendai City, like many cities in Japan, is prone to disasters. Still fresh in the minds of many is the destruction brought by the March 2011 tsunami, which took the lives of 908 and left a great deal more injured and/or homeless in the city. Since then, Sendai has been striving to ensure resiliency is at the core of its numerous rebuilding efforts.

Tagonishi was initially intended as a low-carbon urban development. The 2011 tsunami struck as preparations for construction were underway, dramatically changing the course of the project to include stronger emphasis on disaster resiliency through town planning.

Initiative: When the Tagonishi area was named a relocation area, Kokusai Kogyo decided to add disaster resilience to their basic project concept. This decision was made in consideration of the future residents of Tagonishi, who had survived the GEJ earthquake and tsunami, as well as a long period of inconvenience afterwards, when access to everyday necessities and basic utilities such as electricity was nonexistent or difficult. It is not actually easy for private companies to invest in measures against disaster risk, because their stakeholders demand economically clear and short-term benefits in return for their investments. Central to GC Tagonishi's DRR strength lies in its unique community management framework, with the Sendai Green Community Association at its core. Kokusai Kogyo, with its extensive experience in disaster risk reduction, urban planning and real estate development, was well aware that having all the latest disaster risk reduction technologies, strategies, plans, contingencies and even disaster drills and community dialogue, would be insufficient and unsustainable in the long term.

Outcomes and Relevance to Practice: Highlighted will be the 'soft' side, community consensus building, management structures, intricate partnerships and cooperation at multiple levels, and evacuation route and contingency planning, as well as the more traditional 'hard' measures such as electricity independence technologies and multi-purpose community/evacuation centre. For successful replication there are many hurdles that need to be overcome, and while these will differ according to geography and culture and so on, those encountered at Tagonishi should serve as valuable lessons learned to those to follow. There were organizational issues, both inter and intra. The complexity of the project necessitated the involvement of personnel of varying expertise from various departments of companies, public sector organizations, academia and civil society.

Essential 7: Training, education and public awareness

Case Study 12: Community Emergency Response Teams-Youth (CERT-Youth)

Location: 12 Rural Communities, Sri Lanka

Context: Over the past few decades, disaster losses in Sri Lanka have increased substantially. The country is prone to natural disasters caused by floods, cyclones, landslides, drought and coastal erosion with increasing instances of

environmental pollution related hazards. The devastation caused by the Indian Ocean tsunami of 2004 has highlighted that Sri Lanka is also vulnerable to low-frequency; high impact events which cause extensive damage and reverse years of development gains.

While emergency services personnel are the best trained and equipped to handle emergencies, they may not be immediately available in a catastrophic disaster. In such a situation, members of the community may be on their own for several days or longer. They may have to rely on their own resources for food, water, first aid, and shelter, and neighbours or co-workers may have to provide immediate assistance to those who are hurt or need other help. The tremendous contributions that young people can make to disaster management are largely untapped.

Initiative: When a disaster strikes in any given community at least one third of the victims are represented by youth and children. Youth is a great resource which is available to use in disaster management activities. CERT-Youth is designed with the goals of increasing resilience in rural communities to face disaster and emergency situations by providing professional training to youth and encouraging volunteerism among them. Receiving professional training standardize the level of training each CERT member receive and will help them to work with professional relief workers when they arrive at the incident.

Outcomes and Relevance to Practice: CERT national curriculum will included Introduction to disasters preparedness; Fire safety and utility control; Basic disaster medical operations; Life search and rescue operations; Disaster psychology and how to act in terrorism. After finalizing the curriculum CERT-Youth project team trained 12 teams in 12 most vulnerable rural communities in Sri Lanka. Each team contained 50 members and CERT- Youth trained 50 master trainers to conduct future trainings.

Essential 8: Environmental protection and strengthening ecosystems

Case Study 13: Infuse system to reduce risk of water scarcity in Timur Tengah Utara (TTU) district

Location: Timur Tengah Utara (TTU) district, Indonesia

Context: Drip irrigation consists in slow and controlled administration of water in the area of the root system of the plants and is considered to be one of the variants of localized irrigation. Water is distributed in a uniform and slow manner, drop by drop, in a quantity and with a frequency that depend on the needs of the plant. Drip irrigation has been widely studied and concluded giving higher

productivity of mandarin fruit crops with automatic drip system in Nagpur, tress and vegetables in Egypt, winter wheat in semi arid region, tomato plants, apple tree in hilly area, sesame plants.

Exposure of water scarcity in Timur Tengah Utara (TTU) district, Nusa Tenggara Province (NTT) occurs due to its semi arid climatic and topography condition. Slow onset disaster which is also affected by climate condition like drought is well experience by most people in TTU. Water scarcity that added by mismanagement of water supply may lead to drought condition, is main hazard in semi-arid area such as TTU district, in NTT province in Indonesia. While people's main livelihood is agriculture, reducing vulnerability and increasing adaptive capacity in that livelihood sector becomes urgent need to build people resiliency in dealing with the particular hazard.

Initiative: The initiative came out from experiences inherited from old people, based on difficulty fetching and bringing water to farm location on hilly side. The infuse system practice is drawn from good practice implemented in TTU district, particularly in one project location of Plan Indonesia's Child Centered Climate Change Adaptation (4CA).

Outcomes and Relevance to Practice: Local practice, in the scope of DRR, such an infuse system would minimize the exposure risk of water scarcity in farming sector. Infuse system has almost similar application with manual drip irrigation system in agriculture which water enters into the soil through small emitters to keep soil moist and water stress in the root zone does not generally occur and plants use water more efficiently. The concept of drip is successfully practiced on large and small commercial scales in the arid and semi-arid regions around the world, such as in Australia, Israel, Jordan, Mexico, South Africa, and USA (Belder and others 2007). Water is distributed much more efficiently with drip irrigation than conventional flood and sprinkler systems (Maisiri and others 2005; Polak and Yoder 2006) and surface irrigation (Albaji and others 2008; Kalkhajeh and others 2012), reducing the total amount of water required to grow a crop. For farmers who carry water to their gardens in buckets or watering cans, any interventions that save time, save water and reduce labor demands would help to develop effective agricultural application as well as to consider as local adaptive initiative to reduce impact of water scarcity hazard.

Infuse system is a cheap and simple technology, as well as it is environmental safe, can deal water scarcity hazard in farming livelihood sector in semi arid area, it also could bringing other benefits to farmers such as saving time, man power, and water required to make trees and plants grow more fertile.

Disaster risk reduction could be achieved by reducing exposure of hazard. In some regions, for example in TTU, hazard of water scarcity could not be avoided due to its natural climatic and geographical condition. However, its exposure and people vulnerability can be reduced by such an innovative and simple practices, and using existing material locally.

Case Study 14: Application of Micro Irrigation System, Green House and Mulching in DRR

Location: Junagadh district of Gujarat state, India

Context: Due to climate change, wind velocity, temperature, humidity, soil temperature, rainfall and its distribution, evaporation and transpiration and natural disasters all affect which resulted into decrease in agricultural productions. To maintain production of various field crops, vegetable crops, flowers and fruit crops advance agricultural technologies are useful. Junagadh district of Gujarat state cultivating field crops like Groundnut, Wheat, Jowar, Bajra, Maize, vegetable crops like Brinjal, chili, tomato, bhindi, guards etc and fruit crops like mango, banana, coconut, chikoo.

Draught or Heavy rain is a challenge against crop production; either it may be field crops, vegetable crops or fruit crops. Due to this availability of water, temperature and humidity is changed, so that crop many not be able to produce well. In Gujarat, especially in Junagadh district farmers are cultivating cereals like wheat, bajara, jowar, maize, oil seeds like groundnut, til, pulses like green gram, black gram, chickpea cash crop like vegetable crops like brinjal, tomato, chili, bhindi, fruit crops like mango, coconut, papaya etc. The production of these crops is mainly dependent on rainfall, distribution of rain, temperature and humidity. This climate change has very serious impacts on the ecosystems of the region. Ladakh and its water sources are almost entirely dependent on the glaciers and snow-mesh and changes in water systems can be directly attributed to changes in glaciers and thus climate change.

Initiative: To control these changing climate factors farmers using micro irrigation system to fulfill the water requirement of crops in water stress, mulching to maintain soil moisture and optional soil temperature. Various green houses to maintain temperature, humidity in air. These three technologies are included in high tech agriculture.

Adoption of micro irrigation might help in raising the irrigated area productivity of crops and water use efficiency. Investigations was undertaken to assess the influence of plastic mulching with drip irrigation on fruit yield. The modern irrigation technologies like drip irrigation, which offers efficient and judicious use

of irrigation water in draught condition. Drip irrigation continuously reaping soil moist in the rhizosphere has opened near vistas in the scenario for horticultural crops.

Outcomes and Relevance to Practice: Mulching is more useful in fruit crops like mango, chickoo, coconut, banana etc. 50 to 60 percent farmers are adopting mulching to maintain soil temperature and soil moisture in horticultural crops. It reduces 25 to 35 percent water requirement of crops during drought condition. 30 to 35 percent farmers are adopting low cost Green houses which reduce 20% of water requirement in controlled condition and increase 18-24% agricultural production.

Drip irrigation system is more useful in draught condition for fruit crops because the water requirement of fruit trees are more but drip is given to root zone only. 70 to 80 percent farmers are adopting Drip Irrigation systems and 25 to 40 percent farmers adopting sprinkle irrigation which saves 35 to 70 percent and 25 to 35 percent of water respectively.

Due to climate change like draught or heavy rain the crops would not able to get optimum water. The farmers must adopt micro-irrigation system. Drip irrigation system provides adequate water to crop plants directly to the root zone. We can provide fertilizers with the water. It requires very less amount of water compared to open irrigation. So each farmer has to take advantage of micro-irrigation system to save water and maximum production in changing climate.

In changing climate condition soil become dry, soil temperature increased and evaporate soil moisture, so the crop sown in it would not get moisture. So farmers have to adopt mulching technique with the help of plastic or plant residues. Any type of mulch reduces water evaporation, maintain soil moisture and reduce soil temperature. So they can get maximum crop yield.

To maintain atmosphere temperature, humidity in air and to protect the crops against heat, wind, chilling, the green house is best technique. Farmers have to follow any type of green house according to material availability. Under green house, we can provide optimum temperature and humidity to crop plants, so they produce maximum.

Essential 9: Effective preparedness, early warning and response

Case Study 15: Improving the social performance of flash flood early warnings using mobile services

Location: Sunamganj, Bangladesh

Context: Bangladesh is a flat deltaic country located at the lower part of the basins of three large alluvial rivers, the Ganges, the Brahmaputra and the Meghna. It includes 57 trans-national rivers and a total river basins area of 1.7 million km2, see figure 1. The numerous tributaries of these rivers and extensive floodplains are the main physiographic feature of the country. These features combined with high rainfall result in one-fifth to one-third of the country being flooded during monsoon. Flash floods are a recurrent and hazardous phenomenon in the north eastern, agriculturally dominated districts, positioning this agricultural sector at huge risk each year. An effective flood early warning system, as a disaster risk reduction (DRR) initiative, can promote both national and local level disaster resilience to flooding, by saving lives and reducing livelihood losses.
A warning cannot be considered effective until it is received, understood and responded to by those at risk. The social performance of warning communication techniques is important to achieve an effective warning.

Initiative: The total number of mobile phone subscribers in Bangladesh is 116 million as of February 2014 (BTRC, 2014). The main available mobile service technologies for pushing warning or alert information in an emergency are Short Messaging Service (SMS), Voice SMS and Cell Broadcasting Service (CBS). Interactive Voice Response (IVR) services are information pull based, where users can query information when requested through a specific phone number and dialling options. Awareness-raising was recognised as a key element to the success of all three mobile services, in particular for CBS and IVR.

The study area of this research is the low lying, flash flood prone district of Sunamganj located in the North-Eastern part of Bangladesh. Four Unions (Solukabad, Jagaddal, Uttar Sreepur and Surma) within the Sunamaganj District were selected for the local level field work in order to get a broader overview of the current flash flood situation. At the local level the FGDs included ten FGDs with different community end user groups including farmers and fisher- farmers which represent the key livelihood groups, and women in order to distinguish their views, beliefs to those of the men.

Outcomes and Relevance to Practice: Overall the most pressing challenges for using SMS and CBS are the inability to have a Bangla message, the need to provide simple and easily understandable messages and to reach all end users on different mobile phone networks. Strong social networks were identified between the Imams, village police, teachers, agricultural officers, embankment construction workers, microfinance groups and information centers, with the community. These could play a significant role in awareness raising and warning dissemination.

The following important measures were identified for the effective use of mobile services to improve the social performance and drive community resilience.

Decentralise the warning generation and dissemination process and integrate a feedback system: The FFWC should continue their efforts to improve the quality, accuracy and lead time of the flash flood information but integrate a feedback system so information (indigenous knowledge/local conditions) can be gathered from local social networks. BWDB at the district level should gradually play a more central role warning generation and dissemination.

Utilise the strong social networks at the local level: To support the local government (UP and UDMC) in warning dissemination, awareness raising and training for the use of mobile services in early warning communication.
Voice based services should act as a key part of the warning communication system: Messages disseminated through them are more easily accessible, more likely to be paid attention to and understood by the end users. The IVR service of DDM should be prioritised and must think seriously about integrating the push based Voice SMS into their system.

Utilise push-based services to alert and pull based services to inform: Active information should be provided to alert people where there is serious danger (push) e.g. SMS, CBS, complemented with passive information allowing end users to collect information upon demand (pull) e.g. IVR.

Provide different levels/ types of information: The current methods used at DDM including IVR, SMS and CBS must be extended to more specifically target flash flood areas. For IVR a specific option can be made where flash flood related and daily weather information is available. To ensure sustainability year round non-emergency information (weather alerts, preparedness measures) should be also included in the service. Text based messages (SMS and CBS) should use symbols and local measuring units (hat/ bighat).

Enhance awareness raising and training efforts: In particular to networks at the local level so they are involved in awareness raising, preparedness activities, feedback of information, warning interpretation and aid response.

Understand and reduce the technical obstacles: Such as operator-based access, language incompatibilities and lack of CBS infrastructure.

Case Study 16: Information Management Tools for Disaster Preparedness and Resilience at Community Level in Central America
Location: El Salvador and Honduras, Central America

Context: In El Salvador and Honduras, as well as the rest of Central America, the number of disasters due to meteorological and hydrometeorological events has been doubling in every decade compared to the previous one, showing increasing levels of risk and vulnerability. Hazards like earthquakes, volcano eruptions, droughts, landslides and erosions constantly threaten the lives and livelihoods of the most vulnerable populations. As vulnerable communities are the first to respond in case of disaster, it is crucial to promote, monitor and measure disaster preparedness and disaster resilience at the community level.

Since the 4th DIPECHO Action Plan in Central America in 2006, “Country documents” analyzing hazards, vulnerabilities and disaster risk reduction capacities have been elaborated and have continuously developed more sophisticated tools for assessing disaster risk at municipal, departmental and national level. Within the framework of the DipECHO Action Plan for Central America there has been a concern that due to elevated costs and reduced time schedules it has not been possible to reach the community level in the disaster preparedness and resilience assessments. Additionally these assessments often focused on matters of operational disaster preparedness and response capacity without considering many other aspects necessary for complete assessment of the disaster resilience of affected populations which is key to sustainability reduce disaster risk.

Initiative: In 2013, within the framework of the VIII DIPECHO Action Plan in Central America, a joint collaboration has been undertaken in El Salvador to design a general appraisal of vulnerability and disaster preparedness at community level. The first part was developed from November 2012 to May 2013. The aim was to generate a relevant synopsis of the community conditions in order to orient and prioritize disaster preparedness capacity strengthening initiatives, and at the same time maintain the number of questions as reduced as possible to keep the application feasible for municipal staff with limited resources and time. The piloting of the instrument was completed in coordination with DIPECHO partners in El Salvador, applying the survey in 25 communities of 7 municipalities in 5 departments.

The “Measurement of Community Disaster Resilience”(MCDR Toolkit) was designed for use by technical staff experienced in disaster resilience and should be used in conjunction with other best practice instruments for community consultation and analysis on disaster risk in order to obtain the fullest understanding possible of all the different and complex aspects of disaster resilience at community level.

Outcomes and Relevance to Practice: The tool overcomes the challenge of extensive community assessment, since it offers an inexpensive and rapid

alternative. The “Matrix of community vulnerability related to disasters” assists in unifying criteria on disaster preparation and assessing the capacities at community level. An added value is the inclusion of gender aspects and the protection of special vulnerable groups, issues that according to The Global Assessment *Report* on Disaster Risk Reduction (*GAR*) remain still ignored in most assessments. With an open data kit, the survey could be applied by mobile phones, using an operative Android system. The field data can be accessed on a WEB server without necessity to field connection.
From the measurement results it can be concluded that in order to continue to build resilience to higher levels further emphasis must be placed on reducing vulnerabilities and strengthening governance and institutional capacities to sustain and build on the advances made.

An important lesson learnt is that Resilience building activities are context specific, dependent on the risks the community is exposed to and the assets and resources available to cope with a shock or stress occurring. The measurement tool covers a broad range of resilience characteristics each of which can be tailored to the specific context using a weighting system. This comprehensive assessment allows for the specific context to be analysed in detail in order to plan and design appropriate interventions at community level.

Essential 10: Recovery and rebuilding communities

Case Study 17: Conflict Prevention through Post Conflict Housing Reconstruction

Location: Northern and Eastern Provinces, Sri Lanka

Context: Since, 1983, the conflict resulted in a number of violent phases over 26 year period in Sri Lanka by causing an immense amount of damage. Therefore, Northern and Eastern Provinces, which had been the main battlefield of the conflict, left underdeveloped in comparison with areas the government had controlled. Many people have experienced multiple and protracted displacements during their lifetime due to the cycles of violence.

Infrastructure and housing in most of the North and East had already been severely damaged by the war and reconstruction of conflict affected areas was identified as a major challenge in Sri Lanka. Post conflict reconstruction plays an important role in development and peacekeeping.

Initiative: Post conflict housing reconstruction contributes to development and peace building through the restoration of social and economic life of conflict affected people. It also promotes gender equity and empowerment. As conflicts lead to change the gender roles through creation of high number of female

headed households, it is acknowledged that they need to be given special consideration in post conflict interventions. Housing reconstruction also has important implications for the legitimacy and stability of the state. In this way, the housing reconstruction enables communities to foster goodwill towards the governing institutions through providing sufficient, timely and transparent assistance.

Outcomes and Relevance to Practice: The approach to reconstruction of housing in the original places over relocation and traditional construction over pre-fabricated housing enhanced beneficiary satisfaction and occupancy. Low income and vulnerable people were prioritised in accessing housing assistance while beneficiaries' livelihoods were enhanced though livelihood support packages and construction craftsmen training. These as well as the involvement of local labour and material developed the local economy. Furthermore, local construction materials and local labour involvement in housing reconstruction enhanced the community linkages. Participatory approach to construction promoted a sense of ownership towards housing while reducing the cost of construction. Nevertheless, low income families faced with difficulties in completing the construction, which hindered privacy and security. Also, female head households faced difficulties in contributing unskilled labour and constructing a habitable house with the grant provided.

Low income families faced with difficulties in completing the construction, which hindered privacy and security. It is suggested the need for tailoring the financial grant based on the special requirements of vulnerable families such as female head households.

Case Study 18: Advantages and Limitations of Community-based Post-disaster Housing Reconstruction Project
Location: Aceh and Nias, Yogyakarta and Central Java, and West Suamtera, Indonesia

Context: Located in the juncture of four tectonic plates, Indonesia is frequently hit by earthquakes. In recent years, the occurrence of large earthquakes has increased significantly. Examples of devastating earthquakes include earthquake in Aceh at the end of 2004 that measured 9.0 on the Richter Scale, the 6.3 Richter Scale Yogyakarta earthquake in 2006 and the 7.6 Richter Scale West Sumatra earthquake in 2009. Earthquakes have created considerable losses to Indonesian communities including fatalities, economic losses and number of houses heavily damaged. The total numbers of destroyed/ heavily damaged houses in these areas are more than 500,000 houses and as a result, a number of housing reconstruction programmes have been conducted.

Initiative: For post-disaster housing reconstruction, community is defined as groups of beneficiaries of housing reconstruction whose houses have been affected by disaster. Community-based approach is one method that can be applied on post-disaster housing reconstruction. This method has several advantages. In this approach, the community have a significant amount of control over the project. However, its implementation was not always without problems. The case studies areas are the housing reconstruction after Aceh earthquake and tsunami in 2004, Yogyakarta earthquake in 2006, and West Sumatra earthquake in 2009.

Outcomes and Relevance to Practice: Study revealed 22 advantages of the implementation of Community-based Post-disaster Housing Reconstruction project (CPHRP) in Indonesia. The most significant is 'create sense of ownership', followed by 'build beneficiaries' confidence', 'fit to local culture/customs/wisdom', and 'minimise corruption'. Further, it found that psychological advantages are more dominant compared to physical advantages, particularly when comparing with construction advantages.

Psychological advantages are a distinct advantage of CPHRP, and can contribute to the success of CPHRP. There are two limitations to the implementation of the community-based method in post-disaster housing reconstruction. The first relates to the system of CPHRP. This method requires a long pre-construction process. In the implementation of real community participation, many activities during pre-construction stage, such as forming a community organisation, requires a long time to be completed. On the other hand, the nature of a post-disaster reconstruction project requires that the housing project be completed in the shortest time possible. Rushing the participatory process can hinder the real participation of beneficiaries. The second limitation relates to the capacity of stakeholders. The understanding of stakeholders of the principle of the community-based approach, particularly at project level, is still very limited. The capacity of government, facilitators, and community itself need to be enhanced. This should be carried out long before a disaster takes place.

5.0 Conclusion

This chapter provides a collection of sound practices on DRR that have been tested and implemented in different cities around the world to reduce disaster risks within their cities. The ten essentials identified by the United Nations International Strategy for Disaster Reduction (UNISDR) making cities resilient campaign was used as the basis to illustrate the sound practices that have been undertaken across the world.

The chapter starts with how tsunami affected Batticaloa city of Sri Lanka successfully built the institutional structures and systems to coordinate the disaster management activities at national and local level. Indonesia too suffered severely due to the Indian Ocean tsunami in 2004, and the case study 2 demonstrates how the Ache Province successfully carried out the reconstruction with the involvement of the local community. The case study illustrates how the participation of the local community and civil society were manifested in all phases of the reconstruction process, which is a very good example for other regions to determine how the community could be engaged in the reconstruction process.

A substantial amount of flexible budget is required for post-disaster recovery projects, and securing of such budget is another major challenge for most of the nations. In addressing the budgetary constraints, case study 3 presents how Great Hanshin-Awaji Earthquake Reconstruction Fund was established and secured to implement projects for promptly meeting the multifaceted needs of disaster victims over the long-term as well as on a stable and flexible basis. Case study 4 and 5 demonstrate how Sindh Province, Pakistan and South Australia have successfully carried out the risk assessments to determine high disaster risk areas. In the Sindh Province, a number of initiatives have been implemented using remote sensing and GIS to identify high hazard risk areas. Similarly, by implementing the Zone Emergency Risk Management System (ZERMS) Project, South Australia was able to address multiple hazards across the total prevention, preparedness, response and recovery (PPRR) spectrum in South Australia's eleven regions.

Infrastructure protection, upgrading and resilience is another key essential in the UNISDR's camping and case studies 6 and 7 illustrate how the coastal village of Kumarakudi in Tamil Nadu protected community's agricultural fields from flooding and salinization; and how the Marina Barrage project was implemented in Singapore Central Business District to address the risk of flooding and fresh water shortage.

Case study 8 is another good example of sound practice, which demonstrates how the safety of schools was ensured in Sendai, Japan during the Great East Japan Earthquake, when the life of every child inside a school building was saved, including those children at the three coastal schools. Protecting hospitals is also a key requisite in building resilience, because if the hospitals fail at a disaster, the damages would be much greater. In protecting the hospitals, Iran has initiated a Farsi Hospital Safety Index (FHSI), and all the Iran's hospitals are now required to assess their safety using FHSI and report back to Ministry of Health and Medical Education, which is a worthwhile initiative to protect the vital facilities such as hospitals.

Case study 10 presents an approach for integrating climate change adaptation into local disaster risk reduction planning processes, developed and implemented in coastal communities in Andhra Pradesh, India. The case study illustrates how the community members came to share a common understanding of the issues faced and how the process allowed community members to examine their experiences with climate change and disaster risks, and discuss the triggers and possible solutions to the difficulties at hand. Case study 11 provides another good example for effective use of building regulations and land use planning. Accordingly, case study 11 illustrates how the Tagonishi area in Japan mainstreamed disaster risk reduction values through town planning by public-private partnership.

Training, education and public awareness is yet another important essential identified by the UNISDR as part of their 10 point check-list in making resilient cities, and case study 12 presents how the resilience of rural communities were increased in Sri Lanka to face disaster and emergency situations by providing professional training to youth and encouraging volunteerism among them. Case study 13 and 14 demonstrate how Timur Tengah Utara (TTU) district, Indonesia adopted an infuse system to reduce risk of water scarcity and how Junagadh district of Gujarat state, India applied Micro Irrigation System, to fulfill the water requirement of crops in water stress, mulching to maintain soil moisture and optional soil temperature.

Case study 15 provides another good example on how Sunamganj, Bangladesh successfully implemented flash flood early warning system with the mobile service providers. In doing so, available mobile service technologies such as Short Messaging Service (SMS), Voice SMS and Cell Broadcasting Service (CBS) were used for pushing warning or alert information in an emergency and at the same time, Interactive Voice Response (IVR) services were created to facilitate querying information when requested through a specific phone number and dialling options. Similarly, case study 16 presents how information management tools for disaster preparedness and resilience were developed and implemented at community level in Central America. Case study 17 and 18 illustrates sound practices for recovery and rebuilding communities. Accordingly case study 17 presents how conflict could be prevented through post conflict housing reconstruction in the context of Northern and Eastern Provinces, Sri Lanka and case study 18 highlights some advantages and limitations of community-based post-disaster housing reconstruction project in Aceh and Nias, Yogyakarta and Central Java, and West Suamtera, Indonesia.

With the UNISDR's campaign on making cities resilient, many cities have started working on reducing risks of disasters. The identified sound practices are very few of many sound practices implemented around the globe. Reporting these sound practices provides the opportunity to share and transfer the knowledge

and good practices across various cities, regions and countries. Accordingly, it is intended to improve the knowledge sharing opportunities between cities by reporting practices that have been already tested and implemented by one city and that can be successfully adapted by another. However, it is important to note that cities face many challenges in adapting these sound practices. Some of the challenges faced by the cities in learning from sound practices are discussed below.

Political will and leadership: Political will and the leadership is essential in implementing DRR at city levels and it has been observed that some of the city governments do not give adequate consideration to DRR. There may be many underlying causes for lack of political will and leadership and some of which includes financial constraints; human resource constraints; lack of knowledge and awareness; different priorities; lack of mandates for DRR; and unclear roles and responsibilities. All these issues adversely affect the process of learning from the sound practices.

Budgetary constraints: Budgetary constraints are yet another challenge for learning from sound practices, especially for developing countries. To replicate these sound practices specific budgets need to be allocated, especially for practices such as risk assessments, infrastructure upgrades and resilience, early warning systems, etc. and all cities cannot afford to implement these practices if they do not have a specific and sufficient budget for DRR.

Science, technology and expertise: Similar to budgetary constraints, access to science, technology and expertise are limited in some cities and these act as a barrier in implementing and replicating sound practices, especially practices related to use of advanced science and technology in reducing disaster risks.

Inter-intra organisational trust: Due to lack of trust between organisations, some organisations are reluctant to learn from others and to replicate the practices that other organisations have implemented. Thus, it is important to strengthen the relationships between the organisations, and to facilitate the transfer of good practices and knowledge sharing opportunities. Accordingly, networks need to be built within and across countries to facilitate knowledge sharing and to transfer good practices.

Information requirements: To learn from sound practices, detailed information is required on the context, adopted methods, strategies and outcomes. Some of these detailed data and information are not readily available. Most often, published sound practices are in very abstract forms and in order to be replicated, more in-depth information might be necessary and these sometimes can act as a barrier when adapting successfully to another city.

Thus, it is important to address these constraints in order to ensure transfer of knowledge and good practices. Accordingly, substantial efforts are required from

all the related stakeholders, especially, from the media sector, in publicising these sound practices and to facilitate knowledge transfer between cities, regions and countries.

6.0 List of Input Papers

Arora, R., Chaturvedi, A., Saluja, M.S., Gupta, A.K., Nair, S., and Singh, S., (2014), Climate Resilient Disaster Risk Reduction (CRDRR): Mainstreaming Climate Change Adaptation and DRR in local planning – Experiences and Approaches from two Indian coastal states (Corresponding Author: rachna.arora@giz.de)

Chi-Nguyen, W., (2014), Urban Climate Risk Reduction Projects in the Making of Resilient and Innovative Development (Corresponding Author: cncam@alumni.nus.edu.sg)

Cumiskey, L., Werner, M., Meijer, K., Fakhruddin, S.H.M., and Hassan, A., (2014), Improving the social performance of flash flood early warnings using mobile services: A disaster risk reduction (DRR) initiative to drive resilience at the local level in Bangladesh (Corresponding Author: cumiskey.lydia@gmail.com)

Hild Rivera, A.C., McCaul, B., and Mitsidou, A., (2014), Information Management Tools for Disaster Preparedness and Resilience at Community Level in Central America (El Salvador and Honduras) (Corresponding Author: ahildrivera@gmail.com)

McLean, J.P., and Abe, Y., (2014), Our future neighbourhoods will look like this: mainstreaming disaster risk reduction values through experimental town planning by public-private partnership (Corresponding Author: james_mclean@kk-grp.jp)

Ngurah, I., (2014), Local practice on infuse system to reduce risk of water scarcity in Timur Tengah Utara (TTU) district: A case study on Child-centred Climate Change Adaptation project of Plan Indonesia (Corresponding Author: ida.ngurah@plan-international.org)

Ophiyandri, T., Amaratunga, D., and Pathirage, C.P., (2014), Advantages and Limitations of Community-based Post-disaster Housing Reconstruction Project (Corresponding Author: ophiyandri@ft.unand.ac.id)

Seneviratne, K., Amaratunga, D., and Haigh, R., (2014), Conflict Prevention through Post Conflict Housing Reconstruction: Good Practices and Lessons Learned (Corresponding Author: K.Seneviratne@hw.ac.uk)

Vandra, D., and Tank, A., (2014), Application of Micro Irrigation System, Green House and Mulching in DRR in Indian Agriculture (Corresponding Author: dhirenvandra@yahoo.com)

Wamsler, C., and Brink, E., From Adaptive Capacity to Adaptation: Rethinking the Interface between Institutions and Citizens (Corresponding Author: christine.wamsler@lucsus.lu.se)

7.0 References

AFP. (2012), "Disasters cost $366 bn in 2011: UN", AFP, Available at: http://www.google.com/hostednews/afp/article/ALeqM5gf4gEkooQrptpk9sqy0-UDPrmYDw (accessed 29 February 2012).

Ahmed, M. & Iqbal, K. (2009), "Disaster and decentralisation", Department of Economics, Carleton College, available at: apps.carleton.edu/curricular/econ/assets /200903.pdf (accessed 30 May 2010).

Amaratunga, D & Haigh, R (2014), The full proceedings of the 4th International Conference on Building Resilience, Incorporating the 3rd Annual Conference of the ANDROID Disaster Resilience Network, A volume of Procedia Economics and Finance, Volume 18, Pages 1-976 (2014), with full open access, indexed in ScienceDirect by ELSEVIER (ISSN: 2212-5671).

Amaratunga, D & Haigh, R (2013), Full proceedings of the International Conference on Building Resilience: Individual, institutional and societal coping strategies to address the challenges associated with disaster risk, Full conference proceedings, ISBN 978-1-907842-43-6 (http://www.buildresilience.org/2013/proceedings)

Ardalan, A., Saberinia, A., Khorasani, D., Khankeh, H., Masoumi, R., Maleknia, S. and Kandi, M. (2015), "Integration of Hospital Safety Index into Health System of Iran", Celebrating the success of HFA, available at: http://wp.preventionweb.net/wcdrr/integration-of-hospital-safety-index-into-health-system-of-iran/ (accessed 26 June 2015)

Bendimerad, S. (2003), "Disaster risk reduction and sustainable development", available at: http://info.worldbank.org/etools/docs/library/114715/istanbul03/docs/istanbul03/05bendimerad3-n[1]. pdf (accessed 29 May 2010).

City of Sendai (education Bureau). (2015), “Safe schools and new disaster-prevention education”, Celebrating the success of HFA, available at: http://wp.preventionweb.net/wcdrr/safe-schools-and-new-disaster-prevention-education/ (accessed 26 June 2015)

Government of South Australia. (2015), “Building resilience in South Australia – a better understanding of risk”, Celebrating the success of HFA, available at: http://wp.preventionweb.net/wcdrr/wp-content/uploads/sites/2/Australian-Case-Study-Building-Resilience-in-South-Australia-A-better-understanding-of-risk.pdf (accessed 26 June 2015)

Hayat, E. (2015), “Evaluation of local governments capacity in the maintenance of post-disaster road reconstruction assets”, (unpublished doctoral thesis, University of Salford, 2015)

Kusumasari, B., Alam, Q. and Siddiqui, K. (2010), Resource capability for local government in making disaster. Disaster prevention and management 19(4), 438-451.

Macmanus, S.A. and Caruson, K. (2006), Code Red: Florida City and County Officials Rate Threat Information Sources and the Homeland Security Advisory System. State and local government review 38(1), 12-22.

Malalgoda, C., Amaratunga, D., Haigh, R. (2013), Creating a disaster resilient built environment in urban cities: the role of local governments in Sri Lanka. International Journal of Disaster Resilience in the Built Environment 4(1), 72-94.

Malalgoda, C., Amaratunga, D., Haigh, R. (2014). Challenges in Creating a Disaster Resilient Built Environment. Procedia Economics and Finance 18(0), 736-744.

Malalgoda, C. (2014). “Empowering local governments in making cities resilient to disasters”, (unpublished doctoral thesis, University of Salford, 2014)

Manyena, S.B. (2006), Rural local authorities and disaster resilience in Zimbabwe. Disaster Prevention and Management 15(5), 810-820.

Murata, M. and Nakatsu, N. (2015), “The Great Hanshin-Awaji Earthquake Reconstruction Fund”, Celebrating the success of HFA, available at: http://wp.preventionweb.net/wcdrr/wcdrr_load.php?id=4148&disqus=1 (accessed 26 June 2015)

Niekerk, D. (2007), "Local government disaster risk management", in: Waldt, G. (Ed.), Municiple management: serving the people, Juta and Company Ltd., Cape Town, pp. 227-250.

O’Keefe, P., Westgate, K., Wisner, B. (1976), Taking the naturalness out of natural disasters. Nature 260(1), 566-567.

Osei, P.D. (2007), Policy responses, institutional networks management and post hurricane Ivan reconstruction in Jamaica. Disaster Prevention and Management 16(2), 217-234.

Pearce, L. (2003), Disaster management and community planning and public participation: how to achieve sustainable hazard mitigation. Natural Hazards 28 (2-3), 211-228.

Pelling, M. (2003), The vulnerability of cities, Earthscan Publications Ltd, London.

PUB. (2008), “Singapore’s first reservoir in the city realised”, available at: www.pub.gov.sg/mpublications/Pages/PressReleases.aspx# (accessed 23 October 2008).

PUB. (2012), Water for All: Conserve, Value, Enjoy, PUB, Singapore.

Sabri, N.R. & Jaber, R.Y. (2007), Managerial performance of Palestinian local authorities. Transforming government: people, process and policy 1(4), 350-363.

Satterthwaite, D., Huq, S., Pelling, M., Reid, H. and Lankao, P.R. (2007), “Adapting to climate change in urban areas: the possibilities and constraints in low- and middle-income nations”, available at: http://www.preventionweb.net/files/7902_10549IIED1.pdf (accessed 5 September 2014).

Sinha, A. (1999), “Understanding urban risks - Ministry of Agriculture India”, in: Ingleton, J. (Ed.), Natural disaster management: a presentation to commemorate the international decade for natural disaster reduction (IDNDR) 1990 – 2000,: Tudor Rose Holdings Limited, Leicester, pp. 109-110.

Stren, R. (1989), "The administration of urban services", in: Stren, R. and White, R.R. (Ed.), African cities in crisis: managing rapid urban growth, Westview, Oxford.
Uddin, K, Gurung, D.R., Giriraj, A. and Shrestha, B. (2015), “Remote sensing and GIS for flood hazard management”, Celebrating the success of HFA, available at: http://wp.preventionweb.net/wcdrr/remote-sensing-and-gis-for-flood-hazard-management/ (accessed 26 June 2015)

UN-FPA. (2007), “State of world population 2007- unleashing the potential of urban growth”, United Nations Population Fund, Available at: http://www.unfpa.org/swp/2007/presskit/pdf/sowp2007_e ng.pdf (accessed 25 March 2012).

UNHABITAT. (2013), Batticaloa disaster risk reduction and preparedness plan – towards a sustainable and resilient city, Disaster resilient city development strategies for Sri Lanka, UN-Habitat, Sri Lanka, Colombo.

UN-ISDR. (2005), “Hyogo framework for action 2005-2010: building the resilience of nations and communities to disasters”, International Strategy for Disaster Reduction – ISDR, Available at: http://www.unisdr.org/eng/hfa/hfa.htm (accessed 1 April 2010).

UN-ISDR. (2012), How to make cities more resilient: a handbook for local government leaders. United Nations, Geneva.

Voogd, H. (2004), Disaster prevention in urban environments. European Journal of Spatial Development 12, 1-14.

Wamsler, C. (2006), Mainstreaming risk reduction in urban planning and housing: a challenge for international aid organisations. Disasters 30(2), 151-177.

Westgate, K.N. and O'Keefe, P. (1976), Some Definitions of Disaster. Disaster Research Unit Occasional Paper No. 4, University of Bradford, Bradford.