OECD Green Growth Studies

Building Resilient Cities

AN ASSESSMENT OF DISASTER RISK MANAGEMENT POLICIES IN SOUTHEAST ASIA

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BETTER POLICIES FOR BETTER LIVES

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Preface

We are pleased to present *Building Resilient Cities: An Assessment of Disaster Risk Management Policies in Southeast Asia*, a study conducted by the OECD with the support of the Global Initiative on Disaster Risk Management (GIDRM), a project commissioned by the German Federal Ministry of Economic Cooperation and Development (BMZ) to the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. This study presents a framework for national and subnational governments to assess disaster risk management policies for enhancing resilience in cities exposed to a variety of natural hazards, posing significant threats to the well-being and livelihood of citizens. Many of the disaster risk management (DRM) examples from Southeast Asia analysed in this report are also applicable to other regions of the world.

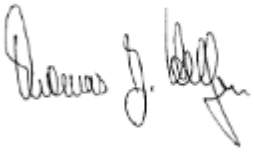
For the German Development Cooperation, the case studies show the challenges at and the importance of the local level in DRM. Linking levels and combining efforts of different sectors are essential to strengthen resilience and create conditions for sustainable development. GIDRM continues to support actors in this respect in order to achieve coherence with regard to planning, implementing and reporting disaster risk management in line with the Sendai Framework for Disaster Risk Reduction, the Paris Agreement and other international agendas, such as the 2030 Agenda and Habitat III.

The policy recommendations provided in this study surely will help governments and other stakeholders in their ambition to enhance resilience – the shared goal of the global agendas mentioned.

For the OECD, this study is another illustration of the critical importance of a multi-level and multi-stakeholder approach to disaster risk management in order to advance the OECD Green Growth Strategy. This evidence-based assessment of policy challenges and opportunities in Southeast Asia highlights the role of urban policies in supporting economic growth that does not increase environmental stress. To this end, the study has placed a particular focus on identifying policy synergies and complementarities between disaster risk management and urban green growth policies.

We are confident that this study will contribute to a whole-of-government, proactive and inclusive approach to disaster risk management to enhance urban resilience in cities of all size.

Lamia Kamal-Chaoui,
Director of the Centre for Entrepreneurship,
SMEs, Regions and Cities, OECD



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Foreword

Asian cities are particularly vulnerable to risks associated with natural disasters. While they are exposed to various types of natural hazards, flooding and other water-related disasters pose particularly significant risks and undermine long-term economic growth, especially in coastal cities. Between 1980 and 2017, Asia suffered disproportionately from natural disasters, both in terms of lives lost (over 1.2 million people or 71% of total global loss of life) and uninsured assets (89% of total losses of USD 1.69 trillion). Therefore, managing natural disaster risks is an essential component of urban policies in fast-growing Asian cities, especially as the impacts of climate change worsen.

This report focuses on national and subnational policy approaches to enhancing urban resilience. It assesses disaster risk management policies to enhance urban resilience in Southeast Asia, and proposes more efficient and effective policy options to policymakers and implementation partners in the region. The project was developed as part of the *OECD Green Cities Programme*, which explores how to promote green growth in cities, examining policies and governance practices that encourage environmental sustainability and competitiveness in a rapidly expanding economy.

In addition to providing a framework for assessing disaster risk management policies in cities, this report also presents the results of assessment and locally tailored policy recommendations in five cities of different institutional, geographic, socio-economic and environmental contexts in Southeast Asia. They include Bandung (Indonesia), Bangkok (Thailand), Cebu (Philippines), Hai Phong (Viet Nam) and Iskandar (Malaysia). Furthermore, the report also provides international best practices on disaster risk management in OECD and non-OECD countries, which can help national and subnational policy makers develop their own disaster risk management strategy.

This publication was produced by the Centre for Entrepreneurship, SMEs, Regions and Cities (CFE) of the OECD and approved by the OECD Regional Development Policy Committee and its Working Party on Urban Policy on 17 October 2018. As part of the OECD Green Growth Studies, this publication complements the broader work of the OECD Green Growth Strategy.

Acknowledgements

This study was produced by the OECD Centre for Entrepreneurship, SMEs, Regions and Cities (CFE) led by Lamia Kamal-Chaoui, Director. It was conducted as part of the Programme of Work of the Regional Development Policy Committee and its Working Party on Urban Policy. This report was made possible through the financial support of the Global Initiative on Disaster Risk Management (GIDRM), a project commissioned by the German Federal Ministry of Economic Cooperation and Development (BMZ) to the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) GmbH, to which the OECD is grateful.

The OECD Secretariat is particularly grateful to Olaf Handloegten, Friedegund Mascher, Martin Dirr, Hajo Junge, Katharina Schaaff, and Stephan Huppertz from GIDRM for their expert inputs, participation in meetings and workshops, and other operational support. Earlier drafts of the report benefited from the comments and inputs of the local teams of the five case study cities in Southeast Asia: Bandung (Indonesia), Bangkok (Thailand), Cebu (Philippines), Hai Phong (Viet Nam) and Iskandar (Malaysia). Valuable insights were gathered from a broader range of stakeholders during five Knowledge Sharing Workshops on *Urban Green Growth in Dynamic Asia* supported by the OECD Knowledge-Sharing Alliance in 2014-15.

The report was co-ordinated by Tadashi Matsumoto, Coordinator, National Urban Policy Programme, Climate Change and Green Growth, under the supervision of Aziza Akhmouch, Head of the Cities, Urban Policies and Sustainable Development Division and Rudiger Ahrend, Head of the Economic Analysis, Statistics and Multi-Level Governance Section. The report was drafted by a core team composed of Tadashi Matsumoto (OECD), Loïc Daudey (OECD), Martin Abbott (OECD) and Richard Carlos Worden (international environmental consultant). Valuable comments were provided by Joaquim Oliveira Martins, Karen Maguire, Taku Honiden, Jack Radisch, Kwame Boye Frimpong, Christophe Etienne and Jonathan Crook of the OECD Secretariat. Pilar Philip prepared the manuscript for publication.

Acronyms and abbreviations

ACCCRN	Asian Cities Climate Change Resilience Network
ASEAN	Association of Southeast Asian Nations
BNBP	Indonesia's national agency for disaster management
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Cooperation and Development)
CSO	Civil Society Organisation
DMA	Indonesian Disaster Management Authority
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
FDI	Foreign Direct Investment
FUA	Functional Urban Area
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse gas
GIDRM	Global Initiative on Disaster Risk Management
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICT	Information and Communication Technology
IPCC	Intergovernmental Panel on Climate Change
KSA	Knowledge Sharing Alliance
KSW	Knowledge Sharing Workshop
LRAP	Local resilience action plan
MOSF	Korean Ministry for Strategy and Finance
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
PHP	Philippine Peso
SDG	Sustainable Development Goal
THB	Thai Baht
UCCR	Urban climate change resilience
UNDP	United Nations Development Programme
UNISDR	United Nations Office for Disaster Risk Reduction
USD	United States Dollar
VND	Viet Nam Dong
VRA	Vulnerability Risk Assessment

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Executive Summary

The frequency of climate-related natural disasters has increased globally. Between 1980 and 2017 in Asia, there were over 1.2 million recorded fatalities and a loss of USD 1.69 trillion in assets due to natural disasters. Asset losses have increased over the past decades due not only to more frequent disasters, but also to the increasing value of public and private assets located in vulnerable locations.

This assessment analyses disaster risk management (DRM) policies across levels of government to enhance urban resilience in Bandung (Indonesia), Bangkok (Thailand), Cebu (Philippines), Hai Phong (Viet Nam) and Iskandar (Malaysia). It aims to: *i)* identify policy challenges related to DRM; *ii)* assess the impacts of current DRM policy practices; and *iii)* propose more efficient and effective DRM policy options to enhance urban resilience.

Main findings

Preparedness: Southeast Asian cities are largely underprepared for natural disaster risks, especially as regards vulnerability and risk assessment practices. Comprehensive hazard assessment and mapping is not uniformly employed, which is particularly harmful for identifying and protecting low-income communities at risk. From the five countries analysed, the Philippines has the most advanced DRM framework for cities, instructing the preparation and implementation of disaster management plans with financial resource allocation to local governments. However, only 1 out of 13 local government units in Metro Cebu has completed such plans.

Land-use: Land-use policies do not often consider DRM, which has resulted in continued urban development in risk-prone areas. For example, in the last 20 years, urbanisation in the vicinities of the Bangkok Metropolitan Region, Thailand has led to the disappearance of natural areas of water retention and flood plain that play a key role in managing excess water and limiting flood damage, as was the case for the 2011 floods.

Urban infrastructure: Two-thirds of Asia's infrastructure needs by 2050 still have to be built and financed, thus providing an opportunity to factor in resilience to natural disasters. The large need for infrastructure investment will require large-scale private sector engagement. To this end, public finance plays a critical role to facilitate, leverage and guide private investment. At the city level, this is a challenge when tax revenues collected by local governments are often small. For example, the municipality of Hai Phong, Viet Nam has limited prerogative to collect its own revenues, and retains only 15-20% of local taxes collected from residents and businesses, and none of the customs revenues collected from port duties.

Insurance: Adequate private and public insurance mechanisms to share disasters risks are not well developed in the case study cities. Almost three-quarters of all financial damages globally are not insured, and this insurance gap is even more pronounced in Asia. The Thai government's National Catastrophe Insurance Fund is a good example of a reinsurance

reserve, where local insurance companies that issue policies retain part of the risk underwritten and transfer the rest to the Fund, which in turn retrocedes a portion to international carriers on the global reinsurance market.

Governance: The co-ordination mechanisms between national and local governments are often lacking or not clearly defined, obstructing the implementation of national policy frameworks (when they exist) at the local level. In Indonesia, the National Agency for Disaster Management and the Disaster Management Authority make an active effort to co-ordinate with other ministries at the national and provincial levels. However, many provincial disaster management agencies have limited resources and are often waiting for national funding instead of actively allocating their limited budgets to their DRM projects.

Stakeholder engagement: While engaging local communities from the early stages of decision-making can help develop more effective and inclusive DRM strategies and frameworks, such opportunities are not always offered in the case study cities. Based on the lesson learned from the 2011 megafloods that local communities are first-responders in the event of a disaster, Bangkok started co-ordinating more with local residents by going out into the field and discussing flood issues with local leaders. Such a strategy could make the residents' future response to disasters better organised and render their co-ordination and collaboration with government even more effective.

Recommendations

Based on these assessments, the study recommends the following disaster risk management actions to enhance urban resilience in Southeast Asian cities:

Conduct a comprehensive vulnerability and risk assessment to develop a local resilience action plan.

Vulnerability and risk assessments and local resilience action plans are tailored to local conditions and rely on multi-level, multi-stakeholder engagement to identify and prioritise DRM policies, plans, and investment actions. They are the first step to enhancing urban resilience and are vital to the success of a long-term DRM framework. Developing data and indicators for DRM at the metropolitan level is another key step.

Adopt risk-sensitive land-use policies combining regulatory and fiscal instruments to guide urban development away from risk-prone areas.

Given the continued pressure for urban development, effective design and implementation of land use strategies and policies is needed to guide private investment, minimise risks and avoid locking cities into vulnerable development patterns that will be costly to reverse in the long run.

Integrate disaster risk management policies and urban green growth policies, especially in the infrastructure sector, to generate "co-benefits".

Complementarities and synergies are often found between disaster risk management and urban green growth policies, which can produce cost-effective "co-benefits". Financing resilient urban infrastructure can be achieved through economic instruments (property taxes, fees, tariffs, and land-value capture mechanisms) that promote DRM and diversify local tax revenues.

Develop disaster risk financing mechanisms to serve as a backbone of effective disaster response planning.

Contingency funds, catastrophe bonds, and insurance schemes can drastically reduce risk exposure. Promoting a multi-layered approach that combines disaster risk financing mechanisms can provide a stronger safety net, limit financial exposure of the central government to disaster risk, and encourage multi-level governmental co-ordination.

Promote the use of information and communication technologies.

Investing in social and human capital and enhancing the availability and quality of innovative emerging information and communications technology is also a potentially useful approach. Key tools include early warning systems, emergency services, and other disaster response efforts in sectors such as transport, energy, water and solid waste.

Foster vertical and horizontal co-ordination to foster a "whole-of-government" approach.

National governments have an important role in aligning national and subnational DRM policies and creating an enabling environment that allows local governments to act more effectively and efficiently. Establishing a dedicated DRM agency will help to facilitate horizontal co-ordination among sectoral departments as well as vertical coherence across levels of government. Conducting in-depth country reviews of urban DRM policies can also be useful to provide a neutral assessment of the current state of play, consider options to fit for the future, and guide public action and decisions.

Engage with stakeholders to promote inclusiveness and encourage a culture of DRM.

Co-ordinated response mechanisms between civil society and local governments as well as public awareness campaigns targeting citizens, especially those at greatest risk, and financially vulnerable SMEs are critical to enhance urban resilience. Local authorities can encourage the private sector, notably SMEs, to design business continuity and post-disaster recovery plans to reduce economic disruption to their activities.

Part I. Synthesis Report

Chapter 1. Analytical framework for disaster risk management in Southeast Asia

Chapter 1 delineates the scope and methodology of the study and provides the definition of key terms such as resilience and disaster risk.

The scope of the study aims i) to identify policy challenges related to disaster risk management (DRM) in differing geographic, socio-economic and environmental contexts of Southeast Asian cities; ii) to assess the impacts of current DRM policy practices; and iii) to propose more efficient and effective policy options to policymakers and implementation partners in Asia in order to enhance urban resilience.

The methodology consists primarily of three key pillars: i) questionnaire; ii) meetings and interviews held during study missions to the five case study cities; and iii) five knowledge sharing workshops and several more associated policy forums.

Together, the scope, definitions, and methodology constitute the analytical framework for DRM in Southeast Asia.

Scope

Southeast Asian cities are particularly vulnerable to risks related to natural disasters. In particular, they are prone to flooding caused by unusually intense rainstorms as well as the rise in sea level, both related to climate change. Such natural disasters not only severely affect the life of urban dwellers and the local environments, but also negatively affect economic growth. People living in slums and informal settlements are particularly vulnerable to these risks. They often live in hazardous locations such as flood plains, steep hillsides or low-lying coastal areas without sufficient protection against floods, proper drainage, waste removal and roads. The consequences of a major flood or storm can be devastating in such areas and can slow urban development and the pursuit of social equity considerably. Vulnerability is also affected by social and economic factors, such as a lack of land tenure rights, informal employment and a lack of social protection. Managing such natural disaster risks is an essential component of urban policies in fast-growing Asian cities (Matsumoto and Daudey, 2014). Recognising the complexity and uncertainty associated with climate change predictions and other natural disasters, disaster risk management (DRM) is becoming a key concept to enhance urban resilience in Southeast Asian cities.

This study assesses DRM policies at national and subnational levels to enhance urban resilience in Southeast Asian cities. It was conducted as part of the OECD Urban Green Growth in Dynamic Asia project under the OECD Green Cities Programme and supported by the Global Initiative on Disaster Risk Management (GIDRM) (Box 1.1). It aims: *i)* to identify policy challenges related to DRM in differing geographic, socio-economic and environmental contexts of Southeast Asian cities; *ii)* to assess the impacts of current DRM policy practices; and *iii)* to propose more efficient and effective policy options to enhance urban resilience to policymakers and implementation partners in Asia. A particular focus is placed on identifying policy synergies and complementarities between DRM and urban green growth policies.

Box 1.1. Urban Green Growth in Dynamic Asia project and Global Initiative on Disaster Risk Management

The **OECD Urban Green Growth in Dynamic Asia project** has emerged as the second phase of the OECD Green Cities Programme. While the first phase of the Programme studied four OECD cities – Paris (France), Chicago (United States), Stockholm (Sweden) and Kitakyushu (Japan), as well as Korea and China, the second phase focuses on fast-growing cities in Southeast Asia. The project explores how to promote green growth in cities in Asia, examining policies and governance practices that encourage environmental sustainability and competitiveness in a rapidly expanding economy. The main aim is to assist Southeast Asian cities in decoupling economic growth from environmental stress, and to promote a long-term trajectory of sustained growth. Assessing DRM policies to enhance urban resilience, and proposing more efficient and effective policy options to policymakers and implementation partners in Asia, is at the core of the project. The project has been supported by the **OECD Knowledge Sharing Alliance (KSA)** as one of the KSA pilot projects. KSA was created in January 2013, in partnership with the German Federal Ministry for Economic Development and Cooperation (BMZ) and Korean Ministry for Strategy and Finance (MOSF). It aims to leverage the OECD's multi-disciplinary expertise for engaging in conversations and mutual learning processes with emerging and developing economies, and to increase its impact by working closely with multi-lateral and bilateral organisations with field presence and implementation capacities and/or on the ground networks.

The **Global Initiative on Disaster Risk Management (GIDRM)** was founded by the German Government and is led by BMZ to strengthen Germany's contribution to improved DRM worldwide. The initiative has three priority areas: (1) Strengthening Disaster Response Preparedness and Civil Protection; (2) Resilient Critical Infrastructure and Economic Cycles; and (3) Effective Early Warning Systems. GIDRM brings together German and regional experts from the public and private sector, academia and civil society to facilitate mutual learning across regions as well as to develop and implement innovative solutions. GIDRM clusters German competencies in the field of DRM and helps to match the demand for specialised services and technologies more effectively. GIDRM has worked extensively in Southeast Asia covering resilience in the tourism sector (Maldives, Myanmar, the Philippines and Thailand), integrating fire prevention and safety in industrial clusters (Bangladesh), installation of local early warning systems for floods (Philippines), introducing the suitability model (Phi, Viet Nam) and strengthening the resilience of small and medium sized enterprises (Thailand).

Source: GIDRM, 2018; OECD, 2016.

This study also provides insights into the ongoing discussion around the implementation of the Sustainable Development Goals (SDG), particularly the Goal 11 on 'making cities inclusive, safe, resilient and sustainable'. The Sendai Framework for Disaster Risk Reduction is also relevant for Southeast Asia's urban leaders and decision makers. It helps to reflect on how to make the best use of their cities' limited human and financial resources

in order to balance rising demand for better urban services and the need for economic development with increasing disaster risks. In many cases, these three complementary goals will form part of a 'triple win' policy framework. However, certain urban development targets may not always be in alignment with other local and national economic policy goals. For example, although urban resilience is a fundamental principal of the sustainable urban development agenda, the channelling of resources towards initiatives that build stronger resilience may conflict with a city's short-term economic development. At the same time, increasing disaster risks threaten cities' long-term urban development goals, and necessitate targeted investment in sustainable policy initiatives and infrastructure, as well as a rethinking of current business-as-usual (BAU) practices.

The study consists of five city-based case studies from multiple countries in Southeast Asia that reflect various geographical, socio-economic and environmental contexts (Table 1.1). The five cities were Bandung (Indonesia), Bangkok (Thailand), Cebu (Philippines), Hai Phong (Viet Nam) and Iskandar (Malaysia). All five cities face similar natural disaster risks to many other Asian cities, but with substantial differences in their urban policy contexts. Each case study analyses the same elements based on the information received through a questionnaire, meetings and semi-structured interviews with key actors (policymakers from local/regional/national governments, academics and researchers, business community, civil society organisations, non-governmental organisations, etc.).

This paper is divided into two parts and continues as follows. The first part is a synthesis part, which introduces the assessment framework and presents key findings from the assessment of the five case study cities. The second part is the summary of the assessment of each of the five case study cities.

Table 1.1. Overview of the five case study cities

Name	Population (million)	Annual population growth	Area (km^2)	Density (people/ km^2)	Gross Regional Product (PPP)	Gross Regional Product per capita (PPP)
Bandung (Bandung Metropolitan Area)	8.6 (2015)	1.94% (2000-2010)	3 509	2 452	USD 54.8 billion (IDR 78.25 trillion) in 2012 (constant 2000 prices)	USD 7 490 (IDR 10.69 million) in 2012 (constant 2000 prices)
Bangkok (Bangkok Metropolitan Region)	14.5 (2010)	0.9% (2004-2014)	7 762	1 347	USD 443.3 billion (THB 5.4 trillion) in 2012 (constant 2005 prices)	USD 29 540 (THB 359 798) in 2012 (constant 2005 prices)
Cebu (Metro Cebu)	2.8 (2015)	2.9% (2000-2010)	1 163	2 450	USD 16.4 billion (PHP 225 billion) in 2012 (constant 2000 prices)	USD 5 084 (PHP 69 700) in 2012 (constant 2000 prices)
Hai Phong (City)	2.0 (2015)	1.0% (2000-2010)	1 527	1 284	USD 13.0 billion (VND 73 967 billion) in 2013 (constant 2010 prices)	USD 3 940 (VND 22 million) in 2015
Iskandar (Malaysia)	2.0 (est. 2015)	3.7% (2005-2015)	2 300	870	USD 37.8 billion (RM 49.9 billion) in 2013 (constant 2005 prices)	USD 19 262 (RM 27,631) in 2013 (constant 2005 prices)

Source: OECD (2016), Urban Green Growth in Dynamic Asia, OECD Publishing, Paris, https://doi.org/10.1787/9789264266360-en.

Definition

Resilience has been defined in a number of ways contingent upon specific thematic foci and/or policy goals. Although many definitions of 'resilience' have much in common, there remain nonetheless subtle differences between them. For the purposes of this paper, this study utilises the OECD's definition of resilience as '*the ability of households, communities and nations to absorb and recover from shocks, whilst positively adapting and transforming their structures and means for living in the face of long-term stresses, change and uncertainty*' (OECD, 2013). The OECD Recommendation on the Governance of Critical Risks similarly defines resilience as the "ability to resist, absorb, recover from or successfully adapt to adversity or a change in conditions" (OECD, 2014).

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) emphasises that the presence of risk and uncertainty is common to all social-ecological systems (GIZ, 2016). In its "broadest sense, resilience can be understood as the ability of a social-ecological systems to deal with shocks and stresses" (GIZ, 2016). Although earlier definitions of resilience have emphasised 'the capacity of a system to tolerate disturbance without changing state' (Levina and Tirpak, 2006), the UNISDR (2009) defines resilience as the "ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions". More recent definitions developed by the IPCC (among others) have stated that "resilience of social-ecological systems [need to] expand beyond these concepts to include the ability to self-organise, learn, and adapt over time" (Lavell, *et al*., 2012).

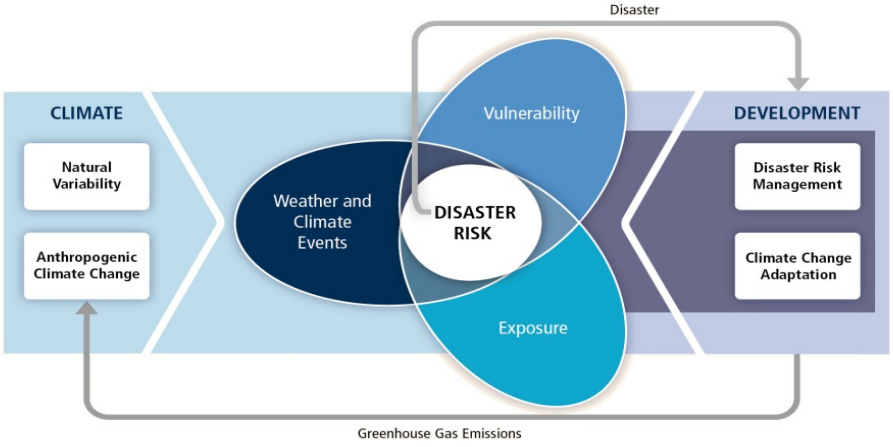
Urban resilience must be tailored to meet specific local policy needs given a variety of geographic, socio-economic and environmental variables found in cities. A local policy agenda promoting urban resilience that may be appropriate in Bandung, Indonesia is not necessarily viable in Cebu, Philippines, and inversely. Hence, a resilient city is prepared to maintain functional systems that continue to meet the primary needs of its urban communities at times of stresses or shocks and is able to recover quickly through the provision of critical urban services. It does this through the long-term development and management of "hard" and "soft" infrastructure, with policy strategies tailored to types of stresses and shocks. Such an approach may also be relevant to human settlements not necessarily classified as 'urban' across Southeast Asia.

The United Nations Office for Disaster Risk Reduction (UNISDR) emphasises that while hazards are natural, disasters are not. An earthquake occurring in an unpopulated area is a hazard; when it affects a large city with poorly built housing stock and unsafe settlement patterns, it exposes the local population to significant risk and may become a disaster (UNISDR, 2011). It should be emphasised that certain natural disasters, especially intense hydrological and meteorological events, are exacerbated by anthropogenic climate change (Thomas, *et al*., 2015). At the same time, accelerating levels of badly-managed urbanisation are placing greater numbers of people in 'harm's way', on steep hillsides and unstable soils or along flood-prone river banks and in earthquake zones. However, the increasing level of risk experienced by Southeast Asian cities is less connected to their exposure to environmental hazards, and rather more connected to four main factors: climate change, rapid urbanisation, poverty, and environmental degradation (UNISDR, 2011).

Exposure and vulnerability are dynamic and depend on economic, social, geographic, demographic, cultural, institutional, governance and environmental factors. As previously mentioned, they are often the result of skewed development processes associated with, for

example, environmental degradation, rapid and unplanned urbanisation in hazardous areas, and limited options of livelihoods for the poor (IPCC, 2012). Many cities in Southeast Asia are expected to undergo rapid demographic, economic and urban change, implying that a concerted policy response to the environmental hazards they face can significantly increase their resilience. It would hence be desirable to understand a number of basic principles applicable to the risks that endanger lives, livelihoods, property and other assets. These include shared problem-solving, risk mapping, community and private sector engagement, and inclusive decision-making. This study uses the IPCC's disaster risk framework as the starting point for its assessment (Figure 1.1), but focuses less on the risks themselves and rather on the institutional frameworks, governance structures and policy approaches affecting each city's DRM strategy to enhance urban resilience.

Figure 1.1. Disaster risk framework



Note: In the source document mentioned below, exposure is defined as "the presence of people; livelihoods, environmental services and resources; infrastructure; or economic, social, cultural assets in places that could be adversely affected". Vulnerability is defined as "the propensity or predisposition to be adversely affected". In the case of the BMR, it is difficult to assess the future impact of climate change on local precipitation and the likelihood of floods. Some studies suggest that precipitation and flood volumes will increase in the region in future (Panya Consultants Co. Ltd., 2009).
Source: IPCC (2012), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.* A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

This paper argues that the following three steps are required to institute effective DRM. These steps will help Southeast Asian cities to better manage the worst disaster risks when they strike, thus making them more resilient:

1. Preparation: Preparation incorporates the crucial early stages of hazard identification and strategic policy formation. A lack of preparation exacerbates the risks posed by environmental hazards that may otherwise be avoided because it does not set in motion more advanced DRM practices. Preparation provides a foundation to manage and limit damage, also considering the cost and time required to recover from a natural disaster. Effective preparation should also identify

governance challenges and potential cross-sectoral co-ordination partners, in addition to generating public awareness.

2. Prevention: Prevention should be proactive and reduce exposure to disaster risks in the long-term through regulation, fiscal instruments as well as investment in resilient urban infrastructure. For instance, risk-sensitive land use could direct urban development to areas that will not be exposed to regular flooding, such as floodplains.
3. Response: Response should facilitate a city's recovery from natural disasters. To be most effective, careful policy co-ordination and planning should occur in advance to 'build back better' rather than lapsing into a process known as 'reconstructing vulnerability'. Insurance and contingency funds are fundamental components of effective response planning, to prepare for unexpected costs arising from natural disasters. Both the public and private sector should contribute to the design and implementation of policies to enhance disaster response. For example, while insurance is normally provided by the private sector, national and local governments create market conditions and can provide contingency lines of credit to complement private insurance in areas where insurance would be socially desirable but is not provided by the private sector.

Methodology

The study is based on the following methodology: i) questionnaire; ii) meetings and interviews held during study missions to the five case study cities; and iii) five knowledge sharing workshops and several more associated policy forums.

Quantitative and qualitative data was collected through a questionnaire. In partnership with local teams, a questionnaire was sent to all participating cities in advance, which aimed to provide the OECD Secretariat with specific information relevant to each case study city (metropolitan area). The information collected by the OECD was used to compare the case study cities, as well as other OECD and non-OECD metropolitan areas, and to assess DRM policies in each city. Specific questions focusing on DRM can be grouped into three sections: i) local characteristics of natural disasters; ii) DRM policies to enhance urban resilience; and iii) governance (Table 1.2). The information obtained through the questionnaire was further elaborated on and enhanced by interviews and meetings held during the respective study missions.

Table 1.2. Questionnaire used for the study

1. Local characteristics of natural disasters	• Human losses due to past natural disasters (specifying the types of natural disasters involved) • Economic impact (real value in USD and as a share of urban GDP) of past natural disasters (specifying the types of natural disasters involved); • The locations within the metropolitan region most affected by past natural disasters in terms of economic and human impacts; • The key elements influencing local vulnerability to natural disasters (e.g. low elevation of coastal zones, subsidence, settlements in disaster-prone areas, socio-economic status, etc.);
2. DRM Policies to enhance urban resilience at the national and local levels	• Existing studies identifying risks and vulnerability, environmental hazards and the potential impact of natural disasters on the metropolitan area; • Policy instruments responding to i) preparation and ii) prevention and iii) response planning (e.g. policies relating to land use, infrastructure, use of ICT, etc.); • Policy instruments to increase the adaptive capacity of low-income households; • Policy instruments to promote 'climate-proofing' of property and other assets, as well as places of significant cultural, historical, or religious importance; and • Policy instruments to enhance complementarities and synergies between different urban policy objectives, such as eco-based adaptation measures;
3. Governance	• Identification of departments/ agencies responsible for urban planning, vulnerability mapping/planning, disaster risk management (preparedness, response, and recovery/reconstruction), economic growth or development, and the budget; • Horizontal co-ordination of these government agencies with each other and other relevant agencies; • Vertical co-ordination and integration of planning and response mechanisms (e.g. national spatial and regional planning) and international assistance agencies/organisations; • Level of interaction with and participation between relevant government agencies and non-governmental and civil society organizations (NGOs/CSOs), and the private sector in problem-solving, decision-making processes; • Existing financial assets, special funds, or ex-ante insurance policies specifically dedicated to addressing the financial requirements of disaster preparation, response and recovery.

Five knowledge sharing workshops were held between August 2014 and December 2015, in addition to several other policy forums (Table 1.3). Around 300 high-level government representatives, predominantly from Southeast Asia, as well as senior management from other relevant international organisations and research institutions participated in these knowledge sharing workshops and forums. These events have acted as a platform to discuss key policy approaches and identify challenges and obstacles to achieve urban resilience / DRM as an integral component of an urban green growth agenda. The main objective of these workshops has been to learn by exchanging and sharing policy practices between government representatives from OECD nations and fast-growing Asian urban contexts.

The unit of analysis for the case study cities was the *functional urban area*, as defined by the European Commission and the OECD (OECD, 2012). A FUA typically goes beyond the administrative border of a city's core municipality and includes other surrounding districts. It usually provides a more accurate and internationally comparable indication of an urban area's size and economic prosperity. This analytical tool could also be used for DRM purposes. For example, it could be utilised to redefine and extend city boundaries to better reflect the FUA which would lead to more coherent metropolitan DRM strategies and plans. However, such data was often not available and instead, the local teams provided alternative information to define the FUA of their metropolitan area. Once the FUA was defined, the local team was then asked to provide data and information corresponding to their FUA, where available.

Table 1.3. OECD knowledge sharing workshops and policy forums (2014-15)

Title	Date	Location
Urban Green Growth and Climate Change Resilience in Bangkok	August 2014	Bangkok, Thailand
Spatial development strategies in Iskandar Malaysia: how to plan, manage and maintain local assets under rapid urbanisation?	November 2014	Iskandar (Malaysia)
Smart Cities and Green Growth	May 2015	Bandung, Indonesia
Green Growth in Port Cities	June 2015	Hai Phong, Viet Nam
Creating a Sustainable and Resilient Cebu: Land use, water and metropolitan governance in the context of rapid urbanisation	December 2015	Cebu, Philippines
Policy Forum on Urban Green Growth in Dynamic Asia from Concept to Implementation Agenda	June 2014	Paris, France
Japan-OECD Policy Forum on Urban Development and Green Growth	October 2014	Tokyo, Japan
Climate Resilience and Disaster Risk Management in Asian Cities (COP21 Side event)	December 2015	Paris, France
Green Growth and Sustainable Urban Development (COP21 Side event)	December 2015	Paris, France

Source: OECD (2016), Urban Green Growth in Dynamic Asia, OECD Publishing, Paris, https://doi.org/10.1787/9789264266360-en.

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Chapter 2. Key lessons from the five case study cities

Chapter 2 provides an overview of key lessons provided by this study on the five case study cities: Bandung (Indonesia), Bangkok (Thailand), Cebu (Philippines), Hai Phong (Viet Nam) and Iskandar (Malaysia). The chapter describes the type, frequency and cost of natural disasters in Southeast Asia. Highlighting findings from the case study cities as well as from different international contexts, the chapter provides an in-depth analysis of the policies and mechanisms required for effective disaster risk management. The chapter concludes with a recapitulation of main findings, and proposes key recommendations to implement in order to enhance urban resilience in Southeast Asian cities.

The geography of natural disaster in Southeast Asian cities

Southeast Asian cities and especially coastal cities are located in a risk 'hotspot' (UNU, 2015), one of the most 'disaster prone' locations on the planet (UNISDR, 2010). With a long history of natural disasters afflicting the region, large and often densely populated cities are increasingly exposed and vulnerable to environmental hazards.

Types of natural disasters

While there is a multiplicity of environmental hazards afflicting Southeast Asian cities, flooding and other water-related disasters pose significant risks in all the five case study cities (Table 2.1). Globally, flooding has affected 2.3 billion people during the last 20 years (UNISDR, 2015). According to the 2012 OECD Environmental Outlook, the economic value of assets at risk of flood is projected to reach USD 45 trillion by 2050, a growth of over 340% from 2010 (OECD, 2012a). This increase will be much higher for emerging countries as compared to OECD countries (respectively 640% and 130%). Between 1980 and 2017, Asia accounted for 70% of fatalities due to global weather-related loss events (Munich RE, 2018). Some cities such as Bangkok (Thailand), which is less than 2 metres above sea level, are particularly prone to floods.

Water-related risks are exacerbated by greenhouse gas (GHG) emissions because the latter intensify tropical typhoons which have the potential to catastrophically affect both cities and ports. Violent tropical storms and the storm surges, flooding and wind damage associated with them, are some of the most obvious and widely known of all climate change driven impacts globally. Slow-onset climate change impacts include sea-level rise, saltwater intrusion, drought and heat waves. At the same time, seismic hazards represent a very different risk profile, based on their potential destructive power and relative unpredictability in comparison to a flood or typhoon, and necessitate different types of DRM policies, plans and programmes.

Table 2.1. Types of natural disasters observed in the case study cities

	Drought	Earthquake	Fire	Heat wave	Flooding	Landslide	Sea-level rise	Storm surge	Tornado	Haze	Tropical storm	Tsunami	Typhoon	Volcano
Bandung	X	X	X		X	X			X	X	X			X
Bangkok	X			X	X		X	X		X	X	X	X	
Cebu	X	X	X	X	X	X	X	X		X	X	X	X	
Hai Phong	X	X		X	X	X	X	X	X	X	X	X	X	
Iskandar	X			X	X	X	X	X		X	X	X	X	

Source: Author's elaboration.

Four of the five case study cities, Bangkok, Cebu (Philippines), Hai Phong (Viet Nam) and Iskandar (Malaysia), are vulnerable in the longer-term to both sea level rise and ocean storm surges caused by rising GHG emissions, as well as localised flooding emanating from more intense rainstorms (precipitation). These risks are due in large part to their coastal locations. Bandung (Indonesia), located at 768 metres above sea level, has mountainous geography and a mild climate which distinguish it from the other case study cities. However, its valley floor location close to the Citarum River and surrounding volcanic peaks that reach heights

of 2000 metres make it vulnerable to flooding as well. More specific details from the five case study cities are described below:

- Bandung's high and extreme variation in rainfall between the wet and dry seasons generates a basin effect where water drains towards the river, presenting manifold and ongoing water-induced challenges. Recent events, such as 2014 Christmas floods that inundated several city districts for two weeks, heavily affected the city and caused considerable damage. West Java Province recorded 290 natural disasters in 2014, more than anywhere else in Indonesia. Moreover, Bandung recorded the second highest number of disaster events nationally with 31 or over 10% for all of Indonesia (Jakarta Post, 2014). Bandung is threatened by catastrophic damage or destruction from earthquakes or volcanic eruptions due to its location in a geophysically active area of central West Java. Bandung, for instance, experienced major earthquakes in 2006 and 2009.
- Bangkok is also highly exposed and vulnerable to floods caused by seasonal storms between the months of July and October. The city is located on low-lying plains at the mouth of the Chao Phraya Basin and is exposed to water discharge from northern and eastern provinces. There is a high risk of flooding because the city's ground elevation is less than 2 metres above sea level. It is also vulnerable to tidal movements, saltwater intrusions into nearby agricultural areas and sea-level rise because of its proximity to the sea. Bangkok experienced major floods in 1942, 1978, 1980, 1983, 1995, 1996, 2002, 2006 and 2011 (Ahsan, 2013). Floods have profound short-term impacts on the economy, environment and public health. They also have long-term national economic and social consequences, such as reinforcing urban poverty and social inequity and negatively affecting the attractiveness of expanding existing manufacturing plants or building new ones. The Bangkok Metropolitan Region is doing much to enhance its urban resilience, although it needs to find ways to better manage flood risks before the next disaster. This would allow the Bangkok Metropolitan Region to better absorb and bounce back from disaster events and ensure green growth in the long-term while adapting to the impacts of climate change.
- Cebu regularly experiences severe flooding, especially after heavy precipitation during the wet season from June to November and annual tropical storms and typhoons. Cebu's topography is undulating and mountainous with heights reaching 900 metres above sea level. Heavy downpours flood low lying areas and lead to landslides in steeply sloping areas as well (Marvette, 2014). Low lying areas extend a few kilometres inland from the coast and represent about 8% of Cebu City's total land area. Despite the small area, this land hosts approximately two-thirds of the population (Cebu City, 2010). Cebu lies in close proximity to three fault lines, including the North Bohol Fault, and soft soil composition in certain quarters exacerbate the city's vulnerability to disaster (Silva, 2015). In 2013, Cebu experienced a magnitude 7.2 earthquake and although the metropolitan area was not at its epicentre, 870 000 people were affected (NDRRMC, 2013).
- Hai Phong has the highest density of rivers in the northern plains of Viet Nam where six major rivers wind their way to the sea. The low-lying delta area accounts for approximately 85% of Hai Phong's urban land which varies between 0.7 and 1.7m above sea level. The city is vulnerable to flooding on a periodic basis, and tsunamis and ocean storm surges at any time, as well as localised flooding due to intense rainstorms (precipitation). Hai Phong has a long history of flooding going back

centuries, and was almost completely destroyed by a typhoon in 1881 that killed 300 000 residents. Between 1990 and 2014, the city of Hai Phong experienced, an average of 20 storm events per year, out of the total of 312 natural disasters (City of Hai Phong, 2015).

- Iskandar is vulnerable to periods of heavy precipitation and flooding, as well as episodes of trans-boundary air pollution. Over the new-year period in 2006-2007, Iskandar experienced major flooding from heavy rains caused by Typhoon Utor, which also struck the Philippines and Viet Nam shortly beforehand, although, its proximity to the equator reduces the risk of typhoons. Furthermore, Peninsular Malaysia and the broader Southeast Asian region experienced significant transnational air pollution in 1999, 2005, 2006, 2009, 2013 and 2015 (Tajudin, *et al*., 2015). Trans-boundary haze in Iskandar has been linked to large forest and peatland fires in neighbouring Borneo and Sumatra which exacerbate already poor air quality levels (Gaveau, *et al.*, 2014).

The frequency and cost of natural disasters are increasing

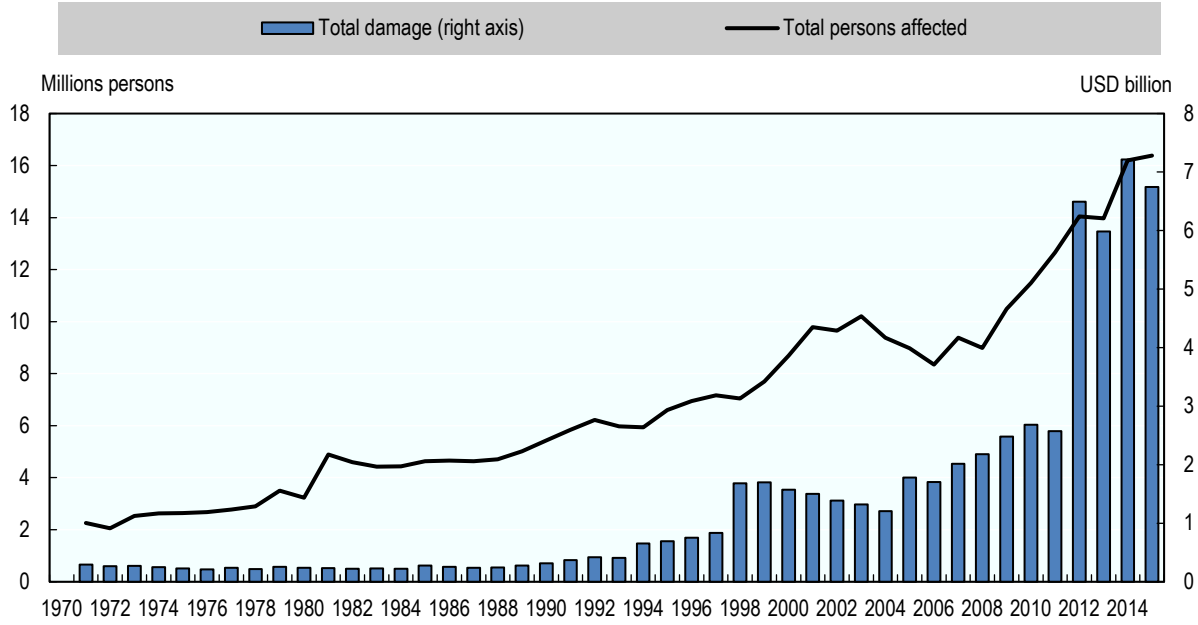
The annual number of natural disasters in Southeast Asia increased from 13 in 1970 to 41 in 2014, with a peak of 66 disasters in 2011 (Guha-Sapir, *et al*., 2016). Globally, the number of weather-related loss events have increased significantly, from 222 in 1980 to 683 in 2017 (Munich RE, 2018). The frequency of natural disasters has increased due to several factors including population growth, economic development, and a changing climate, which can lead to variations in the frequency, intensity, spatial range, duration, and timing of weather and climate extremes (IPCC, 2012).

In parallel with the frequency of natural disasters, the economic costs of natural disasters to urban areas are growing larger as urbanisation and industrialisation advance. The number of people killed or affected by natural disasters, influenced or induced by climate change has increased rapidly and continues to accelerate (UNISDR, 2011). Assuming that sea-levels would rise by half a metre by 2050, a study has estimated the value of exposed assets in 136 port cities at as high as USD 28 trillion (Lenton, Footitt and Dlugolecki, 2009). In recent years, the number of deaths from earthquakes (and subsequent fires) has remained high due to poor housing construction, unsafe settlements, and the lack of early warning systems.

Asia has suffered disproportionately from losses caused by natural disasters. Between 1980 and 2017, losses in human life accounted for over 1.2 million people, or 71% of the total global loss of life, and financial losses up to USD 1.69 trillion, or nearly 40% of the total global losses of assets (Munich RE, 2018). Since 1970, the human impact and economic losses from natural disasters have progressively increased to reach alarming levels (Figure 2.1). Southeast Asian cities must cope with the increasing exposure of urban populations, in particular to floods. Settlement patterns are a critical factor. In Bangkok, Bandung and Metro Cebu, for instance, many informal settlers live along the shore of rivers and canals, in zones which are therefore more likely to be flooded. Sprawling urban development has also often resulted in the destruction of natural habitats that used to play a critical role in absorbing runoff water and protecting cities from flood disasters.

Figure 2.1. Evolution of the number of people affected by natural disasters in Southeast Asia and economic losses

1970-2014



Note: Total damage and total persons affected are smoothed calculations. Total persons affected include persons requiring immediate assistance during a period of emergency, i.e. requiring basic survival needs such as food, water, shelter, sanitation and immediate medical assistance. It also includes homeless and injured people as a consequence of the disaster. It does not include people who died from the disaster. Total deaths over the period 1970-2015 have not followed the same rising patterns as total damage and total persons affected. In 2004 (tsunami) and 2008 (Cyclone Nargis), however, high human losses were recorded.
Source: Guha-Sapir, D., R. Below and P. Hoyois (2016), EM-DAT: The CRED/OFDA International Disaster Database, www.emdat.be.

Estimates on the economic impacts of natural disasters at the city level obtained from the five case study cities are as follows:

- It is estimated that 12 million Indonesians are located in earthquake prone areas, representing a total economic exposure of USD 79 billion (Oxford Business Group, 2014).
- The 2011 mega-floods that hit Bangkok and other parts of Thailand is reported to have been among the costliest natural disasters since the 1980s, along with the Great East Japanese tsunami and earthquake (2011-Japan), the Sichuan earthquake (2008-China), the Kobe earthquake (1995-Japan) and Hurricanes Katrina (2005-United States) and Super Storm Sandy (2012 - United States). The 2011 flood resulted in losses in the global supply chain of USD 44.2 billion and significantly slowed Thailand's economic growth in the months that followed the flood (OECD, 2013a). A high proportion of these losses were not insured. The flood revealed that most manufacturing industries were not prepared for floods. The manufacturing sector suffered a loss of USD 32 billion (i.e. 70% of total losses) at the country level. In the City of Bangkok, total damages reached THB 296 billion (USD 9.3

billion at 2014 prices), of which 58% occurred in the industrial sector (OECD, 2015b).

- In Cebu, the 2013 Bohol earthquake caused USD 2 billion in damages (NDRRMC, 2013). It damaged nearly 1 000 houses, in addition to local infrastructure and community facilities.
- Hai Phong was directly affected by 43 storms and typhoons (tropical depressions) between 1990 and 2015. Statistical data in recent years showed that there was a rise in the number of storms which affected the city's economic performance and affected coastal defences. Typhoon No.8 (named Sơn Tinh) in 2012 was particularly destructive, affecting 10 cities in Northern Viet Nam including Hai Phong. This typhoon is considered to have had the most devastating impact on Hai Phong in the last 10 years. The total of citywide losses caused by typhoon No. 8 is estimated to be VND 1 trillion (USD 47.3 million in 2014 prices) (City of Hai Phong, 2015). Between 2003 and 2013, the estimated costs associated with damage and loss caused by natural disasters in Hai Phong were equivalent to VND 1.4 trillion (USD 66.2 million in 2014 prices), and peaked in 2013 at VND 600 billion (USD 28.4 million in 2014 prices) (City of Hai Phong, 2015)[1].
- In Malaysia, the Johor floods of 2006-07 that inundated Iskandar led to USD 489 million in damages (Chan, 2012).

Policies to prepare for, prevent and respond to natural disasters

Promoting vulnerability and risk assessment (VRA) and local resilience action plan (LRAP)

The study has found that Southeast Asian cities are by and large "underprepared". Even though the five case study cities have been pioneering many DRM actions in their respective countries, they have not yet undertaken sufficient disaster prevention and response planning, in spite of the increasing frequency of disasters and the high costs they inflict. Preparation is critical to anticipate the intensity, frequency and extent of environmental hazards, as well as to identify vulnerable urban population groups, private assets and critical public infrastructure. A lack of preparation exacerbates the environmental risks to which populations are exposed, as well as the economic and social impacts.

The lack of preparedness is most clearly observed in vulnerability and risk assessments (VRAs) and asset inventory practices. VRAs and asset inventories form the basis of a Local Resilience Action Plan (LRAP), which should work as an interface with other DRM measures as well as other urban policy instruments as part of a strategic, concrete and long-term DRM framework (Box 2.1).

Box 2.1. Vulnerability and Risk Assessment (VRA) and Local Resilience Action Plan (LRAP)

A **Vulnerability and Risk Assessment (VRA)** first requires support of local political leaders as well as broad stakeholder participation encompassing representatives from the private sector, civil society and local communities to take stock of their interests and concerns. In addition to broad public engagement, a level of technical analysis is needed to identify the most important natural hazards and their likely impacts. The people, places and assets that are expected to be most exposed to those risks must be inventoried and geographically located. Next, the vulnerability of those populations, assets, and places should be estimated, taking into account their ability to avoid or mitigate the anticipated impacts (their 'adaptive capacity'). The resulting policies, plans and investment actions – that can either i) reduce the severity of the risk or the exposure of those potentially affected by it; or ii) increase their capacities to prepare for, avoid or recover from the threat – are then weighed against each other and prioritised. Financing for these policies, plans, investments, and actions must be simultaneously determined so that they can actually be implemented once the stakeholders are in agreement, and political and fiscal decisions are made.

A **Local Resilience Action Plan (LRAP)** is a collaborative process led by government agencies in association with stakeholder groups such as the private sector, civil society organisations, residential communities and the media. A LRAP should function as an interface with other DRM measures as well as other urban policy instruments. It is iterative, rather than "linear or circular", because certain activities must be periodically revisited throughout the process to ensure that new considerations have not changed earlier decisions. A LRAP should be more of a living document that guides a city's resilience efforts and is updated periodically. Its five core phases are:

1) **Initiation and sensitisation**: The success of any LRAP process will depend on a credible, fact-finding and participatory decision-making process and structure in place representing all major stakeholders. Such a goal will be achieved through the establishment of a capable LRAP steering committee and effective 'core technical team';

2) **Technical and financial analyses**: This involves the development of large-scale city-wide GIS maps identifying the city's physical characteristics, such as topography and drainage, land use, transportation networks, water supply and sewage system, electrical grid and emergency response facilities. Concurrent to the above step is a parallel analysis of the financial implications flowing from the examination of risks and vulnerabilities. Gradually, the core technical and financial teams should narrow their focus to the most exposed and vulnerable populations by area and type based on the initial vulnerability mapping and financial analyses.

3) **Institutional, stakeholder, and financial gap and needs assessment**: Once a set of DRM options are identified, a capability assessment of the institution responsible for implementation should be conducted. Vulnerabilities should be subjected to a "gaps assessment" to determine the deficiencies and obstacles blocking effective action from being taken.

4) **Evaluating and prioritising resilience options**: Technical analyses can serve as useful inputs to discussions between key stakeholders and the steering committee about which resilience interventions are likely to be most effective. Thus, the process may become more political and subjective in nature at this point. The job of the technical team, steering committee, and stakeholders is to identify, evaluate, and prioritise the most viable resilience options and strategies. Once complete, a detailed plan of action should be developed.

5) **Implementation with effective monitoring and evaluation feedback mechanisms in place**: A results framework highlighting the intermediate and expected objectives and outcomes, output targets, planned activities and budgets with deadlines should be prepared. This framework should also identify the government entities responsible for their achievement with key collaborating agencies and/or non-government partners identified. Equally important, this framework should be monitored continuously. Detailed financial planning, in addition to a communications strategy to reach stakeholders and the general public should also be incorporated into the LRAP.

Source: Ranghieri, F. and Shah, F. (2012), Workbook on Planning for Urban Resilience in the Face of Disasters, World Bank, Washington DC, http://dx.doi.org/10.1596/978-0-8213-8878-5.

In the case study cities, comprehensive hazard assessment and mapping is not widely used, which is particularly harmful for identifying and protecting low-income communities at risk (Table 2.2). For example, in Bangkok, the Disaster and Prevention Management Plan (2010-2014) defines the actions of the lead agencies in charge of disaster relief, and follows the guidelines of the equivalent national DRM plan. These plans particularly target pre-disaster, incident and post-disaster management. In Hai Phong, it is estimated that 98% of its land surface is prone to moderate (86%) to high (12%) risk of flooding during periods of high precipitation (Secoa, 2011; HDX, 2015). Iskandar has identified drainage and stormwater management as major hazards with the potential to affect the metropolitan area (IRDA, 2011a). Bandung appears to lack any kind of hazard or asset identification and VRA process (Bandung City, 2015). This may stem from insufficient local capacity to develop and use the necessary technology, or a lack of awareness in local government about the benefits of such tools.

Cebu appears most advanced among the studied cities. In the Philippines, Disaster Management Plans are mandated by the government's Disaster Risk Reduction Management Act (No. 10121), and enabling laws also ensure that sufficient financial resources are allocated to local government units to implement disaster risk reduction (DRR) programmes. This underscores the role of national government in setting a policy framework for VRAs. However, the implementation at the city level is a challenge. Among 13 local government units in Metro Cebu, only one has completed disaster risk reduction management (DRRM) plans so far. A promising approach is VRA at the metropolitan scale. The Metro Cebu Roadmap for Sustainable Urban Development, developed by MCDCB and JICA, has undertaken detailed studies to identify physical and environmental features which make it vulnerable to natural hazards and pose a risk to the metropolitan population. This has resulted in thematic maps including all the 13 local government areas of the Metro Cebu. The GIDRM has also been supporting the Province of Cebu and MCDCB in developing a Suitability Map for Cebu Island (Table 2.2).

Table 2.2. Vulnerability and Risk Assessment in the selected case study cities

Case study areas	Name of initiatives	Organisation	Outline
Bangkok (Thailand)	Bangkok Disaster and Prevention Management Plan (2010-2014)	Bangkok Metropolitan Administration	Defines the actions of the Fire and Rescue Department which is the lead disaster relief agency and particularly targets pre-disaster preparation, incident and post-disaster management. Focuses on post-disaster management of government agencies to co-ordinate disaster response at the time of disaster.
Cebu (Philippines)	Disaster Management Plan	All the 13 local government units	Focuses on post-disaster management of local government agencies to better co-ordinate disaster response planning.
	Metro Cebu Roadmap for Sustainable Urban Development	MCDCB / JICA	Identification of physical and environmental features which make Cebu vulnerable to natural hazards and pose a risk to the metropolitan population.
	Suitability Map	MCDCB / GIZ-GIDRM	Development of Suitability Map for Cebu Island for residential buildings and agricultural crops. The Suitability Map will be used in updating the Comprehensive Land Use Plan of Local Government Units and the Provincial Physical Framework Plan which incorporates disaster risk reduction and climate change adaptation.
Haiphong (Viet Nam)	Flood Hazard Maps	UNOSAT	Geodata of Overview of Flood Waters Near Hai Phong City, Vietnam.
		SECOA	Analysis of: i) Topography (elevation); ii) Hydrology (distance from river); iii) Land use/cover; and iv) Socio-economic (population density).
Iskandar (Malaysia)	Shoreline Management Plan: Blueprint for Iskandar Malaysia	IRDA	Intended to guide policies for coastal management, and areas at risk of flooding and erosion.
	Drainage and Stormwater Management Plan: Blueprint for Iskandar Malaysia		Identifies major drainage and stormwater management hazards with the potential to affect the metropolitan area.

Note: Iskandar Regional Development Authority (IRDA); Japanese International Cooperation Agency (JICA); Metro Cebu Development and Coordinating Board (MCDCB); Solutions for Environmental Contrasts in Coastal Areas (SECOA); United Nations Institute for Training and Research - Operational Satellite Applications Programme (UNOSAT).
Source: Author's elaboration.

An important caveat observed from these practices in the case study cities is that their VRAs do not link hazards with identification of vulnerable populations at risk. More work needs to be done to link the identification of hazardous areas with the location of at-risk populations, critical infrastructure and community and private assets to build more comprehensive VRA and LRAP practises.

A common obstacle shared by many developing cities is the difficulty to penetrate and produce data (e.g. the number and size of households) in the poorest areas of the city. In addition, these tend to be located in the most vulnerable sites such as river shores. The city of Kumamoto (Japan) set up a smart tool initiative that consists in collecting data directly from local residents to inform hazard maps. Citizens can directly access a digital base map provided by the municipality and add information about the vulnerability of their own house. Adopting a strategy like the city of Kumamoto will require investments to engage even the poorest communities in this process, through ICT training for instance. Projects in the developing world have proven that this is achievable: in Dar es Salaam, Tanzania, locally trained students equipped with tablets have mapped the slums for the first time

(OECD, 2016a). Similar processes could be used to create vulnerability maps in the case study cities.

Encouraging participation and input from businesses and industries could also be helpful in building a database on economic vulnerability. Local authorities can involve private stakeholders by providing a platform where the public and private sectors can exchange information on their vulnerabilities and needs. In the United States, the US Economic Development Administration (EDA) of the Department of Commerce, organised conferences via its six regional offices working closely with local partners where community actors, including business owners, were invited to share their experience regarding disaster resilience. The US EDA then funded the Vermont Economic Resilience Initiative, which culminated in local action plans being sent out as templates to all communities in Vermont (Vermont Agency of Commerce and Community Development, n.d.). The US EDA has also set up a website that disseminates best practices for economic resilience where economic stakeholders can exchange information on how to overcome challenges (Restore Your Economy, n.d.).

In Bangkok Metropolitan Region, such joint discussions could be organised with the help of major private organisations, such as the Thai Federation of Industries, or TIPMSE, or within the framework of metropolitan taskforces/committees specifically dedicated to resilience to floods, as noted previously. Not only could it help obtain information from the private sector, but it could raise the awareness of the private sector about flood resilience issues in the city.

Risk-sensitive land use is at the core of DRM strategies

The location and structural integrity of urban development are major factors in determining a city's vulnerability. In particular, the location of crucial urban systems that provide energy, water and access to transportation and communication networks will greatly affect a city's adaptive capacity to cope with natural disaster threats. Globally, it is estimated that urban land at risk of flooding will increase from 44 000 km^2 in 2010 to 72 000 km^2 by 2050, a development that is expected to treble the associated financial costs to USD 80 trillion during this time (compared to 27 trillion in 2010) (World Bank, 2016). If properly designed and managed, the built environment and the functional systems that sustain it can play a critical role in decreasing a city's vulnerability, while also contributing to urban sustainability.

The case studies have demonstrated that land use policies in the five case study cities do not always take into account DRM, which has resulted in continued urban development in flood-prone areas. Where plans and regulations do exist, they are often not implemented effectively. For instance, in Bandung, residents continue to settle and build in flood-prone areas, increasing the city's exposure to further flooding risks (Section 0). Another major challenge in land use is the conversion of agricultural or natural areas into commercial and residential uses. This reduces the land that would otherwise temporarily store and/or absorb excess rainwater and thus mitigate flood damage in cities. This is the case in the Bangkok Metropolitan Region (BMR), where more than 30 km^2 of residential areas were created in the province of Pathum Thani between 2001 and 2010, while around 184 km^2 of agricultural land was lost (Section 0). Similarly, in Hai Phong, the conversion of rice fields upstream in the northern branch of the Red River watershed for commercial and residential uses has significantly reduced rainwater retention and placed additional demands on Hai Phong's stormwater drainage system. Over the past 15 years, the city's built-up areas have increased by nearly 47% since 2000 (City of Hai Phong, 2015). In Iskandar, natural and

agricultural land is disappearing quickly, while urban land, characterised by low-density development patterns, is expanding rapidly. The continued loss of natural environments and coastal mangroves in particular is a critical issue because it erodes the city's natural defences against flooding. This remains a persistent challenge, as in many other fast-growing cities in Southeast Asia.

It is important for national and local governments to incorporate DRM considerations into land use regulations (OECD, 2014). Given the continued pressure for urban development, clear land use visions and effective implementation mechanisms are needed to guide private investment, minimise risks and not to lock cities into vulnerable development patterns that will be costly to reverse in the long run. In Cebu, the Roadmap for Sustainable Urban Development, developed by Metro Cebu Development and Coordinating Board (MCDCB) and Japan International Cooperation Agency, have proposed 'urban limits' that will restrict land use in zones at risk of flooding or landslide in order to avoid exposing infrastructure, firms and people unnecessarily to risks. The next step is to translate the 'urban limits' into legally binding comprehensive land use plans and zoning ordinances at each local government unit in Metro Cebu.

Table 2.3. Land use plans and DRM in the case study cities

City	Name	How DRM is addressed by the plan
Bandung	Bandung City Master Plan	No binding land use regulation (zoning) to prevent development in flood prone areas (especially at the metropolitan level).
Bangkok	Bangkok Comprehensive Land Use Plan	No zoning regulations in provinces surrounding Bangkok city in the Metropolitan Region.
Cebu	Roadmap for Sustainable Urban Development	Proposes 'urban limits' that will restrict land use in zones at risk of flooding or landslide.
Haiphong	Hai Phong City Master Plan 2025: A vision towards 2050	Targets environmentally friendly development, the creation of an urban green carpet and harmonious ecological environments to create balance for the municipality.
Iskandar	Comprehensive Development Plan II / Low Carbon Society Blueprint	Sets out specific targets to promote higher density, non-motorised transport modes and the environment to guide sustainable urban development.
	Local land use plans	Local land use plans guide development within municipal areas and should correlate to the National Physical Plans.
	Blueprint for Iskandar Malaysia	Integrated land use guidelines promoting property value, transportation system, public utilities, public services, and environment in the city.

Source: Author's elaboration.

Investment in critical urban infrastructure needs a risk-sensitive approach

Linking climate-resilient infrastructure, crucial urban services, and land-use planning to more holistic and integrated policy making is at the core of DRM strategies. The built environment and the crucial urban systems that provide energy, water, waste removal or transportation services to densely populated urban areas, are major factors in determining a city's exposure to the threats it faces. They also affect a city's capacity to adapt or cope with those threats, and as well as its vulnerability to them. The built environment and these systems can be critical elements in increasing the adaptive capacity and resilience of cities to prepare for and recover from disasters when properly designed and managed. They also contribute to the development of urban green growth pathways that lead to healthier and economically prosperous cities.

This study has confirmed that investment in critical urban infrastructure (roads, electricity grid, water supply and sanitation, stormwater drainage system, etc.)[2] in Southeast Asian

cities needs to further account for DRM. Natural hazards have the power to severely damage infrastructure, thereby devastating the provision of basic urban services and conditions necessary to ensure economic production, public health and the environmental quality of a city. For example, in port cities like Hai Phong, a lack of DRM planning for new port facilities could result in severe regional economic consequences, as well as negative environmental externalities. Opportunities for urban economic growth can be lost very quickly if critical urban infrastructure is not resilient in the long-term. Regular maintenance of existing infrastructure, such as drainage systems, would also limit threats and should be a top priority of local leaders and planners.

A lack of focus in financing preparedness and prevention measures has been a persistent challenge observed in the case study cities. For example, Indonesia's current DRM paradigm is dominated by a reactive post-disaster response approach which accounts for 20% of total humanitarian disaster relief expenditure, while disaster preparedness spending accounts for less than 1% (Give2Asia, 2016). However, this focus is gradually shifting as preparedness and prevention measures are seen as a more cost-effective way to address climate and other natural disaster impacts.

There are numerous ongoing infrastructure projects in rapidly urbanising Asian cities, which presents a timely opportunity to enhance urban resilience (Table 2.4). Two-thirds of Asia's infrastructure that will exist in 2050 still needs to be built and financed (Global Commission on the Economy and Climate, 2014). The large need for infrastructure investment will require large-scale private sector engagement. To this end, public finance plays a critical role to facilitate, leverage and guide private investment. However, at the city level this can be a challenge when tax revenues collected by local governments are often small, as is the case in Hai Phong, which has limited prerogative to collect its own revenues, and retains only 15-20% of local taxes collected from residents and businesses, and none of the customs revenues collected from port duties.

Well-designed, long-term investment in electricity grids, transportation and water infrastructure can markedly improve the capacity to recover from disasters and support climate adaptation. Therefore it is essential to systematically consider the vulnerability of critical infrastructure and the possible impacts on socio-economic systems while planning public investments. However, a challenge observed during this study is that "resilient infrastructure" is often claimed as being more expensive which makes policymakers and investors hesitant to invest. Estimates indicate these costs are 10 to 50% higher, and even higher if transport or water networks are factored in (GFDRR, 2010). An equally important consideration is the competition for investment with other (shorter-term) policy priorities which limits the pool of available funding. Serious budget constraints do not make it easy to allocate resources for expensive investment in resilient infrastructure.

Visualising long-term benefits of "resilient critical infrastructure" and facilitating risk-sensitive public investment would enable Southeast Asian cities to cope with this challenge. While there are extra costs associated with "climate proofing" new infrastructure projects, local leaders and planners must recognise that such additional upfront costs can avoid huge losses that could be debilitating or very difficult to recover from in the future. For example, the 2011 flood in Thailand is reported to have been among the costliest natural disasters since the 1980s, and it demonstrated that disasters disrupt regional and global trade which carries with it important ramifications for financial investments. More research is needed to quantify the long-term benefits so that such information can be considered in decision-making processes.

Developing national technical standards for resilient infrastructure would also be an important action to support local decision-making processes. It is crucial to integrate disaster risk information in the assessment of risks of infrastructure investment to facilitate risk-sensitive public investment, further highlighting the need for making disaster risk information available and accessible. However, financial considerations should not be left until the end of resilience planning. It is of little value to undertake a participatory process entailing significant financial, human and political resources if there are no resources to pay for the implementation of the plans and actions on which the stakeholders have agreed. Thus, financial planning needs to occur in concert with technical and political initiatives to contribute to the decision-making process.

Table 2.4. Major infrastructure projects to enhance urban resilience in the case study cities

	Initiatives/projects for directly enhancing DRM	Major large-scale infrastructure projects which would require consideration of DRM
Bandung (Indonesia)	- Integrated rainwater and wastewater management system - Rehabilitation of the Citarum Basin - Installation of biopores in residences	- Jakarta – Bandung – Surabaya High Speed Rail - Intra-city transport (cable car, etc.) - 3 landfill sites in the BMR
Bangkok (Thailand)	- Development of large-scale polder and drainage systems since the 1980s - Flood Control Centre (FCC)	Mass Rapid Transit Master Plan: 5 new urban mass transit lines
Cebu (Philippines)	- Metro Cebu Integrated Drainage Master Plan - Rainwater storage facilities in buildings	Bus Rapid Transit in Cebu City
Haiphong (Viet Nam)	- Dikes along Cam-Ca river - Flood Control Master Plan	Lach Huyen International Gateway Port
Iskandar (Malaysia)	Segget River Restoration Project	Kuala Lumpur – Iskandar – Singapore High Speed Rail

Source: Author's elaboration.

The OECD recommends that risk management decisions and standards should be incorporated in national and local regulations for building codes and the design, development and operations of critical infrastructure. Moreover, businesses should be encouraged to take steps to ensure business continuity, with a specific focus on critical infrastructure operators by (OECD, 2014):

- Developing standards and toolkits designed to manage risks to operations or the delivery of core services;
- Ensuring that critical infrastructure, information systems and networks still function in the aftermath of a shock;
- Requiring first responders stationed in critical infrastructure facilities to maintain plans to ensure that they can continue to exercise their functions in the event of an emergency so far as is reasonably practicable; and
- Encouraging small community-based businesses to take proportionate business resilience measures.

Integrating DRM policies and urban green growth policies to generate 'co-benefits'

The case studies demonstrate that policy complementarities and synergies are often observed between DRM and other policy objectives related to the natural environment, in

particular with urban green growth policies. For example, ecosystem-based adaptation measures present a considerable, yet unrealised investment opportunity to enhance urban resilience. Such measures can also generate benefits for urban green growth. They are often more cost-effective than conventional large-scale urban infrastructure investment. Also, strategic investment in smaller, locally tailored and decentralised projects is more likely to create co-benefits with other policy objectives. Adopting place-based and cross-sectoral policy frameworks, such as urban green growth, appears to be a potentially efficient strategy for the sustainable long-term development of fast-growing Southeast Asian cities, such as the case study cities, none of which have currently adopted such a comprehensive vision for development (Daudey and Matsumoto, 2017).

Land use, water resources management and flood risk are typical, interconnected urban resilience and resource efficiency challenges that bear a metropolitan dimension. However, the lack of co-ordinating mechanisms at the metropolitan scale often presents obstacles to urban resilience. For instance, the development of the Bus Rapid Transit which is only being designed and implemented in Cebu City, despite metropolitan commuting flows, may create expensive infrastructure lock-in (and rising GHG emissions) that will be difficult to circumvent in the future (Daudey and Matsumoto, 2017).

Among different eco-system based adaptation measures, rainwater harvesting presents an interesting opportunity in Southeast Asian cities. It has been incorporated into Bandung's Integrated Rainwater and Wastewater Management System and is expected to reduce pressure on the city's drainage infrastructure and diminish the risk of flooding (Lee, 2013). It also exploits policy synergies with Indonesia's National Long-Term Development Plan (2005-2025), which prioritises rainwater harvesting and should ameliorate formal water network access in Bandung City which remains a challenge. This UNESCAP led pilot project should be expanded by the Bandung City government and complimented by other green adaptation measures, such as swales and green curbs which can increase natural vegetation in cities, create pedestrian space and de-incentivise private car use while also serving their function of retaining rainwater run-off to minimize flash flooding (in comparison to more conventional polder or drainage infrastructure). In addition to offering increased absorptive capacity during heavy rainfall, swales and green curbs are also likely to win public support more easily and be implemented more quickly than other large and disruptive solutions.

Initiatives enhancing floodwater management are especially important in coastal cities. In Bangkok, there is considerable unused land in downtown, such as old parking lots or railroads currently used as 'graveyards' for old trains, that might serve as retention ponds, while connecting them to the city's water supply and sewerage system. Installing semi-permeable surfaces on secondary roads (*soi*) and small sidewalk rain-absorbing planter boxes could also yield high retention rates. Cebu City's Integrated Storm Water Management (ISWM) project not only delivered an eco-efficient model for rainwater and stormwater recycling, but it also strengthened the capacity of local government officials through training, raised public awareness and introduced new information technology (UNESCAP, 2011). However, such projects are not yet widespread in Cebu. Likewise, Iskandar's Segget River restoration project is a symbolic initiative that forms part of wider flood mitigation measures. The project seeks to ensure that core urban areas are not affected by 100-year flood levels, while cleaning-up the once heavily polluted river, to enhance attractiveness and quality of life, as well as improving floodwater management (ADB, 2016). These 'multi-objective' projects are applicable to other cities in Southeast Asia and their continuation will help to build citizens' support for investment in critical urban infrastructure.

In the case of Hai Phong, physical improvements to the drainage system within the city need to be complemented by more targeted efforts to conserve vegetated areas upstream of the city. The city's drainage system capacity (culverts, canals, conditioning lakes) is not up to standard whenever the city receives more than 100mm of rain within 24 hours (City of Hai Phong, 2015). This creates serious environmental and health risks when combined with poor wastewater and solid waste management. One option would be to transform the current Flood Control Master Plan into a comprehensive, 'green' floodwater management plan which would deliver co-benefits with other policy objectives. Such a plan, if implemented properly, may lower the long-term costs of controlling floods, treating wastewater and providing other urban amenities as part of a more co-ordinated and effective solution.

Land resources and natural habitats are being consumed at a fast rate in Southeast Asia. Between 2000 and 2010, the surface area of urban areas in Iskandar and Metro Cebu increased by 53.5% and 31.3%, respectively (an annual growth rate of 6.7% and 2.7%) (Daudey and Matsumoto, 2017). Natural and agricultural land in northern Bandung, which once captured significant amounts of rainfall and benefitted residents by reducing flooding risks and protected local ecosystems and biodiversity, is being converted to built-up areas, exposing the city to increased flooding risks. There is no commensurate water management plan to guide investment. This land-use change is also increasing the pressure on local aquifers, which are in decline because there is less space for rainwater run-off to seep into the ground and to feed the water supply (OECD, 2015a).

Developing disaster risk financing mechanisms

Disaster risk financing (DRF) is clearly one of the key policy areas for Southeast Asian countries to develop. The present study's assessment of DRF mechanisms in the case study countries reveals a lack of diversity of mechanisms which can drastically reduce risk exposure. DRF mechanisms can be implemented in an *ex ante* or an *ad hoc* manner. Typically, *ex ante* disaster risk financing tools involve significant opportunity costs, especially in terms of investment potential. In part, this explains why governments that are well placed to access international capital markets and have the ability to create fiscal resources quickly when needed often opt in favour of *ad hoc* DRF mechanisms (OECD, 2015c).

On the other hand, as outlined in the G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing (OECD, 2012b: Section II.2), compensation arrangements that are explicit and well-defined *ex ante* have important advantages relative to financial assistance that is provided on an *ad hoc* basis after a disaster event. Well-defined rules and processes provide clarity on access to financial assistance, helping to ensure prompt assistance, reduce moral hazard and decrease the potential for unplanned post-disaster assistance. In this paper, the application of three types of *ex ante* DRF mechanisms in the case study cities was examined. Table 2.5 provides an overview of the advantages and limitations of the three mechanisms:

1. **Contingency funds** such as dedicated contingency reserves for disasters (with allocated funds lapsing at year end), or multi-year disaster reserve funds (with allocated funds building up over time);
2. **Catastrophe bonds** or other types of catastrophe-linked securities or derivatives which provide an alternative means for risk transfer; and

3. **Insurance**, which enables the transfer of risks and indemnifies against damage (e.g. to cover damage to government assets such as buildings and infrastructure) (OECD, 2012b).

Table 2.5. Three types of DRF mechanisms examined in this study

DRF Mechanism	Contingency Funds	Catastrophe bonds	Insurance
Description	Contingency funds, which may be specifically dedicated to disasters or may serve a more general purpose of addressing contingencies, are financed by annual appropriations and can be drawn down in the event of a disaster. Absent a disaster or other call on the fund, they may, depending on the arrangements, lapse at the end of year or be allowed to be built up over time. Reserve funds act as an explicit form of self-insurance for governments.	Catastrophe bonds transfer risk to the capital markets via the issue of a high-yield bond where repayment of principal is contingent upon the occurrence of a predefined catastrophe such as a hurricane or earthquake. Catastrophe bonds are collateralised with high-quality collateral, reducing counterparty risk, and can be designed to trigger pay-outs based on indemnity, an industry index, modelled losses, or a parametric basis (e.g. magnitude and location of an earthquake).	Insurance may provide beneficial protection for those facing larger disaster risks relative to risk-bearing capacity. Insurance permits risks to be transferred to undertakings, namely insurers and reinsurers, whose business is to pool and diversify risks. Alternative, simplified risk transfer tools such as micro-insurance and parametric insurance products may be deployed in countries where insurance markets are not well developed or broad-based.
Advantages	- Funds immediately available for disbursement and are still available even if no disaster occurs - Can lower costs relative to insurance given lower payments and lower opportunity costs as funds set aside to meet future disaster costs earn returns - Reduces dependency on debt financing - Can provide a structure for inter-agency co-ordination and facilitate the earmarking of budget funds on a recurring basis - For markets lacking insurance and disaster risk financing, or where access to such markets is limited, may be the only available *ex ante* financial tool	- Effective transfer of disaster risk; no accumulation of funds needed as in the case of reserves - In comparison with reinsurance, can provide greater security and rapidity of payment as securities are fully backed by collateral and are based on clear, easily verifiable triggers, particularly if a parametric trigger is used - Are less sensitive to potential disruptions in global insurance markets and can provide multi-year coverage - In the event of significant disasters which may trigger large capital outflows, can ensure "macro-stabilisation"	- Immediate, effective transfer of disaster risk - No accumulation of funds needed as in the case of reserves - Provides useful protection against catastrophic disaster events that might otherwise have a material impact on wealth and greatly impede recovery, at a cost that should reflect diversification benefits gained from risk pooling
Limitations	- Opportunity cost of maintaining a liquid reserve - Time delay for the build-up of an appropriate levels of funds to cover disaster risks at initial set-up and following any depletion of funds; less protection compared with insurance during the build-up of funds - May prove more challenging as the level of severity and frequency of disaster events increase; it may be difficult to build up sufficient reserves and, between events, there may be a temptation to use the funds for other purposes	- Opportunity costs of ongoing interest payments - May present relatively large fixed costs if bespoke securities are issues - For parametric products, may present basis risk - Potential regulatory barriers for recognition as a risk management tool - Investor knowledge and education may be limited, limiting demand and affecting pricing - May negatively impact non- or lightly-regulated investors, given limited knowledge of long-tailed risks - Reinsurance solutions may prove more flexible, competitive	- For indemnity-based products payment may not be immediately available - Counterparty credit risk - Opportunity costs of ongoing insurance premiums - In contrast to reserves, funds cannot accumulate if a disaster does not occur - Pricing subject to fluctuations in pricing in global insurance markets - May become relatively expensive and possibly unviable as absolute size and level of uncertainty surrounding occurrence of a risk event increases

Source: OECD, 2015c; OECD, 2012b; Wolfrom, *et al.*, 2016.

Contingency funds

Contingency funds are especially important to consider in the context of Southeast Asia as they may be the only available *ex ante* financial tool for markets lacking insurance and disaster risk financing, or where access to such markets is limited. The OECD Recommendation on the Governance of Critical Risks proposes that governments plan for contingent liabilities within clear public finance frameworks by enhancing efforts to minimise the impact that critical risks may have on public finances and the fiscal position of a country in order to support greater resilience (OECD, 2014).

Different types of contingency funds have been developed in the countries of the case study cities, although most of them are still in an experimental stage (Table 2.6. Examples of contingency funds in the selected case study cities).

Table 2.6. Examples of contingency funds in the selected case study cities

Metropolitan Area	DRF Tool	Purpose
Indonesia	National Rehabilitation and Reconstruction Fund	Finances public post-disaster expenditure as part of state government budgets.
	PT Bangun Askrida,	In Indonesia, to protect public assets, almost all local governments are owners of PT Bangun Askrida, an insurance company through which insurance is usually provided.
	Asuransi Wahana Tata	A micro-insurance pilot to cover flood risks in Jakarta.
	PT. Asuransi MAIPARK	A parametric earthquake micro-insurance product for homeowners to protect against earthquake risk.
Malaysia	National Disaster Relief Fund	Provides financial aid to disaster victims as well as burial costs for fatalities due to disasters.
	1 Malaysia micro-protection plan	With the support of Bank Negara Malaysia (central bank), this plan aims to provide affordable life and non-life insurance coverage against a variety of risks, including natural disaster risks. It establishes a set premium based on age and sum insured.
Philippines	Local Disaster Risk Reduction and Management Fund	Directs LGUs to establish a DRM contingency fund of at least 5% based on recurring sources of revenue. The legislation also allows for 70% of contingency funds to be spent on preparation and prevention planning, as well as insurance premiums and disaster response measures.
	National Disaster Risk and Reduction and Management Fund	Provides a calamity fund for disaster relief and rehabilitation; utilised for disaster risk reduction purposes (e.g., preparedness and mitigation programmes, training and procurement of equipment, construction of evacuation centre and other facilities, payments for insurance policies, etc.).
	General Insurance Fund	The Government Service Insurance System (GSIS) insures public assets through the Property Insurance Fund (renamed General Insurance Fund in 1973), which was established in 1951 to indemnify or compensate the government for any damage to, or loss of, its properties due to fire, earthquake, storm, or other casualty.
Thailand	National Catastrophe Insurance Fund	Utilised as a reinsurance reserve, whereby local insurance companies that issue policies retain part of the risk underwritten and transfer the rest to the NCIF, which in turn retrocedes a portion to international carriers on the global reinsurance market
	Rice Disaster Relief Top-up Crop Insurance Scheme	An index-based micro-insurance product that provides coverage for damage that occurs to rice in the growing or harvest stage when affected by flood, drought, windstorm, frost, hail or brushfire.
Viet Nam	National Financial Reserve Fund	In Viet Nam, states are required to contribute between 2%-5% of their budget to a reserve fund to address natural disaster costs. If the amount in such a fund is insufficient, there is a national Financial Reserve Fund that can be accessed.

Source: Author's elaboration; OECD, 2013a; OECD, 2015c.

For example, in Bandung, the central government's Rehabilitation and Reconstruction Fund finances public post-disaster expenditure as part of state government budgets. The amount of the reserve fund reflects the potential disasters that might occur and the financial capacity of the state government concerned (OECD, 2013a).

The Philippines demonstrates a promising policy option to support local governments. While most contingency funds are nationally budgeted, the Philippines' Disaster Risk Reduction and Management Act requires all the local government units (LGUs) in the Philippines to establish a DRM contingency fund of at least 5% based on recurring sources of local revenue. The legislation also allows for 70% of contingency funds to be spent on preparation and prevention planning, as well as insurance premiums and disaster response measures (ADB, 2015). The Government of the Philippines also established a USD 500 million contingency fund with the World Bank in 2015 and is trying to establish a sub-national variant for local governments (World Bank, 2015a). Such contingency funds tailored to the local contexts will strengthen pre-disaster planning to mitigate risks while also providing post-disaster financial assistance at the local level.

In order to complement their actions to mitigate disaster risks, national and local governments may also seek out mechanisms with the assistance of the international community. For instance, the World Bank Group and the Global Facility for Disaster Reduction and Recovery offer two joint programmes seeking to mitigate the financial losses caused by natural disasters. The Disaster Risk Financing and Insurance Program (DRFIP) assists national and subnational governments to implement comprehensive financial protection strategies through sovereign disaster risk financing, agricultural insurance, property catastrophe risk insurance, scalable social protection programs and public-private partnerships (GFDRR/World Bank, 2018a). Although DRFIP works with national and subnational levels of government, the City Resilience Program (CRP) specifically works to enhance urban resilience around the world, including in three of the case study countries, Indonesia, Thailand and Viet Nam. CRP facilitates strategic investments addressing vulnerabilities and risks at the urban level and aims to encourage cities around the world to put climate resilience at the forefront of investment programs (GFDRR/World Bank, 2018b).

Catastrophe bonds

The case study cities are either not authorised or equipped with very limited capacity to issue municipal bonds, and their respective countries have not been issued catastrophe bonds to date. The Philippines recently launched a catastrophe risk insurance programme (World Bank, 2017), which has a contingent credit line with the World Bank, the Second Disaster Risk Management Development Policy Loan with a Catastrophe Deferred Drawdown Option (CAT-DDO) (World Bank, 2015b), and has engaged in catastrophe bond discussions but has yet to be issued a catastrophe bond.

The OECD Recommendation on Disaster Risk Financing Strategies proposes that risk transfer markets for disaster risks be encouraged through a variety of methods, including by supporting the scope of financial protection provided by financial institutions and public entities, where the definition of "financial protection"[3] includes catastrophe bonds as a DRF mechanism. It is also recommended that a financial sector regulatory and supervisory framework be implemented that ensures a sound, open and efficient financial sector with sufficient financial capacity to absorb disaster risks, including by enabling the use of risk transfer to national and international (re)insurance and capital markets (OECD, 2017).

Insurance

This assessment has found that disaster insurance is narrowly used in the case study cities. Indeed, lack of insurance to cover natural disaster losses is an increasing global concern. It is estimated that global losses exceeded USD 4.2 trillion (in 2014 dollars) between 1980 and 2014, nearly 80% of which was related to climate-related disasters (Munich RE, 2018). Only USD 1.1 trillion of losses was insured, implying that three-quarters of the global losses were "uninsured" and borne predominantly by the private sector (Global Reinsurance Forum, 2014). This "insurance gap" is even more pronounced in developing countries. However, recent innovation in the insurance sector has been designed to address these more complex and interconnected risks and impacts. The following insurance options could be considered for the case study cities:

- **Micro-insurance**: Micro-insurance can be defined as the protection of low-income people against specific perils in exchange for regular premium payments proportionate to the likelihood and cost of the risk involved (ILO, 2006). The development of micro-insurance has been one avenue through which governments have sought to enhance financial protection among the financially vulnerable, such as small-scale farmers. Parametric structures require reliable data and technology to monitor hazard levels, which may be costly to acquire, manage and maintain, presenting relevant implementation challenges. On the other hand, existing technological and financial networks can be exploited to improve accessibility and lower transaction costs for financial tools: for instance, mobile phone technology can enhance access to micro-insurance while the purchase of portfolio protection against disasters by credit co-operative or rural banks and micro-finance institutions can enhance access to finance. In some APEC economies with more developed insurance markets and infrastructures, but where insurance coverage for disaster risks may not be sustainable given the scale of the risks and/or level of capital in the insurance industry, different forms of disaster insurance schemes have been established to encourage widespread coverage of catastrophic risks, with the government acting as primary insurer, as reinsurer and/or as guarantor (OECD, 2013a).
- **Parametric insurance**: Parametric insurance schemes base pay-outs on pre-agreed thresholds for certain defined parameters being surpassed, such as the seismic strength of earthquakes, level of storm surge, rainfall rates, inundation of urban areas, and wind speeds. This has quickened and simplified the process of settling claims and providing timely payments to policy-holders that can at least partially cover the costs of DRM efforts during the immediate response, recovery, and reconstruction phases.
- **Re-insurance**: The re-insurance sector is an effective risk-spreading mechanism that aims to avoid "peak losses and risk concentration" and take advantage of the reduced probability of a natural disaster occurring across several different regions, economic sectors, or disaster types during a defined period of time. Re-insurance enables a financial entity to take on the risks covered under other policies and bundle them together into larger "packages" in return for a premium paid by the originating insurance companies. It is becoming an increasingly important component of comprehensive DRM strategies worldwide because of its capacity to absorb the increasing costs of disasters and climate change impacts.

- **Locally-tailored insurance**: Insurance schemes at diverse geographic scales could also effectively support localised response planning. While most insurance schemes globally available at present are at the national scale and remain mostly a prerogative of national governments, insurance schemes tailored at the city level could also be considered. A major challenge to this approach is that estimated natural disaster risks in some cities might be so significant that no insurance company would assume the risk. However, public support including comprehensive disaster risk assessments at the city level may help the private sector develop such a local insurance. In Copenhagen, following dramatic rises in insurance prices for both private and public sector explained by the increase in weather related damage, the local government undertook the "Cloudburst Management Plan"[4], partnering with the insurance sector by sharing the data on disasters and DRM in exchange for a reduction of insurance prices. The community and individual levels may also be of interest, with contingency trusts raised by community development funds (CDFs), or through the development of a pro-poor micro-insurance framework, that has proven quite effective and is growing in the Philippines (GIZ RFPI, 2015).
- **Regional cross-country insurance**: A regional cross-country insurance could be an option in Southeast Asia. In the Caribbean region, Caribbean Catastrophe Risk Insurance Facility (CCRIF) has shown that by putting contingency funding in place before catastrophes occur and streamlining the settlement process, countries can dramatically reduce the indirect economic and financial impacts by quickening the recovery and reconstruction process. Inspired by the Caribbean model and launched in 2007, the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) aims to provide Pacific nations with disaster risk assessment and financing tools for enhanced DRM and climate change adaptation. One component of PCRAFI is the Pacific Disaster Risk Financing and Insurance programme, designed to increase the financial resilience of Pacific Island countries to natural disasters by improving their capacity to meet post-disaster funding needs. Through this programme, advisory services are available for public financial management of natural disasters, including: (i) the development of a national disaster risk financing strategy, recognising the need for *ex ante* and ex post financial tools; (ii) post-disaster budget execution to ensure that funds can be accessed and disbursed easily from the onset of a disaster; and (iii) the insurance of key public assets to contribute to post-disaster reconstruction financing. Under the program, Pacific Island countries – such as Vanuatu, the Cook Island, Marshall Islands, Samoa and Tonga – were able to gain access to aggregate risk insurance coverage of USD 43 million for the third (2014-2015) season of the pilot.

National governments play a key role in facilitating the development of a well-functioning private insurance market by reviewing the framework conditions, inviting reinsurance companies and by mobilising local financial resources in Southeast Asian countries. In parallel, governments must actively pursue disaster risk reduction measures in order to develop such a robust and feasible private insurance market. When risk is too high, so too are insurance premiums, and the market will not develop as anticipated. Establishing an insurance market without sufficiently diminishing risk may lead to adverse selection and moral hazard (Box 2.2).

Box 2.2. Moral Hazard

In order for a well-functioning private insurance market to develop without government intervention, the distribution of risks across insured individuals should ideally be similar to that of the underlying population (no adverse selection), and coverage should not overly influence individuals' actions (no moral hazard). Moral hazard, which refers to a situation where having insurance changes the behaviour of the insured in the sense of making the insured event more likely or costly, must be avoided. Although present in the context of catastrophe risk, adverse selection and moral hazard usually do not pose severe problems to private insurance provision, given the absence of informational problems and the exogenous nature of many of the events (Ahrend, *et al.*, 2011).

While pricing catastrophe risk may be challenging, technical difficulties have historically not prevented the existence of well-developed catastrophe insurance markets as shown for example by marine insurance. Finally, even when the potential loss may be large, most types of catastrophe events are usually local and uncorrelated with a global market index, meaning that they should in principle be diversifiable in financial markets (Ahrend, *et al.*, 2011). Although the use of parametric triggers can reduce moral hazard (since claim payments are based on an index, not on actual loss experience), it may introduce "basis risk" if the index is not well correlated with the occurrence of actual losses (Wolfrom, *et al.*, 2016).

Source : Ahrend, *et al.*, 2011; Wolfrom, *et al.*, 2016.

Promoting a multi-layered approach

In addition to exploring these DRF mechanisms individually, a multi-layered approach to DRF can combine catastrophe bonds with complementary DRF mechanisms such as contingency funds and insurance, thereby providing a stronger safety net and other benefits such as limiting financial exposure of the central government to disaster risk. Mexico's FONDEN is a relevant example of an effective multi-layered approach to DRF that might serve as an inspiration (Box 2.3).

Box 2.3. Mexico's Multi-Layered Approach: FONDEN

In light of the lack of an issued catastrophe bond in the case study cities, Mexico's Fondo de Desastres Naturales (FONDEN) will be discussed. FONDEN was established in 1996 as a tool to finance the costs of recovery and reconstruction of damaged public assets and infrastructures and co-ordinate the actions of intergovernmental and inter-institutional entities. Although FONDEN was initially established as an *ex ante* disaster risk fund, it also benefits from a related reinsurance and catastrophe bond programme which serve to augment the financial capacity of FONDEN, thereby limiting the financial exposure of Mexico's federal government to disaster risk (Government of Mexico/World Bank, 2012).

In 2006, FONDEN issued a USD 160 million parametric catastrophe bond against earthquake risks in three zones for a three year duration; in addition, it secured USD 290 million of parametric reinsurance coverage for the same three zones for three years, bringing its total protection to USD 450 million. In October 2009, it issued a USD 290 million multi-peril parametric catastrophe bond covering both earthquake and hurricane risks with a three-year maturity. After the 2009 bond matured, a third issuance was made in October 2012. MultiCat 2012 is a three-tranche catastrophe bond, with an overall value of USD 315 million, covering earthquake and hurricane risks in multiple regions with a parametric trigger. Starting from 2011, moreover, FONDEN secured a USD 400 million indemnity-based excess of loss reinsurance treaty that will cover the losses sustained by the federal government for government assets and low-income housing, limited to replacement costs (OECD, 2015c).

Source: Government of Mexico/World Bank, 2012; OECD, 2015c.

Similar to FONDEN, the Thai government's National Catastrophe Insurance Fund (NCIF) has adopted a multi-layered approach to DRF. After the devastating 2011 floods in Bangkok, many businesses and individuals struggled to find affordable insurance policies to cover flood damages and losses. Of the total losses in 2011, only about USD 10 billion were insured (as compared to losses of about USD 45 billion). As a response, and as a measure to restore public confidence, the Thai government set up NCIF in January 2012, with a view to making disaster insurance coverage broadly available to businesses and individuals alike. The NCIF is used as a reinsurance reserve, whereby local insurance companies that issue policies retain part of the risk underwritten and transfer the rest to the NCIF, which in turn retrocedes a portion to international carriers on the global reinsurance market (OECD, 2015c). The government regularly raises awareness about the NCIF and other insurance products at seminars and events (OECD, 2013b).

In order for such a multi-layered approach to function effectively, co-ordinating the efforts of central and local authorities in the various phases of DRM, from risk assessment to risk financing and transfer, is critical. Collaborating with the private sector is another indispensable factor of success, and the national government has a key role to facilitate such collaboration.

Promoting the use of information and communication technologies

Information and communications technology (ICT) infrastructure can improve cities' early warning systems (EWS), emergency services, and disaster response efforts, in addition to transport, energy, water and solid waste services. Digital technologies can help to make

urban planning more resilient through flood EWS, to co-ordinate the evacuation and rescue response teams, to reach-out to and receive real-time feedback from local communities and the private sector on the status of current conditions, and to assess the performance of recovery efforts more efficiently. The use of geographic information system (GIS) technology, and other digital tools is a considerable asset in the endeavour to co-locate vulnerable populations, assets and geographic areas on "risk or vulnerability maps" and would contribute to more comprehensive VRAs. This critical information is largely absent from the case study cities with the exception of Cebu, and would provide Southeast Asian policy and decision-makers with data to formulate and implement more effective, targeted, and responsive DRM measures.

Among the case study cities, Bandung is currently developing strategies to become a regional leader in the smart city field, and is exploring the extent to which this can support DRM efforts. As part of a specific research focus on urban green growth in Bandung, this study observed that the city is embracing ICT in the roll out and provision of many cost effective solutions to enhance DRM. This distinct approach is in contrast to the four other case study cities and could be useful in human settlements across Southeast Asia. A smart city uses digital technologies and ICT to make critical urban infrastructure components and services more intelligent, interconnected, and efficient. It is expected that the global market for smart urban services will reach USD 400 billion per year by 2020 (BIS, 2013).

Efficient early warning systems can be developed by ICT to quickly mobilise emergency services. Coupled with meteorological weather forecasting systems, advance warning times can be increased from a matter of minutes or hours to one or more days, allowing potentially affected people to move themselves, their families and their assets out of harm's way, and to protect their property and other possessions which cannot be relocated in time. Early warning systems reaching out to citizens can therefore be installed throughout a city and remotely controlled. Screens in shopping malls and other public areas (e.g. public green space), SMS, and social networks such as Facebook and Twitter can diffuse information on what citizens should do when a flood or earthquake happens. Austin's Flood Early Warning System (FEWS), in Texas (United States), combines flood maps, real-time data and predictive modelling to improve the efficiency of evacuation decisions and plans. The system predicts which streets will become flooded up to six hours beforehand and maps flooded areas and road closure. Before this system, evacuation mostly took place after the disaster had occurred (City of Austin, n.d.).

Smart city tools can help to mobilise the resources of local communities and the private sector in responding to a disaster. Organising domestic and international support effectively was notably one of the issues faced by the Philippines in the aftermath of cyclone Haiyan in 2013. During the 2011 Bangkok megafloods, the help of volunteers was critical in mitigating the impacts of the flood (OECD, 2015b). Smart city tools could be developed so that the local government can directly contact volunteer communities (including companies that can provide basic daily needs such as water and food) and co-ordinate support. These volunteer communities should be identified, with leaders so that they can easily be contacted during a disaster to organise the response of the civil society.

Smart city tools can assist local government or any relevant agency coping with the disaster to get street-level information from citizens to identify priority needs. A common existing method is the emergency switchboard (e.g. 911 in the United States). However, this is often inefficient in the event of a major disaster due to a high volume of calls. During Hurricane Sandy, New York City's switchboard was receiving around 20 000 calls an hour, many of which were not emergencies. This created slow response times and lack of prioritisation,

which is particularly problematic to provide support for residents in life-threatening situations. New York City is trying to better education citizens about what qualifies as a 911 call, but is also developing a parallel 311 line able to analyse text and data received through SMS, calls, and social media posts, for less urgent reports.

Governance to ensure concrete implementation actions for DRM

Mainstreaming DRM into urban policy decisions through a Local Resilience Action Plan

This study finds that DRM is often understood as a technical or environmental issue, rather than as a cross-cutting principle of a sustainable urban development agenda in local governments in the case study cities. For example, Bandung's efforts largely focus on enhancing co-ordination between the fire and police departments, and less on broader 'whole-of-government' initiatives. In Bangkok, the Fire and Rescue Department leads disaster relief measures and is implementing the city's Disaster Prevention and Mitigation Plan 2010-2014. This plan mostly targets preparation, incident and post-disaster management. Ultimately, however, it is unclear who exactly is co-ordinating and responsible for the implementation of these and other resilience measures in Bangkok (OECD, 2015b).

What is needed for Southeast Asian cities is a policy framework to mainstream DRM into different urban policy decisions. As previously mentioned, a Local Resilience Action Plan (LRAP) can function as an interface with other urban policy instruments (Box 2.1). Hai Phong's 2008 Action Plan on implementing the National Strategy for Prevention and Mitigation of Natural Disaster Vision 2020 would certainly be a good starting point, although it should extend its scope to resilience-oriented policies and programmes for Hai Phong Port, a lynchpin in the regional economy.

This study also underscores a need for a 'whole-of-government' approach which can co-ordinate the complex pre- and post-disaster policy measures with myriad stakeholders. An institutional arrangement, such as a dedicated local government agency under the mandate of the mayor would assist during the implementation of DRM policies by facilitating horizontal and vertical co-ordination between public agencies and departments. The case study cities have developed different institutional co-ordinating mechanism across departments for DRM (Table 2.7):

- In Bandung, an ad-hoc Task Force on Disaster Management (Satkorlak Penanggulangan Bencana dan Pengungsi), which incorporates several public agencies, focuses solely on post-disaster response, and while the fire department is responsible for disaster preparation, uncertainty clouds other agencies' respective responsibilities (Bandung City, 2015). The lack of clearly defined roles has led to inadequate co-ordination and communication between departments, especially as regards preparation and prevention efforts.
- The Cebu City Disaster Risk Reduction Management Council (CDRRMC) co-ordinates initiatives and actions introduced by the local government. Cebu City also hosts the Provincial Office for Disaster Risk Reduction and Emergency Management.

- Hai Phong's Steering Committee for Natural Disaster Prevention and City Rescue is a cross-departmental organisation which has taken responsibility for advisory, planning management, general DRM, search and rescue, and oil spill clean-up operations. When a disaster occurs, based on the functions and tasks of the branches and units, the Committee is responsible for creating favourable conditions for collaboration of all agencies in the response activities. The Committee is made-up of heads of Hai Phong Departments, Agencies and Government Units. Every year, they are requested to prepare local plans of natural disaster prevention and submit them to the Committee, at which point a general resilience master plan for the whole city is prepared.
- In Iskandar, there is no dedicated local government agency co-ordinating DRM, except for the National Disaster Management and Relief Committee (present at regional and local level).

Southeast Asian cities could consider several prospective international examples, such as the appointment of a Chief Resilience Officer, as is also implemented in Bangkok. The primary aim of the Chief Resilience Officer is the co-ordination of measures and communication between different levels of government, their agencies and other private stakeholders. An alternate model under the mandate of the Mayor of NYC is the Mayor's Office of Recovery and Resiliency which secured USD 300 million in new funding during 2015 to implement a raft of coastal defence and infrastructure maintenance projects (NYC Mayor's Office of Recovery and Resilience, 2016). It leads NYC's efforts to enhance urban resilience through the implementation of the plan for 'A Stronger, More Resilient New York'.

Table 2.7. Local government agencies responsible for DRM

	Local government agencies for DRM	Functions
Bandung	City's Ad-hoc Task Force on Disaster Management	Post-disaster response
	City's Fire department	Disaster preparation
Bangkok	BMA's Fire and Rescue Department (BRRD)	Lead agency in charge of disaster relief in the City of Bangkok
Cebu	Disaster Risk Reduction Management Council (for each of the 13 LGUs)	Co-ordinates initiatives and actions introduced in each LGU
	Provincial Office for Disaster Risk Reduction and Emergency Management	Co-ordinates DRR in the LGUs in Cebu province
Hai Phong	Hai Phong City Steering Committee for Natural Disaster Prevention and City Rescue	Advisory, planning management, general DRM, search and rescue, oil spill clean-up operations

Source: Author's elaboration.

Aligning national and local resilience plans and strategies

This study has found that in many cases, the co-ordination mechanisms between national and local governments are unclear. Where national and local resilience plans and strategies do exist, they are often not aligned. Sound vertical governance can be an effective approach to enhance urban resilience in Southeast Asian cities. To date, few national policy frameworks are accompanied by processes to assist local governments in translating and implementing national development strategies, and sometimes, they are missing altogether. An unclear delegation of responsibilities usually leads to inefficiencies, as seen in the multi-dimensional water sector in Bangkok. Below are details for the case study cities:

- In Bandung, DRM falls under the aegis of Indonesia's National Agency for Disaster Management (BNBP) and Disaster Management Authority (DMA). As the lead agency, it co-ordinates with other national ministries and provincial level BNBP agencies (known as BPBDs) to determine and implement their roles and responsibilities. Despite extensive technical and financial assistance from international donors, co-ordination appears weak between national and local DRM offices. For example, the DMA reports that only 18 of the 33 provinces in Indonesia have established corresponding regional offices and that many provincial disaster management agencies (BPBDs) have limited human and financial resources, inadequate equipment, and lack local disaster preparedness plans (Give2Asia, 2016).
- In Bangkok, the Thai government has established major disaster prevention and relief guidelines for action at lower levels of government through the National Disaster Prevention and Mitigation Plan (2010-2014). However, for example a local project to build a pumping station has been blocked because it was not well co-ordinated with a different department at the central government (Department of Rural Roads and the Marin Department). There is a lack of collaboration and capacity-building strategies, reflected in the incomplete translation of national spatial plans at the local level and management failures between the national government and BMA during the 2011 floods.
- The Philippines has made a concerted effort to align national and local planning through the Disaster Risk Reduction and Management Council (DRRMC). The recognition of local government's on-the-ground role as first-responders in the event of disaster has led to the establishment of equivalent DRM offices in nearly 1 500 LGUs including in Metro Cebu. Moreover, the initiative has allocated specific financial budgets and staff resources as well. The central task of these offices is to prepare a local DRM plan as part of a greater effort to mainstream disaster planning, prevention and response efforts (Government of the Philippines, 2011).
- In Malaysia, the National Disaster Management Agency (NADMA) was established in 2015 under the Prime Minister's Department, taking over the responsibility for disaster management from the National Security Council. While NADMA functions as a focal point for Malaysia's disaster management, co-ordination mechanisms between national, state and local governments remain unclear with no reference to how Iskandar Malaysia's five local municipal governments could contribute to DRM efforts.

These complex practices underline that national governments have an important role to play in aligning national and local DRM policies and to create an enabling environment whereby local governments can act more effectively and efficiently.

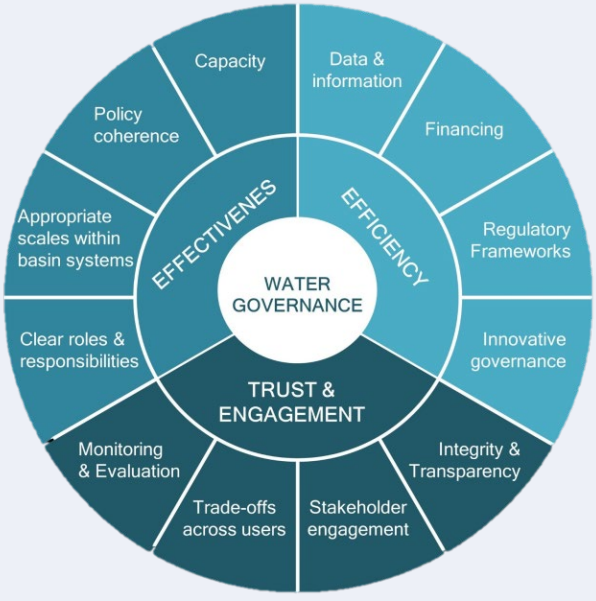
Horizontal co-operation can deliver more effective disaster risk management

Policy coherence is a crucial component of disaster risk management and should be encouraged through effective cross-sectoral co-ordination. Adopting this holistic approach to policy coherence forms one of the twelve pillars of the OECD Principles on Water Governance, which provide a framework for enhancing urban water resilience (Box 2.4).

Box 2.4. The OECD Principles on Water Governance

By 2050, the OECD estimates that water demand will increase by 55% globally and that 4 billion people will be living in water-stressed areas. The international community has recognised that "water crises" are often "governance crises." Technical solutions to water-related challenges often exist and are well-known, but the difficulty lies in the political economy environment to put them in practice, which requires *effectiveness*, *efficiency* and *inclusiveness*.

The OECD Principles on Water Governance (the Principles), endorsed by OECD countries in 2015, set standards for governments to reap the economic, social and environmental benefits of good water governance through effective, efficient and inclusive design and implementation of water policies.



The Principles provide a framework for enhancing urban water resilience, including: properly allocating roles and responsibilities for flood, drought and water pollution management to avoid conflicts and overlaps across levels of government; engaging stakeholders to raise awareness towards risk prevention; putting in place the necessary arrangement for sustainable finance over time

Since 2014, the OECD has been working on the implementation strategy of the Principles, through the development of *Water Governance Indicators* and the collection of *Water Governance Stories*.

Source: OECD (2015e), Principles on Water Governance, http://www.oecd.org/gov/regional-policy/OECD-Principles-on-Water-Governance-brochure.pdf.

As the cases of Bangkok and Bandung demonstrate, a lack of horizontal co-operation can increase cities' vulnerability to flooding and further exacerbate the already poor provision of municipal services. National governments should therefore spearhead metropolitan governance initiatives and allocate sufficient financial and political resources for their

proper functioning. Like in many OECD metropolitan areas, there is an opportunity for greater collaboration between local governments at the metropolitan level in Southeast Asian cities. The Metro Cebu Development Coordinating Board (MCDCB) is an excellent example of a public-private sector approach to facilitate horizontal co-operation at the metropolitan level. The MCDCB has adopted a development framework (Metro Cebu Roadmap) that promotes a green growth agenda, although integration with the Philippines' national economic development strategies is lacking. Similarly in Bandung, a presidential decree issued in June 2018 officially approved the establishment of a metropolitan co-ordinating body, the first of its kind in Indonesia. Since 2007, Iskandar has benefited from the establishment of the Iskandar Regional Development Authority (IRDA), the mandate of which is to co-ordinate various public agencies and to work with private stakeholders to plan, promote and facilitate investment in, and the development of the metropolitan area. In contrast, in the Bangkok Metropolitan Region (BMR), no such authority exists and co-ordination mechanisms at the metropolitan scale are lacking. Although a regional development plan has been promulgated, it has not been implemented in all local land-use plans in the BMR.

Enabling subnational finance for urban resilience

This study underscores that investing in urban infrastructure is a critical strategy for enhancing urban resilience and that financing is a critical implementation lever. In the context of subnational financing in Southeast Asian cities, two persistent challenges are observed from the case studies:

1. Capacity of local governments to access funding markets to meet the investment needs. In particular, there has been intense debate focusing on the question of how difficult it is for developing countries and cities to access dedicated climate funds. The problem is often not the availability of capital, but the lack of well-vetted and viable project proposals. Indeed, local governments are likely to require high levels of financial sophistication to prepare 'bankable' project proposals.
2. The lack of own revenues in subnational governments. The proportion of tax revenues collected by local governments in the region is small, often less than 10% of the total tax revenues as a country (OECD, 2016b). Indonesia's Disaster Management Authority reports that provincial DRM agencies are reluctant to use their limited budgets and instead rely on Indonesia's national disaster funds (Give2Asia, 2016).

Given these challenges, three key policy directions should be pursued: *i)* to develop diverse mechanisms to leverage private funding; *ii)* to provide more opportunities for local governments to raise their own revenue; and *iii)* to place more focus in the local budget on financing disaster preparedness and prevention measures. Below are concrete options that can be considered:

- Leveraging private sector funds by public sector involvement. Public resources could be used to offset the higher costs associated with 'climate-proofing' critical infrastructure to address some of the long-term risks associated with such investments. Some of these risk mitigation policy instruments include credit-enhancement schemes, revenue supports, public-private partnerships (PPPs), or a combination of several different financial mechanisms as part of more comprehensive financial 'packages'. National governments play a key role in creating these incentives.

- Promote the use of 'social impact investment'. Social impact investment is a new, evolving form of financing, providing finance to organisations addressing social needs with the explicit expectation of a measurable social, as well as financial, return. It has become increasingly relevant in today's economic setting, as social challenges have mounted while public funds in many countries are under pressure (OECD, 2015d). By branding itself as environmentally, socially and fiscally responsible ('creditworthy'), a city could become an attractive partner for impact investors.
- Introducing a transparent public accounting system and obtaining credit ratings. Currently, only 4% of the 500 largest cities in developing countries have international credit ratings while 20% have domestic credit ratings (World Bank, 2013). The lack of a credit rating at the municipal or provincial level creates a powerful barrier for cities to potentially secure large sources of financing and hampers cities from carrying out efficient DRM policies.
- Developing partnerships with local governments, local lenders and community groups. There is a need to catalyse partnerships with local lenders by increasing the banking and investment communities' awareness of the role they can play in supporting climate-resilient investments and initiatives. Businesses and the investors who finance them realise that they cannot operate profitably in isolation from their surrounding environments and labour forces, and know that they depend on public services like roads and the electric power grid to function normally.
- Making more use of economic instruments that can both raise and diversify local revenues, such as property taxes, combined waste and sanitation services and electricity tariffs, and land development/land-value capture taxes along public transport corridors. The case of Bangkok demonstrates an opportunity for local governments in Southeast Asian cities to raise their revenues by linking land-use control tools with taxes/charges. For example, levying higher taxes/charges for urban development in areas where flood risks are high could be considered. In the Netherlands, developers who locate property beyond the dykes generate future liabilities and are required to pay higher taxes for the future costs of protecting their assets. A portion of the higher revenues collected by local authorities from such taxes could be earmarked for flood resilience projects, such as those that might cover relocation costs for poor communities living in flood zones. Authority to implement these taxes and development fees typically lies with national governments, implying that close co-ordination between national and local governments is essential.[5]

Engaging stakeholders can enhance inclusiveness and foster a culture of DRM

Engaging local communities from the early stages of decision-making can help develop more effective and inclusive DRM strategies and frameworks. The poor, and especially poor women and children, are the most acutely exposed to natural disaster risks in Southeast Asian cities. They often lose their homes, assets and livelihoods, making them even more vulnerable to the next disaster, while having weaker adaptive capacities, no insurance, and little influence in decision-making processes. Women and children are 14 times more likely to die than men during a disaster, and more than half of all those affected by disasters are children (UNISDR, 2011). By 2030, it is estimated that three billion people will be living in urban slums (Baker, 2012), which indicates that these trends may worsen.

The assessment has found that local communities are not always offered opportunities for engagement. For example, in Hai Phong, the city implemented an action plan between 2013 and 2015 to raise public awareness about DRM through community participation. The action plan was based on a national project, the National Strategy for Prevention and Mitigation of Natural Disasters with the Vision 2020, which aims to mobilise resources to ameliorate disaster response, prevention and mitigation and to minimise loss to human life, property and damage to natural, cultural and environmental assets (City of Hai Phong, 2015). Presently, however, in most cases, the local government and its citizens are simply informed of decisions already made at much higher levels of government, which may not adequately reflect local preferences and needs.

One of the most effective strategies to contain the social impact of floods on local communities in Southeast Asia is the direct involvement of local communities before, during and after a disaster. In disaster response, promoting organisational capabilities and response skills within urban communities is key, as in most disasters, the 'first responders' are either family members or neighbours in the time-window immediately following a disaster and before local authorities arrive. The creation of a 'self-help first' culture should be promoted by incorporating local community structures into resilience efforts, starting with the most vulnerable community groups first. Local communities in Bangkok were aware of the fact that local government efforts to build DRM were not exhaustive and they prepared to act as first-responders in the event of disaster, as occurred in 2011. During the 2011 mega-floods, many residents volunteered to fight the floods by helping the most vulnerable populations (Global Disaster Preparedness Centre, 2013). This encouraged the BMA to change its strategy and to co-ordinate more with local residents, by going out into the field to the volunteers' camps and discussing the flooding issues with local leaders in these camps. Such a strategy could make the residents' future response to disasters better organised and render their co-ordination and collaboration with governments even more effective. The state of Victoria (Australia) has set up a dedicated agency to create safer and more resilient communities (Box 2.5). Collaborating with the local community and NGOs for public awareness-raising campaigns is another key strategy.

Engagement with the local business communities and the private sector is equally important. Flooding is likely to have serious economic consequences through the loss of employment, livelihoods and trading opportunities with local and international markets. For instance, natural hazards not only have the power to damage city infrastructure, but also affect international trade because they impact major ports such as those located in Iskandar and Hai Phong. Multi-stakeholder forums could be set up on a number of issues of concern beyond flood resilience in the case study cities, at the regional scale as well as at the individual provincial and district levels. Such interactions could be facilitated by officials and local leaders, especially in slum areas, which typically are less accessible and under-represented in public policy discussions and decisions.

To ensure long-term economic resilience, national and local authorities can also encourage the private sector to design their own business continuity and post-disaster recovery plans, to reduce disruption to their economic activities. For example, the Greater London Authority has developed a Business Preparedness Checklist available online, and a five-step strategy to assist the private sector in business continuity planning: 1) analyse the business; 2) assess the risks; 3) plan and prepare; 4) communicate the plan; and 5) test the plan. Each of the five strategies are adapted according to the size of the business at risk (small, medium or large) and the Greater London Authority's website also features key actions to be taken in case of a shock, and pools knowledge on best practices for DRM

worldwide (Greater London Authority, n.d.). Local authorities in the case study cities can learn from such examples.

Box 2.5. Community Engagement for Resilience in Australia

The ability of broader networks to generate resources was demonstrated during the so-called "Black Saturday" bushfires, which took place in 2009 in the state of Victoria. Over $378 million and a myriad of other resources were drawn through Victorian networks to support those affected. In addition to these material resources, communities mounted a volunteer fire fighting response, cared for those affected, and have been working after the disaster with a range of decision-makers to ensure their towns, and the industries that support them, recover and rebuild. The floods across Victoria in January 2011 also showed the importance of mobilising communities to help each other prepare, respond, clean up and recover.

To improve both preparedness and post-disaster response, and to create safer and more resilient communities, the state of Victoria created a dedicated agency, the EMV (Emergency Management Victoria), which has the following objectives:

- Creating and supporting institutional mechanisms for collaborative community planning;
- Building governance capacity to ensure equal participation in governance including: grants to support organisations build their capacity for community engagement or planning (for example, Local Government Capacity Grants, Volunteer Support Grants); Office of the Community Sector work to improve the community sector by reducing red tape and building sector capacity; leadership and governance training;
- Providing grants to support community planning processes (such as the Community Support Fund, a trust fund aiming to direct a portion of gaming revenues back into the community.); and
- Creating an evidence base to support community planning in the three areas of technical/empirical data, local knowledge and strategic analysis including: participation of communities in data collection; release of data to communities; support to help communities use data; community forums, strategic roundtables and conferences about best-practices for resilience.

Source: Victoria State Government, Department of Land Planning and Community Development (2011), "Indicators of community strength in Victoria: framework and evidence".

Summary of assessments and recommendations

This section summarises the study's assessment of DRM policies in Bandung (Indonesia), Bangkok (Thailand), Cebu (Philippines), Hai Phong (Viet Nam) and Iskandar (Malaysia), and presents the following main findings and recommendations.

Main findings

Preparedness: Southeast Asian cities are largely underprepared for natural disaster risks, especially as regards vulnerability and risk assessment practices. Comprehensive hazard assessment and mapping is not uniformly employed, which is particularly harmful for identifying and protecting low-income communities at risk.

Land-use: Land-use policies do not often consider DRM, which has resulted in continued urban development in risk-prone areas.

Urban infrastructure: Two-thirds of Asia's infrastructure needs by 2050 still have to be built and financed, thus providing an opportunity to factor in resilience to natural disasters. The large need for infrastructure investment will require large-scale private sector engagement. To this end, public finance plays a critical role to facilitate, leverage and guide private investment. At the city level, this is a challenge when tax revenues collected by local governments are often small.

Insurance: Adequate private and public insurance mechanisms to share disasters risks are not well developed in the case study cities. Almost three-quarters of all financial damages globally are not insured, and this insurance gap is even more pronounced in Asia.

Governance: The co-ordination mechanisms between national and local governments are often lacking or not clearly defined, obstructing the implementation of national policy frameworks (when they exist) at the local level.

Stakeholder engagement: While engaging local communities from the early stages of decision-making can help develop more effective and inclusive DRM strategies and frameworks, such opportunities are not always offered in the case study cities.

Recommendations

Conduct a comprehensive vulnerability and risk assessment to develop a local resilience action plan.

Vulnerability and risk assessments and local resilience action plans are tailored to local conditions and rely on multi-level, multi-stakeholder engagement to identify and prioritise DRM policies, plans, and investment actions. They are the first step to enhancing urban resilience and are vital to the success of a long-term DRM framework. Developing data and indicators for DRM at the metropolitan level is another key step.

Adopt risk-sensitive land-use policies combining regulatory and fiscal instruments to guide urban development away from risk-prone areas.

Given the continued pressure for urban development, effective design and implementation of land use strategies and policies is needed to guide private investment, minimise risks and avoid locking cities into vulnerable development patterns that will be costly to reverse in the long run.

Integrate disaster risk management policies and urban green growth policies, especially in the infrastructure sector, to generate "co-benefits".

Complementarities and synergies are often found between disaster risk management and urban green growth policies, which can produce cost-effective "co-benefits". Financing resilient urban infrastructure can be achieved through economic instruments (property taxes, fees, tariffs, and land-value capture mechanisms) that promote DRM and diversify local tax revenues.

Develop disaster risk financing mechanisms to serve as a backbone of effective disaster response planning.

Contingency funds, catastrophe bonds, and insurance schemes can drastically reduce risk exposure. Promoting a multi-layered approach that combines disaster risk financing mechanisms can provide a stronger safety net, limit financial exposure of the central government to disaster risk, and encourage multi-level governmental co-ordination.

Promote the use of information and communication technologies.

Investing in social and human capital and enhancing the availability and quality of innovative emerging information and communications technology is also a potentially useful approach. Key tools include early warning systems, emergency services, and other disaster response efforts in sectors such as transport, energy, water and solid waste.

Foster vertical and horizontal co-ordination to foster a "whole-of-government" approach.

National governments have an important role in aligning national and subnational DRM policies and creating an enabling environment that allows local governments to act more effectively and efficiently. Establishing a dedicated DRM agency will help to facilitate horizontal co-ordination among sectoral departments as well as vertical coherence across levels of government. Conducting in-depth country reviews of urban DRM policies can also be useful to provide a neutral assessment of the current state of play, consider options to fit for the future, and guide public action and decisions.

Engage with stakeholders to promote inclusiveness and encourage a culture of DRM.

Co-ordinated response mechanisms between civil society and local governments as well as public awareness campaigns targeting citizens, especially those at greatest risk, and financially vulnerable is critical to enhance urban resilience. Local authorities can encourage the private sector, notably SMEs, to design business continuity and post-disaster recovery plans to reduce economic disruption to their activities.

Notes

[1] In 2014 USD 1 = VND 21,148.00 World Bank (2016), Official exchange rate (LCU per US$, period average), available at: data.worldbank.org/indicator/PA.NUS.FCRF (26 April 2016).

[2] The definition of critical infrastructure varies from country to country. This paper is based on the following definition by the European Commission: "an asset, system or part thereof located in Member States which is essential for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact in a Member State as a result of the failure to maintain those functions" (COUNCIL DIRECTIVE 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection).

[3] "Financial Protection": in the context of disaster risks, the level of payment to be expected based on the occurrence of a disaster event and/or the specific costs incurred as a result of a disaster event (*e.g.* property insurance contract, parametric insurance contract, catastrophe bond, government compensation or financial assistance for disaster losses)" (OECD, 2017).

[4] A "cloudburst" is an extreme precipitation event.

[5] Close co-ordination between national and local governments neatly encapsulates the need for effective assessment practices (policy) and a whole-of-government approach to derive co-benefits between different policy objectives, so as to deliver long-term financial and material dividends.

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Part II. Case studies

Chapter 3. Bandung, Indonesia

Chapter 3 examines the threat of natural disasters in Bandung, and how the city and metropolitan area can build greater resilience to them systematically and comprehensively through a variety of means.

The chapter is divided into three sections: 1) the natural hazards that pose the greatest risk to Bandung are identified; 2) the current state of DRM policy in Bandung is assessed; and 3) co-ordination and governance mechanisms between government entities and other stakeholders are discussed.

A focus is placed on the impacts of natural disasters and urban resilience policies on the most vulnerable segments of the local population. In addition, the chapter also stresses the need for broad support and full engagement of affected communities, civil society, and the private sector, with local political leadership.

This chapter draws on the key findings of the OECD study "Green Growth in Bandung, Indonesia" (OECD, 2016). It also benefited from discussions held during the third Knowledge-Sharing Workshop 'Smart Cities and Green Growth' in Bandung (6 -7 May, 2015), and by independent research and discussions with subject matter experts in Indonesia, Asia, Europe, and the United States.

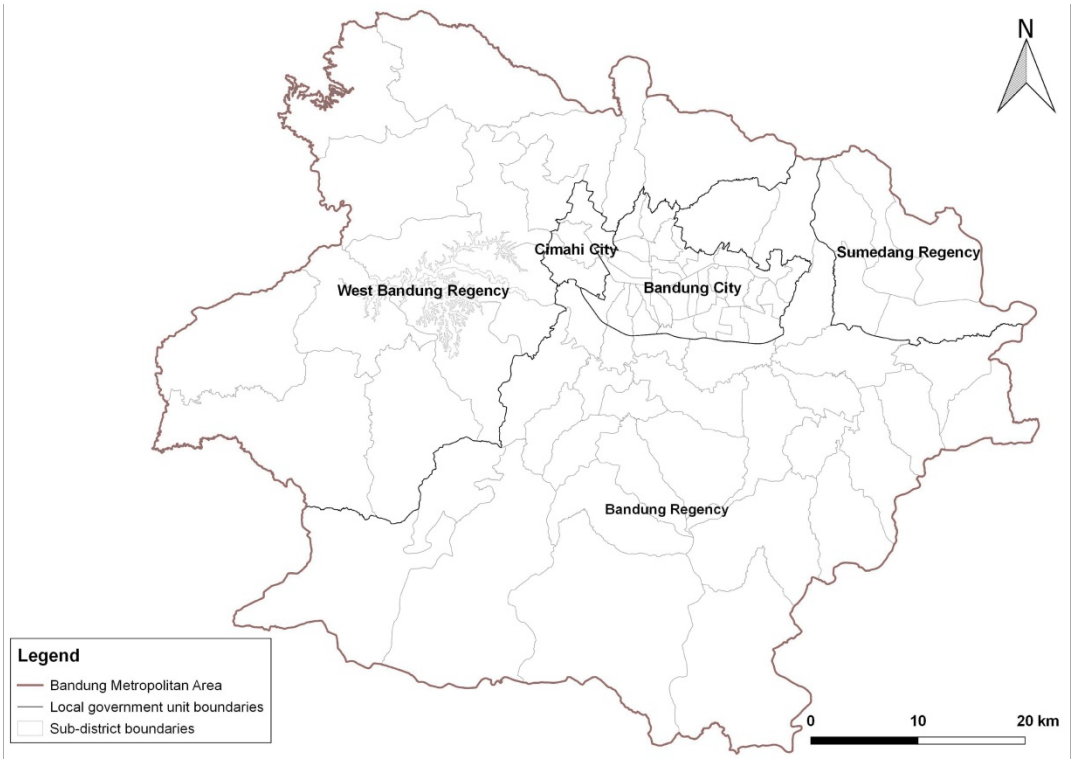
Main Points

- The most serious natural hazards facing the Bandung Metropolitan Area (BMA) stem from **increasingly frequent and destructive floods** followed by less frequent, but potentially more devastating impacts from volcanic eruptions and earthquakes. Fires and landslides also pose risks. This is partially due to topography and Bandung's location in a geologically and seismically active area, and tropical monsoon climate. The city's exposure to flooding risks is exacerbated by the concentration of poorly prepared urban populations in highly exposed parts of the city.
- One of the basic building blocks for the BMA is to undertake **a vulnerability and risk assessment (VRA) and asset inventory**. Currently, no hazard maps have been developed by the City of Bandung and other local government units in the BMA. The next step is to revise zoning regulations and land use controls based on the VRA and asset inventory in order to prevent urban population and economic activities from locating in the most risk-prone areas.
- **Applying ICT tools to DRM is a promising option for the BMA**, given that the City of Bandung is developing strategies to become a regional leader in the smart city field. Digital technologies can help to make urban planning more resilient through a flood early warning system, to co-ordinate the evacuation and rescue response teams and to reach-out to and receive real-time feedback from local communities and the private sector and to assess the performance of recovery efforts more efficiently.
- The current DRM approach in the BMA is very focused on disaster response and co-ordination between local governments in the BMA has been a challenge. In June 2018, a presidential decree officially approved the establishment of a **BMA-level metropolitan co-ordinating body**, which should be particularly useful to enhance horizontal policy co-ordination on DRM.
- Within the City of Bandung, a lack of horizontal co-operation also increases the cities' vulnerability to flooding. A possible solution is to create a **DRM taskforce** which could put all the relevant departments in the city government on board, and advised by external advisory groups. The Bandung Command Centre could be used as a more central governance tool in DRM in the city, co-ordinating data and action from the various relevant departments.
- Building greater DRM requires the **participation of a broad spectrum of stakeholders and collaboration in shared decision-making processes.** An inclusive approach involving all major stakeholders includes public agencies at various levels of government and across different agencies and has been shown to greatly improve the quality, acceptance, and durability of the solutions generated. An ideal vehicle for such collaboration would be the VRA and Local Resilience Action Plan (LRAP) processes.

Natural disaster risks

Bandung is located in the central-west interior of the island of Java, about 140 kilometres south-east of the Indonesian capital, Jakarta. The Bandung Metropolitan Area (Cekungan Bandung, as it is widely known) covers a mountainous and elevated area of 3 488 km² (Figure 3.1). Bandung City, located at the centre of this metropolitan area, is the capital of West Java Province. Bandung's economic activities extend beyond the administrative borders of Bandung City and encompass a much larger urban agglomeration. The Bandung Metropolitan Area (BMA) boundary identified in the West Java Province Spatial Plan is the principal analytical unit of this report. On some occasions where data for the metropolitan area are not available, the analysis only takes Bandung City into account.

Figure 3.1. Map of Bandung Metropolitan Area



Source: Bandung City (2016), "Answers to the OECD case study questionnaire", internal document, unpublished.

Bandung's location 768 metres above sea level, mountainous geography and a mild climate distinguish it from the other case study cities. It also exposes it to a number of natural hazards. For example, in 2014, West Java Province recorded 290 natural disasters, more than anywhere else in Indonesia. Moreover, Bandung recorded the second highest number of disaster events nationally with 31 or more than 10% (Jakarta Post, 2014a). The most serious natural hazards facing Bandung stem from increasingly frequent and destructive floods followed by less frequent and predictable, but potentially more devastating impacts from volcanic eruptions, landslides, and earthquakes. Fires also pose serious risks to Bandung.

These natural hazards have the power to severely damage Bandung's critical infrastructure, public services, and built environment, putting people and their livelihoods and assets at risk. They also have the potential to undermine the sustainability of Bandung's economic and social advances in the future, and its environmental quality. The potential failure of critical urban systems, such as the city's electrical grid, transportation links or water supply and sanitation systems impedes immediate disaster response and recovery efforts.

Bandung's valley floor location close to the Citarum River and surrounding volcanic peaks that reach heights of 2 000 metres make it vulnerable to flooding. High and extreme variation in rainfall between the wet and dry seasons generates a basin effect where water drains towards the river, presenting manifold and ongoing water-induced challenges.

Flooding has the largest impact on people's livelihoods in Indonesia and represents nearly 40% of all disasters nationwide. For instance, the 2014 Christmas floods that inundated several city districts for two weeks heavily affected the city and caused considerable damage. The floods also inundated 36 000 households in five northern districts upstream of Bandung along the Citarum River for almost two weeks (Jakarta Post, 2014b). Indonesia's national agency for disaster management (BNBP) has warned that flooding in Bandung has become an almost annual occurrence since the 1980s due to its growing population, local topographic location on a valley floor surrounded by mountains, and tropical monsoon hydrological regime. In the future, these factors will leave Bandung increasingly exposed and vulnerable to floods especially as the climate changes.

The threat posed by flooding in Bandung, due to heavy rainfall associated with the tropical monsoon climate, is exacerbated by a number of human factors, including: i) Land conversion of natural areas upstream for agricultural or new housing projects; ii) presence of larger populations living in 'harm's way' in low-lying flood-prone areas in Bandung; and iii) Poorly-maintained drainage systems in parts of the old city centre along the Citarum River and its tributaries as well as along dozens of drainage canals.

Bandung is also threatened by earthquakes or volcanic eruptions due to its location in a geophysical active area of central West Java. These are the two other most serious, but less frequent, natural hazards Bandung is facing. The most recent major earthquake in 2009 (magnitude 7.0 on the Richter scale) killed 79 people, injured hundreds of others, and damaged many buildings in Bandung (Earthquake Track, 2016). The active Tangkuban Perahu volcano is also one of 17 volcanoes monitored by Indonesia's National Agency for Disaster Management (BNBP) in West Java. In combination, landslides instigated by seismic activity also pose significant risks as well.

Assessment of DRM policies

Vulnerability and risk assessment

One of the basic building blocks of resilience enhancement in any city is to undertake a vulnerability and risk assessment (VRA) and asset inventory. The fundamental steps and processes involved are only just beginning in Bandung now. The VRA mapping exercise that city officials and community representatives conducted with assistance from USAID in 2015 represents one of several methodologies that have been developed by various multi-lateral development banks and international organisations (Box 3.1).

Box 3.1. VRA mapping and LRAPs in Bandung

The City of Bandung recently received a one-week training workshop (May 2015) in the Vulnerability Risk Assessment (VRA) methodology developed under the USAID Adapt Asia and Pacific Project by the East-West Centre of the University of Hawaii. That methodology can be accessed from Dr. Kem Lowry at http://www.eastwestcenter.org/about-ewc/contact-us, or at http://www.adaptasiapacific.org/.

Many variations of VRA methods exist from most of the multi-lateral and bi-lateral donors as well as a number of international NGOs, such as 100 Resilient Cities, ICLEI, ACCCRN, etc.

The World Bank has developed the methodology for creating Local Resilience Action Plans (LRAPs), which have been piloted in various cities around the world and are available on-line through the World Bank's "e-Library."

Source: Author's elaboration.

Zoning regulations and building codes

Buildings and the housing stock in cities are among the greatest causes of death and destruction in most disasters. When buildings or homes collapse in earthquakes, floods, mudslides or landslides, they injure or kill many people. Collapsed buildings have accounted for nearly two-thirds of all natural disaster fatalities since 1980 (Munich RE, 2015). In Bandung however, people have been allowed to settle and build in flood-prone areas and this development is actually increasing the city's exposure to further flooding risks (Tarigan, *et al*., 2016). At a national level, it is estimated by the Ministry of Public Works that in excess of 25 million people already live in highly exposed settlements in rapidly growing and unprepared urban slums (Give2Asia, 2016). Their vulnerability is more attributable to poorly enforced zoning regulations and land use controls than it is to topography or hydrology. Bandung should critically strengthen its enforcement of zoning regulations and building codes to minimise damages and losses from flooding or landslides caused by periodically intense tropical rainstorms.

Bandung could facilitate efforts to convert these areas into attractive and widely used public spaces to prevent re-settlement by squatters or from being used illegally to dump wastes. The Citarum River, which runs through the heart of Bandung, is heavily polluted by human and toxic wastes containing lead, mercury, arsenic and other toxins (Box 3.2). They are dumped into the river without treatment from more than 2,000 industries and textile factories located in Bandung and Cimahi (ADB, 2007).

Box 3.2. Revitalising the Citarum River

In 2008, the Asian Development Bank approved a $500 million loan to clean up the Citarum river. However, work did not begin until late 2011 when a much larger (USD 4 billion) and more comprehensive project to revitalise 180 kilometres from Mount Wayang through eight regencies and three cities, including Bandung, was initiated. As of yet, the area running through Bandung has not been developed into a 'showpiece' of urban renewal efforts. This is an opportunity for Bandung to use it for the dual purpose of providing much needed space for urban recreation while retaining its flood-protection properties when needed. There are also other ways to create multi-purpose public spaces, such as below grade parks, playing fields, and underground parking lots, for their temporary water storage capacity, which could significantly improve Bandung's resilience to periodic floods.

Source: Author's elaboration.

Co-benefit DRM approach

Bandung has begun to pursue integrated, cross-sectoral planning in at least two critically important areas: (i) land-use spatial planning efforts to create new development projects as self-contained, multi-purpose areas where people can 'work, live, and play' in safer, less crowded areas, and (ii) by connecting them to other areas using high-quality public transportation modes. This type of transit oriented development (TOD) which promotes interconnected nodes could also incorporate other DRM strategies by making greater use of renewable energy sources, land and water resources, and more energy efficient buildings, cars, and factories.

This assessment found that poor solid waste management is one of the critical issues undermining DRM in Bandung. Bandung requires an improvement to solid waste collection systems and public health awareness-building campaigns in order to reduce the amount of garbage illegally dumped into local streams and drainage canals. The use of ICT should be pursued to enhance solid waste management. For instance, Bandung could create a special smartphone application to report uncollected solid waste in the city so that citizens can alert a special waste management unit of the City of Bandung. The Bandung Command Centre has the capacity to easily collect such input from citizens since it already communicates with them through Twitter. In parallel, awareness programs would need to be launched by the city government to communicate the benefits of such an application.

The Love Clean London initiative is a good inspiration: it enables citizens to report environmental problems such as poor waste storage, through texts, uploaded photographs, and reports submitted through a free application. The reports can be visualised on a map by the city government to show where clean-up actions are most needed (BIS, 2013). In Barcelona (Spain), garbage bins are equipped with sensors that send alerts to residents when they get full, to encourage them to minimise waste and recycle. In Groningen (the Netherlands), smart bins automatically send text message to the city government when they are full. It allows reducing labour and petrol costs – and thus environmental impacts – by sending garbage trucks only to bins that need emptying (BIS, 2013).

Use of ICT

Smart city tools can be an effective means to make Bandung more resilient to disaster risk. They are rapidly developing in many cities, which are already relying on sensors to monitor water levels and seismic activities. Bangkok's Flood Control Centre (FCC) is a good example (see Section 0). Although there is room for improvement of the FCC (e.g. such as adding more elaborated analytical capacities such as the 3Di tool), it can be an interesting starting point to create smart resilient infrastructure in the City of Bandung. A complementary initiative that the City of Bandung could consider to monitor river and canal management would be to assess the conditions of waterway infrastructure such as gates. In the Santa Clara County, California, district field staffs were sent to the field to catalogue the condition of such infrastructure, with the help of GIS tablets. This initiative not only digitalised such information but also made it more easily accessible for the city government.[1]

There is a need to assess the quality of river and canal water in Bandung, as poor quality water represents a major health hazard if a flood occurs. Sensors could be placed in strategic locations and send data to the Bandung Command Centre for on-screen visualisation. While the city's Command Centre will be useful to co-ordinate the action of emergency response teams, developing other smart initiatives could allow the city to tackle the lack of resilience more comprehensively, in particular by enhancing urban planning, infrastructure management, and the effectiveness of local community and private sector engagement before, during and after a disaster.

GIS is one of the most common digital tools used for mapping flood risk assessment. With regard to floods for instance, it consists in overlaying different types of GIS maps (e.g. topography, rivers, urban areas) to identify populations physically exposed to floods and earthquakes. However, no hazard map has been developed by the City of Bandung to identify such populations and take actions accordingly to prevent high human and economic damages from a potential future flood or earthquake. Capacity building is therefore required to develop such hazard maps.

However, GIS hazard maps are relatively static and do not provide an understanding of the dynamic impacts that a disaster such as a flood can have. In this regard, the City of Bandung could also consider complementary types of digital technologies to inform resilient urban planning. The Public Utilities Board of Singapore, for instance, is using simulation software called 3Di.[2] This not only measures real-time water levels in different places in the city, but analyses, models and forecasts potential water flows in the city in case of flash floods. Such a system can help to identify catchment-wide solutions to reduce the speed of surface runoff in urban areas, to identify which areas to monitor and to decide proactively on appropriate land-use and infrastructure strategies (Public Utilities Board of Singapore, 2013). Such technology should be distributed to other local authorities in the West Java Province and to the provincial government, to assess region-wide water flows and encourage a comprehensive regional approach. This is critical because the software may help to identify weaknesses in other local areas that are also risk factors for the City of Bandung.

The Aqueduct Global Flood Analyser estimates the human and economic damages potentially born by floods, based on different scenarios and geographical scales. For instance, it estimates that even in a scenario of moderate climate change and continuation of current socio-economic development trends, and assuming a 50-year infrastructure protection, the West Java State could undergo damages of more than USD 500 million by 2030, and more than 47 000 persons would be affected. Since West Java State is the

smallest unit of analysis, the Aqueduct Global Flood Analyser does not produce detailed information on the City of Bandung or its metropolitan area. The local government could therefore consider developing a partnership with the WRI to produce data at the local level.

This study found that ICT can provide a more ambitious and needed understanding of the performance of infrastructure as regards resilience. The Bandung Command Centre could connect information on water levels collected through sensors and warning systems that would automatically be activated. Such sensors need to be developed and digitalised in parallel with a geo-referenced database of natural streams and man-made drainage channels to help identify their proper locations. Although sensors are important, further tools need to be developed to grasp the complexity of the impact of a natural disaster on urban infrastructure, and how to manage all types of infrastructure (transport, energy, water, etc.) in a co-ordinated way when a disaster occurs. Rio de Janeiro's Operations Centre is a citywide data system integrating information on different types of urban infrastructure. It collates all data, input online, to identify trends and complex impacts of potential disasters, such as floods, fires and landslides. Further, the Operations Centre remotely controls sirens that indicate to people in the poorest urban areas where to take shelter in case of heavy rainfall The City of Bandung could consider developing such technology, and integrate it in the Bandung Command Centre, considerably enlarging its disaster response capacities, which are mostly limited to police and fire brigade interventions.

The Bandung Command Centre already informs police and fire brigades if a disaster occurs, but this study has found that the local government should also include the citizens as a critical resource to ensure resilience. The Centre can utilise smart city tools during a disaster to collect street-level information from citizens to identify priority needs. The leaders of volunteer communities should be identified and can be equipped with mobile devices so that the local government or the Centre can contact them directly. Since Bandung faces the risk of a major earthquake, flood or volcanic eruption, it should develop a system to identify priority needs such as an emergency switchboard. The Bandung Command Centre could work as a central unit collecting and organising SMS, calls, and social media posts since it already collects input from citizens via Twitter. The staff in charge of the Centre must be ready to receive a greater number of inputs in case of disaster, and thus, capacity building may be required.

Assessment of DRM governance structure

Vertical and horizontal co-ordination

Disaster response falls under the aegis of the National Agency for Disaster Management (BNBP) and Disaster Management Authority (DMA) as the lead agencies in Indonesia. They co-ordinate with other ministries at the national level and with provincial level BNBP agencies to carry out their respective roles and responsibilities. At the national level, the BNBP has been actively implementing programmes to enhance the country's DRM, many of which are related to cities. For example, a program to strengthen its national and regional hydro-meteorological institutions has been conducted with technical and financial assistance from USAID as part of the Asia Flood Network. Overall, there were 14 country-specific programmes in 2014. The other programmes include: the Program for the Enhancement of Emergency Response (PEER), the Volcano Disaster Assistance Program (VDAP), Mobile Communication for Preparedness in Southeast Asia Program, and the Indonesia Liquidity Facility After Disasters (ILFAD) Program.

Despite the Indonesian government's active engagement, DRM actions at local levels are not well linked with the central government. For example, the DMA reports that many provincial disaster management agencies (BPBDs) have limited human and financial resources, inadequate equipment, and lack local disaster preparedness plans. They also reported that BPBDs are reluctant to use their limited provincial budgets and instead rely on Indonesia's national disaster funds. Only 18 of the 33 provinces in Indonesia have established corresponding regional offices (Give2Asia, 2016). In addition, the current DRM approach in the BMA is very focused on disaster response. A governance reform within the administration may be necessary to adopt a more holistic approach including preparation and prevention policies. Understanding the potential benefits of a holistic approach to DRM would be crucial to gain political support at the provincial and local levels and to lead policy actions.

The City of Bandung demonstrates a lack of horizontal co-operation within the city government in terms of DRM. An ad-hoc Task Force on Disaster Management (Satkorlak Penanggulangan Bencana dan Pengungsi), which incorporates several public agencies, focuses solely on post-disaster response, and while the fire department is responsible for disaster preparation, uncertainty clouds other agencies' respective responsibilities (Bandung City, 2015). The lack of clearly defined roles has led to inadequate co-ordination and communication between departments, especially as part of preparation and prevention efforts. This is partly because DRM is understood as disaster response (thus understood as something for which the fire department should be responsible). In addition, although the notion of DRM becomes wider, cities where their governance systems are rigidly 'stove-piped within sectoral silos' tend to have greater difficulty addressing the cross-sectoral implications of climate and disaster threats. Responsibilities and roles tend to be rigidly defined, but fragmented and disputed. This slows down efforts to build greater climate resilience beforehand and to respond afterwards.

A possible solution is to create a DRM taskforce chaired by the Department of Development and Planning of Bandung City. Such a taskforce could bring all the relevant departments in the city government on board, and be advised by external advisory groups who can oversee all the city government's DRM actions. The Bandung Command Centre could also be used as a more central governance tool in DRM in the city to co-ordinate data and action from the various relevant departments (not only fire and rescue but also environment, urban planning, communication, police, etc.). Another important option is a Local Resilience Action Plan, which can mainstream DRM across Bandung's plans, budgets, and daily operations.

Local co-ordination

In June 2018**,** a presidential decree officially approved the establishment of a BMA-level metropolitan co-ordinating body. The first of its kind in Indonesia, the establishment of such a body should be welcomed as it seeks to enhance policy co-ordination on DRM. The objective of this body is to co-ordinate policies through BMA-wide master plans, but also to facilitate private investment in the region. West Java Province functions as a co-ordinator for the body and decisions will be collectively made by the five municipalities. This executive structure will be particularly helpful as the West Java Province is always involved in any project mobilising at least two municipalities, which is the case of some ongoing projects such as the Light Rapid Transit (LRT). It could also be an opportunity for the provincial government to be more active and visible in the development of the BMA. The central government can intervene on certain issues – the BMA is designated as a

"national strategic area" – and also has important financial influence as it can decide whether to prioritise projects collectively agreed upon by the BMA.

The establishment of the new body will be particularly useful since co-ordination between local governments in the BMA has been a challenge to date. As mentioned previously, decentralisation reforms in Indonesia have tended to empower cities without creating incentives for horizontal collaboration in parallel, thereby discouraging local governments from making efforts to talk to and govern with their neighbours. In addition, many local government officials lack awareness on the co-ordination needs created by decentralisation reforms and their potential benefits (Firman, 2009). The parochial attitude of many local governments has caused a number of problems in services which require cross-border co-operation, including solid waste management and water supply, in many regions in Indonesia (Firman, 2009). This has exacerbated the already limited provision of urban services because the BMA's local governments work counterintuitively to their collective good.

In order to enhance DRM in the BMA, the new metropolitan co-ordinating body could address in priority the following most critical horizontal co-ordination issues in the BMA:

- **Flood risk management**: rapid land-conversion for real estate development in the BMA has decreased its ecological function and water absorptive capacities, leading to higher risks of floods (Hudalah, *et al*., 2010). Part of the problem lies in the absence of a metropolitan-wide action plan for flood management, with strategies such as the creation of buffer zones.
- **Solid waste management**: the City of Bandung lacks appropriate space to dump collected solid waste in sanitary landfills and to adapt to the increasing amounts of waste generated, which already exceed current collection and treatment capacities. At present, BMA's five municipal areas rely on the same landfill site, which is under great stress and has been repeatedly scheduled to close, most recently in 2015 (IGES and City of Kawasaki, 2015). Negotiations to use vacant lands in the surrounding areas of BMA have been unsuccessful (Tarigan, *et al*., 2015) and further co-operation is needed. Some current green projects such as the introduction of biodigesters in Bandung City will also receive waste from the surrounding municipalities and require efficient co-operation on the conveyance system; and
- **Water supply:** the five municipalities of the BMA use the same groundwater aquifer, which is under stress from high consumption from residential, commercial and industrial activities. To avoid depletion of water resources and ensure sustainable supply to the households and economic activities, all local government units must agree together on a water supply and sanitation plan and adopt harmonised water extraction rules in the whole BMA. Likewise, the study on the drainage master plan undertaken in 2009 in the BMA recommended metropolitan-wide watershed management actions such as building dams and water ponds. No implementation has followed the study to date.

As the co-ordinating body was only recently approved by presidential decree in June 2018, it is too early to assess its implementation. In order to assess the effectiveness of its implementation in the future, a few criteria must be considered: the transparency of decision-making; the adequacy of the technical, political, and financial resources of the BMA; whether co-ordination mechanisms with other levels of government have been established, and the legitimacy of such mechanisms; whether the intended authority

conferred to the body has been respected in practice. Effective monitoring and evaluation practices must be implemented to assess these criteria and should be prioritised.

Disaster risk financing

Bandung is in a similar situation to many other cities in the developing world in that the financial resources are difficult to obtain and are inadequate relative to the scale required. To date, Bandung has used traditional financing instruments and approaches of "balance sheet" self-funding, transfers from provincial and central governments, and conventional financing to pay for public amenities and services.

There was little evidence of innovative financing strategies or climate risk insurance instruments being used to pay for or insure investments that would enhance Bandung's financial capacity. Although Bandung's revenue has recently increased, the city of Bandung still has limited authority and scope to internally generate its revenue and must depend upon its own limited resources, government transfers, and private sector financing.

Stakeholder engagement

Building greater resilience to climate change and natural disasters will also enhance Bandung's local social capital. In addition to the Bandung government's own DRM efforts, public officials should engage the largest possible coalition of local stakeholders in all shared decision-making processes. These stakeholders should come from local private sector associations, community and civic groups, religious and educational institutions, and work together in partnership with local and provincial government authorities to create innovative solutions to their most pressing concerns and needs related to DRM. An ideal vehicle for such collaboration would be the VRA and LRAP processes.

In addition to urban planning and infrastructure strategies, effectively engaging the private sector and local communities is a very important requirement to ensure economic and social resilience. Of course, the internet provides opportunities to diffuse information about natural disasters and how to be prepared for them, as exemplified by the Greater London Authority (detailed above). The City of Bandung should replicate this digital tool while diffusing information about resilience more comprehensively. The overall objective should be to more effectively engage the private sector and local communities before, during and after a disaster.

Main policy recommendations

- Continue the development and implementation of a comprehensive vulnerability risk assessment (VRA) and a local resilience action plan (LRAP) for the BMA through international assistance.
- Establish a DRM taskforce chaired by the Department of Development and Planning of Bandung City and consulted by relevant city government departments and external advisory groups in order to oversee the city government's DRM actions.
- Enhance resilient urban planning through GIS vulnerability mapping and flood simulation software, as well as data collection in co-operation with international institutes such as the WRI.
- Strengthen enforcement of zoning regulations and building codes to minimise damages and losses from natural disasters.
- Develop the capacities of the Command Centre to manage infrastructure in times of disaster by collecting real-time data on their condition, with the help of digital technologies.
- Create a smart early warning system and ICT mechanisms to reach-out to and to provide assistance to citizens and the private sector, as well as to collect real time data in the event of a disaster.
- Engage companies and financial institutions in the private sector with economic interests at stake or strategic contributions to make, as well as affected communities, civil society groups, researchers and academicians, and the media.
- Monitor the implementation of the co-ordination mechanism introduced by the recently created BMA co-ordinating body, and consider adjustments where necessary.

Notes

[1] http://datasmart.ash.harvard.edu/news/article/how-can-data-and-analytics-be-used-to-enhance-city-operations-723.

[2] The 3Di Water Management software was developed by Deltares, the Delft University of Technology and Nelen & Schuurmans, in the Netherlands.

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Chapter 4. Bangkok, Thailand

Chapter 4 examines the resilience of the Bangkok Metropolitan Region (BMR) to floods, which occur during the rainy season. It is critical to address this risk to ensure sustained and cost-effective urban green growth while adapting to the impacts of climate change, because precipitation and flooding affecting the region will likely increase in the future.

This chapter consists of three sections: 1) the natural disasters that pose the greatest risk in the BMR are identified; 2) the current state of DRM policy in the BMR is assessed; and 3) co-ordination and governance mechanisms between government entities and other stakeholders are discussed.

In particular, the chapter analyses four critical elements for enhancing DRM to floods:

1) Flood-resilient urban infrastructure in the BMR;

2) Flood-resilient land use in the BMR;

3) The BMR's economic resilience to floods; and

4) The BMR's social resilience to floods.

This chapter draws on the key findings of the OECD study "Green Growth in Bangkok, Thailand" (OECD, 2015). It also benefited from discussions at the Knowledge-Sharing Workshop on Urban Green Growth in Dynamic Asia, held in Bangkok on 6-7 August 2014, which was supported by the OECD Knowledge Sharing Alliance.

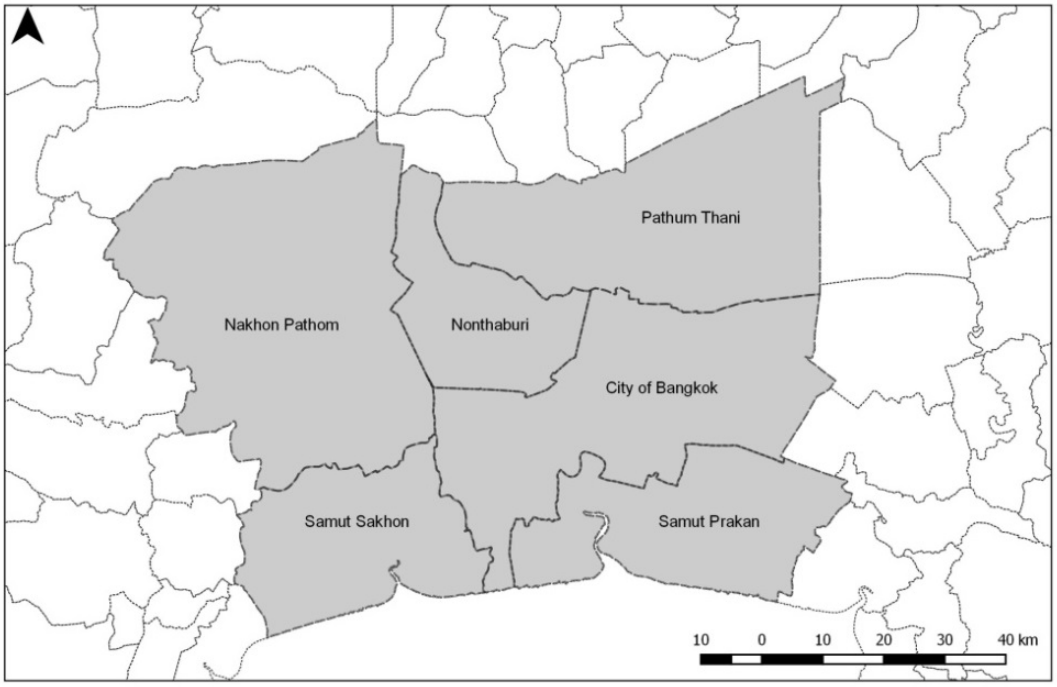
Main Points

- **The Bangkok Metropolitan Region (BMR) is highly exposed and vulnerable to floods** caused by seasonal storms between the months of July and October. It experienced major floods in 1942, 1978, 1980, 1983, 1995, 1996, 2002, 2006 and 2011. The BMR needs to find ways to become more resilient to floods – in other words, to better absorb and bounce back from such events to ensure green growth in the long-term and adapt to the impacts of climate change.
- To protect the city of Bangkok from floods, the Bangkok Metropolitan Administration (BMA) and the national government have made massive investments since the 1980s to develop large-scale polder and drainage systems. To avoid over-burdening the city's finances and escalating the need for such infrastructure in the future, public authorities need to consider complementing them with a variety of more adaptive infrastructure measures, such as **ecosystem-based adaptation or semi-permeable surfaces**. State-of-the-art information and communication technology (ICT) also offers many opportunities to optimise city functioning, better inform infrastructure decisions and improve emergency response services, to complement existing flood-control systems.
- The city of Bangkok and five surrounding provinces in the BMR have seen major changes in land use over the past 20 years, with significant loss of agricultural lands and conversion to residential, commercial and industrial uses. In particular, the city has lost natural water retention areas (swamps, wetlands, mangroves, etc.) and natural drainage systems that played a key role in managing excess water and limiting the damage done by floods. **An efficient region-wide strategy will require co-ordinating land-use strategies and assessing the climate-induced threats, exposure, adaptive capacity and the resulting vulnerability of urban areas**.
- The devastating flood of 2011 that affected the BMR and other parts of Thailand is reported to have ranked among the costliest natural disasters in the world since the 1980s. It caused damages in excess of USD 9.1 billion in the city of Bangkok alone. Among the economic activities affected, the manufacturing and business sectors were particularly hard hit, absorbing 58% and 18% of the total damages in the city of Bangkok, respectively. **As a consumer and supplier of climate adaptation measures and public infrastructure, the private sector must be targeted and engaged in strategies to increase the city's economic and physical resilience to floods**.
- The 2011 flood also had severe social costs. 42 of the 50 districts of the city of Bangkok were left underwater for weeks. The flood highlighted the vulnerability of the BMR's poorest residents to extreme weather events, affecting 73% of people living in low-income communities, often located in the most exposed areas near canals and rivers. **Local and national governments should involve local communities in raising public awareness** about the need to increase their resilience to floods and other threats. A more consistently integrated and comprehensive approach to this issue from governments at all levels would build their social capital, cohesion and on-the-ground preparedness during a crisis.

Natural disaster risks

As a functional economy, defined by settlement patterns and human activity rather than by administrative frontiers, Bangkok extends far beyond the city of Bangkok, the capital city of Thailand, to the Bangkok Metropolitan Region (BMR) and beyond. The BMR consists of the city of Bangkok and five adjacent provinces (Nakhon Pathom, Nonthaburi, Pathum Thani, Samut Prakan and Samut Sakhon), encompassing 7 761.50 km^2 (Figure 4.1). The BMR is the unit of analysis in this study, although some analyses cover only the city of Bangkok due to limited data availability. There is no metropolitan government to administer the BMR. The city is governed by the Bangkok Metropolitan Administration (BMA), and does not belong to any province; it has a status of special local authority. It is subdivided into 50 districts, which are further subdivided into 169 sub-districts.

Figure 4.1. Map of the Bangkok Metropolitan Region



Source: OECD, based on Global Administrative Areas (n.d.), GADM database of global administrative areas, available at: www.gadm.org (retrieved in May 2015).

The Bangkok Metropolitan Region (BMR) faces high flood risk, in particular during the rainy season, between the months of July and October. It experienced major floods in 1942, 1978, 1980, 1983, 1995, 1996, 2002, 2006 and 2011 (Ahsan, 2013). The BMR also faces development challenges associated with environmental degradation, rapid and unplanned urbanisation in hazardous areas, and limited options of livelihoods for the poor. Since the BMR is projected to undergo rapid demographic, economic and urban changes, a concerted policy response to the high flood risk it faces can significantly increase its resilience.

Floods are only one of several possible risks that the BMR will face in the near future, both anticipated and unexpected. This chapter mainly discusses DRM policies to enhance urban resilience against floods, which can also be relevant for other types of risk.

Assessment of DRM policies

This section assesses two sets of policy challenges observed in the BMR. First, it looks at "hard" investments in flood-resilient urban infrastructure integrated with land-use planning and zoning policies. Urban infrastructure and land-use policies are at the core of flood resilience strategies. Physical capital and the urban form shape the built environment and are major factors exposing land and urban residents to floods. If properly managed, they can, however, be critical in containing such risks. It then looks at "soft" (i.e. non-structural) resilience measures to shift economic and social patterns and behaviour toward a greener, more sustainable development. Engineering solutions to flood risks have been the dominant paradigm for enhancing DRM, but in the BMR and elsewhere, economic and social policies can help mobilise resources and synergies from other groups in civil society, communities, the media and the private sector.

Vulnerability and risk assessment

Local governments in the BMR should develop instruments to assess which urban zones and residents are particularly vulnerable to floods and design land-use regulations accordingly. Flood-risk assessment and mapping is not used widely, especially to protect low-income communities at risk. This may be the result of a lack of local capacity to develop and use the necessary technology, or a lack of awareness among local governments about the benefits of such tools. USAID provides useful guidance and key policy recommendations that local, provincial and national authorities could follow to develop capacities to assess their vulnerability (USAID, 2014).

Flood-risk assessment tools should be used to assess both current and future threats. From this perspective, risk screening should be applied to areas where new development is likely to occur, and land-use regulations (e.g. zoning, building permits) could be used to create disincentives to develop such lands to avoid creating new zones at risk. In France, local prevention plans delineate areas at various levels of risk based on previous floods, but also according to predictions for the future. These measures should reinforce or complement economic interests (e.g. tourism) by taking flood risks into account.

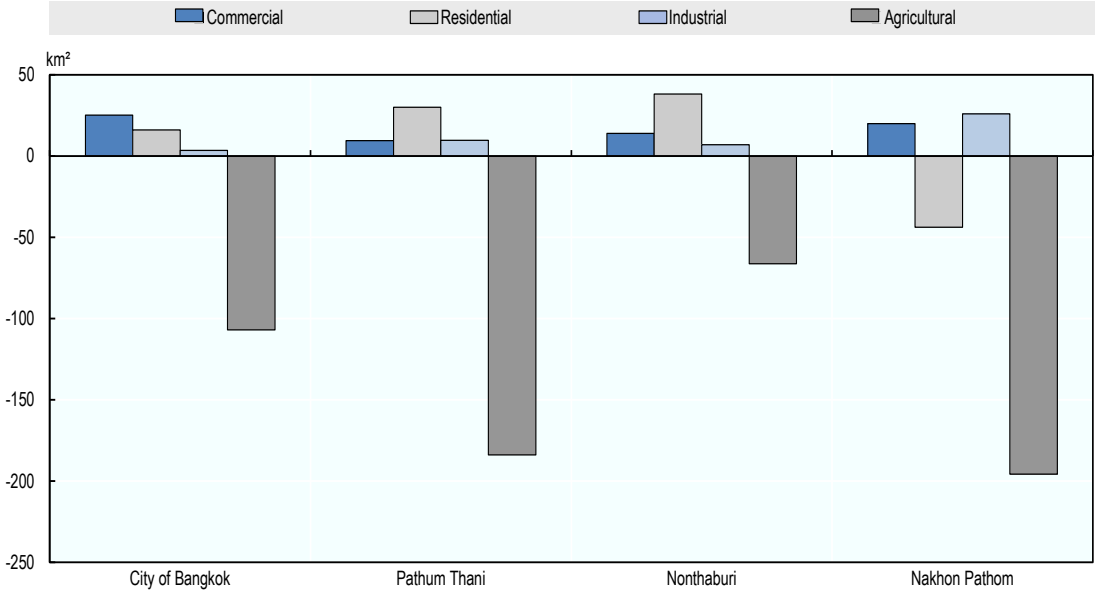
The BMR must develop a knowledge base of economic vulnerabilities in order to increase its resilience to floods. Experts and policy makers in the BMR could make use of the Aqueduct Global Flood Analyser,[1] which estimates the future economic and human consequences of floods under a variety of scenarios. For instance, in a scenario of severe climate change and continued current socio-economic development trends, it estimates that even with a 100-year flood protection system, the annualised gross domestic product (GDP) affected by inland floods in the BMR could currently reach USD 450 million (USD 272 million for the city of Bangkok alone) and USD 2.7 billion in 2030 (USD 1.7 billion for the city of Bangkok alone). Experts and policy makers must also integrate cost-benefit analyses of resilience policies and develop "soft" policies to properly tackle economic vulnerability to floods.

Local governments in the BMR should further develop information and mapping of the people, places and assets at risk. This will provide the basis for flood risk assessments so that corrective action can be taken. A database of businesses and industries could be built, with information on the type of enterprises by sector and area, employment size, access to roads and other basic services, etc. This would inform the risk assessment exercise and help create maps showing information on economically valuable areas and assets, as well as centres of employment for lower skilled people who live and work in the BMR.

Land-use policies

The city of Bangkok and the surrounding provinces of the BMR in particular have undergone major changes in land use over the past 20 years, with significant loss of agricultural lands and an increase in residential, commercial and industrial land use. More than 30 km^2 of residential areas were created in the province of Pathum Thani between 2001 and 2010, while around 184 km^2 of agricultural land was lost (Figure 4.2). According to international research,[2] private construction and real estate driven by speculation and short-term economic gain has been a critical component of the BMR's rapid urban growth (Marome, 2013). Such development has had a detrimental effect on the city's flood resilience, whereby industrial firms located in Pathum Thani and Samut Prakarn are highly exposed to floods because of their proximity to the Chao Phraya River. In the last 20 years, urbanisation in the vicinities of the BMR has been responsible for the disappearance of natural areas of water retention (swamps, wetlands, etc.) and natural flood ways (Snidvongs, 2012) that play a key role in managing excess water and limiting the damage from flooding. Mangroves, a critical natural feature in the metropolitan region that buffers the effect of storm surges, are also being cut down at a rapid rate, and are affected by coastal erosion (WWF, 2009). Land subsidence has also affected the city's exposure to floods, but it is no longer proceeding as rapidly in the city of Bangkok, unlike in industrial areas in the east of the city.

Figure 4.2. Land-use change in Bangkok and three surrounding provinces of the Bangkok Metropolitan Region 2001-10



Source: Marome, W. (2013), "Urban risk and vulnerabilities of coastal megacity of Bangkok, Thailand", proceedings of the 4th Global Forum on Urban Resilience and Adaptation, 31 May-2 June, Bonn, Germany.

Local governments in the BMR lack instruments to assess which urban zones and residents are particularly vulnerable to floods which would allow them to develop land use regulations accordingly (OECD, 2015b). Local governments could enhance land-use control tools so that they can effectively promote DRM. The FAR Bonus System, for instance, encourages developers to provide green space and rainwater storage areas (OECD, 2015a). However, it is not mandatory for developers and its effectiveness is

questionable. Incentives to increase its impact (e.g. financial incentives for implementing the bonus) or the imposition of more binding rules could be considered. The potential for the local land improvement tax to reshape land use for flood resilience is underutilised in the BMR. The BMA and other BMR local governments could target specific locations where the rate of the land improvement tax could be raised, or alternatively, introduce development fees as disincentives to build and settle in areas of the city exposed to floods. Part of the revenues collected by local authorities from such taxes could be earmarked for flood resilience projects, to ensure that financial resources for this purpose are scaled up. Authority for implementing these taxes and development fees lies in the central government, which would need to closely co-ordinate these proposed measures with local governments.

Local governments should also improve the enforcement of land-use controls. Financial instruments could promote flood-resilient land use and strengthen the enforcement of land-use regulations. Penalties should be imposed on developers that do not comply, for example building in flood-sensitive areas in violation of zoning codes. In the BMA, the Financial Department and the City Planning Department are key stakeholders for achieving this objective, but financial and technical capacities need to be built up with the support of the central government.

Adaptive infrastructure

Flood-resilient urban infrastructure is a crucial element in the flood risk the BMR faces. The local climate, high exposure to water runoff from the north and the east, and the numerous possible flood ways make monitoring and maintaining infrastructure extremely demanding. Flood protection infrastructure in the BMR is developed and maintained by different authorities since 1983, including the BMA (Department of Drainage and Sewerage) and the central government (Royal Irrigation Department, and also, the Water Resources Department and Electricity Generating Authority of Thailand in the vicinities of the BMR), which has created some co-ordination challenges, as discussed below.

The first type of infrastructure in place is a polder system, consisting of numerous dykes to prevent water discharge from the north, the east and from high tides, and to prevent overflow from urban waterways. This is particularly important, considering that some areas of the city, mainly in the eastern districts, are found below these waterways. The second type of infrastructure is a drainage system that supplements the polder system and whose aim is to protect urban areas that are already inundated. It consists of: 1 682 canals (*klongs*) totalling approximately 2 600 kilometres, whose objective is to drive water to the Chao Phraya River and the sea through pumping stations and water gates; 6 400 kilometres of drainage pipes along major and secondary roads, and 7 drainage tunnels to evacuate excess water from the surface to the Chao Phraya River and the sea; and 25 stormwater retention ponds scattered across the city to capture early rainfall and decrease peak runoff in low-lying areas and in areas where the drainage capacity is too low to bring stormwater to the river and canals. The city of Bangkok's flood protection and drainage infrastructure was primarily developed to cope with localised flooding, more precisely water overflow from the river and canals from exceptional heavy rainfall. A substantial amount of water runoff originated upstream, north of the Chao Phraya Basin, and was carried by the Chao Phraya River down the Gulf of Thailand through the BMR during the 2011 floods. Since the overflow could not be contained by the current infrastructure, the BMA is trying to expand its capacity to avoid a similar disaster in the future. The current project consists of the construction of six new diversion tunnels, including three large drainage tunnels, five

additional retention ponds and water expressways to drive overflow to the sea or to diversion tunnels.

The BMR is making good progress in developing polder and drainage infrastructure. However, these tools (new diversion tunnels, waterways, etc.) are a burden on the city's finances, and the 2011 floods illustrated that they alone may not be able to protect the city from exceptional and unanticipated water runoff caused by extreme weather. One alternative is to develop more "adaptive" infrastructure, such as ecosystem-based measures. Such an example can be found in the city of Portland, Oregon (United States). One of its key policies, in the city's 2005 Watershed Management Plan (PWMP), is the use of plants and soil in order to slow, filter and infiltrate runoff close to its source, in a way that strengthens and mimics natural functions/processes (OECD, 2012). Such adaptive measures are important complementary resilience strategies and present three main benefits:

- These strategies are often more cost-effective than polder and drainage infrastructure. It is estimated, for example, that Atlanta's tree cover has saved more than USD 883 million by precluding the need for stormwater retention "grey" facilities (US EPA, 2007). Chicago's experience with its Green Alleys programmes has shown that investing in permeable pavements, downspout disconnections, rain barrels and tree planting are an estimated three to six times more effective in managing stormwater per USD 1 000 invested than conventional methods (American Rivers, *et al.*, 2012).
- These alternatives can be put in place more quickly and are more flexible than polders and drainage systems. This is especially important given that projections of future changes in precipitation (due to climate change) and socio-economic trends are subject to considerable uncertainty. Ecosystem-based adaptation measures to counter flood risk can therefore contribute to an "adaptive" management of the BMR.
- These measures, in particular ecosystem-based adaptation measures, can simultaneously address other green growth policy goals. Green curbs, for example, offer increased absorptive capacity in heavy rainfall, increase natural vegetation in cities, create pedestrian space and dis-incentivise private car use.

The Bangkok and Vicinities Development Structure Plan 2013 and the Bangkok Comprehensive Master Plan (2014-2018) already incorporate some principles of adaptive management to floods, through land-use strategies such as the creation of environmental conservation areas and flood diversion channels (OECD, 2015a). Agricultural land is also used, to some extent, to drain water runoff. The following "adaptive" infrastructure strategies could be developed to enhance the BMR's flood resilience:

- Local governments in the BMR should assess how more flexible infrastructures can complement the existing polder and drainage systems, not only in the plains of the BMR but also in denser areas of the city of Bangkok. Cost-benefit and cost-effectiveness analyses could be carried out to compare their performance with conventional flood-protection infrastructure;
- Peri-urban ecosystem-based infrastructures could be developed: in the vicinities of the BMR, the creation or restoration of lost natural habitat (coastal and upstream wetlands, mangroves, forests) and retention ponds can play a critical role in draining and retaining water runoff. This is particularly relevant in the northern suburban upstream areas, where this strategy is more economically feasible;

- Canals need to be preserved and well maintained. Many have been buried and replaced by roads as a result of sprawling urban development. Those that remain are also losing their function as waterways, partly because they are not well maintained. Dredging canals and removing waste as well as contaminated soils would recover their functions and improve water quality; and
- Smaller scale infrastructure could also be developed in urban centres. There is considerable unused land in the downtown areas of the city of Bangkok that might serve as retention ponds, such as old parking lots or railroads used as dumps for old trains. Instead of buying the land outright, which is prohibitively expensive in these areas, the BMA could simply purchase the right of usufruct for these areas in times of flooding and build dykes around them, while connecting them to the city's water supply and sewerage system. Installing semi-permeable surfaces on secondary roads (*soi*) and small sidewalk rain-absorbing planter boxes could also yield high retention rates. Amendment of building codes, branding of office buildings, compensation mechanisms for water storage capacity and green roof subsidies are some instruments local authorities could use to implement these strategies.

Many of these actions could contribute not only to adaptation but also mitigation and create other co-benefits. Green roofs, trees and green corridors could reduce the "heat island" effect and lower energy needs, and provide social benefits by preserving livelihoods in local communities and providing recreational green spaces. Local authorities could start out with some pilot projects in the city to assess how to adapt existing best practices (from the Netherlands, Sweden and the United States, for example) in the context of the BMR, while raising public awareness among local communities about their benefits.

Disaster risk financing

The 2011 mega-floods that hit the BMR and other parts of Thailand is reported to have been among the costliest natural disasters since the 1980s. It resulted in losses in the global supply chain of USD 44.2 billion and significantly slowed Thailand's economic growth in the months that followed the floods (OECD, 2013). The flood revealed that most manufacturing industries were not prepared for floods, which increased the magnitude of the damages. The manufacturing sector suffered a loss of USD 32 billion (i.e. 70% of total losses) at the country level. Forty-five percent of the world's manufacturing capacity of computer hard disk drives are produced in the affected area, and due to the flood disaster, it is estimated that global supply of hard drives fell 30% that year (OECD, 2013). The tourism, financing and banking sectors were also significantly affected (Ahsan, 2013). In the city of Bangkok, total damages reached THB 296 billion (USD 9.3 billion at 2014 prices), and 58% of the damage went to the industrial sector (Table 4.1). More than 1 000 factories were affected in the Bangkok region and Bangkok's secondary airport, Don Mueang, was closed for six months (OECD, 2013).

Table 4.1. Damages sustained by different economic sectors in the city of Bangkok from the 2011 flood disaster

Sector	Damage (THB billion)	Damage (% of total damage)
Industries	171.9	58
Business and infrastructure	54	18.3
Agriculture	37.1	12.5
Services and others	33	11.2

Source: BMA (2014), "Bangkok flood control", Department of Drainage and Sewerage, presentation made at the Bangkok Knowledge Sharing Workshop on Urban Green Growth in Dynamic Asia, 6-7 August, Bangkok.

Economic resilience does not only imply being prepared for and withstanding shocks, but also being able to bounce back and emerge stronger than before (Matsumoto and Daudey, 2014). Insuring disaster-related losses is a critical instrument of flood resilience, complementing infrastructure protection. In Thailand, the insurance sector provides property insurance for losses due to the interruption of commerce by natural disasters. It also offers natural disaster coverage under life insurance policies, for automobile and personal accident insurance and for crop-failure insurance (OECD, 2013).

The affordability of flood insurance policies, however, can be a significant barrier, especially considering the frequency of such disasters, which increase premiums on the instruments. After the 2011 floods, many businesses and individuals struggled to find affordable insurance policies to cover flood damages and losses. Of the total losses in 2011, only about USD 10 billion were insured. In response, the national government set up the National Catastrophe Insurance Fund (NCIF) in 2012, which is used as a reinsurance reserve, and regularly raises awareness about it and other insurance products at seminars and events (OECD, 2013). Local insurance companies that issue policies carry part of the risk and transfer the rest to the NCIF, which passes on a portion of that risk to international carriers operating on the global reinsurance markets (OECD, 2013).

Properly evaluating the impact of disasters is crucial to prepare for post-recovery and reconstruction plans. The Ministry of Interior, with the help of the World Bank and other development partners, undertook an assessment of the impact of the 2011 floods in 26 of the 66 provinces affected by the disaster. This offered recommendations for recovery in several economic sectors (OECD, 2013). Thailand's Office of Insurance Commission (OIC) collects data from insurance companies, which keep track of insured losses. These data are then transmitted to the NCIF. The OIC also reviews the capital adequacy of companies' exposure to disaster risks, so that they can be adequately covered in risk-based capital reserve calculations (OECD, 2013).

Insurance systems could be further developed to provide further protection against floods for the BMR's economy. Crucially, the private sector should be encouraged to participate in the system though tax incentives, especially for small and medium-sized enterprises. Certain industries could also be required to participate. Such risk-financing mechanisms could be combined with risk reduction: more incentives could be given to developers and builders to "build back better" (e.g. by increasing access to public transport, nearby shopping centres, restaurants and recreational opportunities, and providing green public spaces), to avoid simply rebuilding and exposing housing to the same risks.

The national government could subsidise insurance compensations or provide matching funds based on such efforts (OECD, 2014). The national and local governments could also consider investing in *ex ante* parametric risk-financing instruments or disaster reserve

funds. The objective is to avoid having to mobilise and shift budgets from other competing demands in the aftermath of a flood disaster. In Austria, for instance, the Catastrophe Fund (*Katastrophenfonds*) is used to finance damages from disruptive shocks sustained by public bodies, households and businesses, which also require *ex ante* prevention investments and actions taken before the fact. It is financed by a mix of income, capital and corporate taxes (OECD, 2014). International development partners and donors could also participate in such schemes, given that Thailand may have lower financing capacities than a developed country. Finally, more research needs to be conducted on how to optimise such safety-net mechanisms. A clearer evaluation of potential damages across sectors and jurisdictions would be useful to raise awareness on the need for safety nets and insurance policies.

Private sector engagement

National and local governments should also encourage the private sector to take voluntary infrastructure measures to protect their businesses. After the 2011 floods, the Industrial Estate Authority, a public company run by the national government, provided financial assistance for the construction of flood protection infrastructure around industrial facilities. In the city of Bangkok, and the provinces of Pathum Thani, Samut Sakhon and Samut Prakarn, a total of around THB 6.8 billion (USD 211 million at 2015 market prices) was invested in the construction of concrete walls, dykes and sheet piles (Thampanishvong, 2013). One option would be to develop such initiatives, especially for small and medium-sized (manufacturing) enterprises with relatively weak financial reserves and limited management capabilities. It is critical, however, that such investment does not result in mal-adaptation measures. An "individualised" approach to protect one business (e.g. building a single dyke) could put neighbourhood or downstream properties and assets at greater risk, and it is in the financial interests of businesses to invest in flood resilience measures consistent with regional plans and strategies, to guard against this.

National and local authorities should assist the private sector in making comprehensive investments to prepare for large-scale floods in the BMR. Standing committees or councils involving major stakeholders from the public and private sector could be created at the BMR level to organise defences against floods. They should be chaired by the Thai government, which plays a prominent role in building resilience to floods in the BMR, and should also be supported by specific funds allocated by the Thai government to support these strategies (OECD, 2015a). Decisions should be based on the information of the database on businesses and industries and their vulnerabilities, as mentioned previously.

Such infrastructure efforts by the private sector can contribute to the resilience of the communities in which they are located, their workforce and its ability to get to work, and the ability of supply chains to continue functioning or return to normal functioning as quickly as possible. Moreover, resilience measures also generate significant co-benefits, such as improved green spaces, healthier environments in which workers live, a more attractive and safer community to attract a better labour pool, and a better quality of life. For example, the financial support provided by the Industrial Estate Authority could expand such a comprehensive approach in its efforts to create pocket parks in neighbourhoods.

Use of ICT

The BMA and other relevant agencies operating infrastructure in the BMR should develop technology to help policy makers rethink systems. The objective is to obtain a comprehensive understanding of how water flow and infrastructure interact, and how different types of infrastructure are connected. This will help to inform policies to increase

the BMR's capacity to withstand floods. Simulation and monitoring tools are critical instruments that can also encourage green growth.

The BMA has a Flood Control Centre (FCC) that was established in 1990. It uses computer technology to systematically manage flood protection. The FCC monitors and collects hydrological data (rainfall and water level), data on the condition of operation facilities, on flood damage and water quality, using an online system. This is very helpful for city staff to remotely monitor water gates and pumps of the main canals and the river of the city, and act quickly and efficiently in case of flood. Improvement of this flood technology system could also help inform decisions on infrastructure that can boost the BMA's resilience to floods. The Public Utilities Board of Singapore, for instance, is using a cutting-edge simulation software called 3Di.[3] This not only measures real-time water levels in different places in the city, but analyses, models and forecasts potential water flows in the city in case of flash floods. Such a system can help to identify catchment-wide solutions to reduce the speed of surface runoff in urban areas, to identify which areas to monitor and to decide proactively on appropriate infrastructure and land-use strategies (Public Utilities Board of Singapore, 2013). Such technology would be a good complement to the existing FCC for the BMA.

The FCC and other types of technology-based assessment such as 3Di could be scaled up to other local authorities in the BMR and integrated into the metropolitan-wide monitoring framework, in order to harmonise the analytical capacities across the entire metropolitan region, thereby encouraging a comprehensive regional approach. This is critical, because most of the infrastructure is in the city of Bangkok, and the software may help to identify needs in other provinces of the BMR that are also risk factors for the city. It is equally important to ensure that the data collected and monitored by the FCC are available to other DRM-related departments and agencies in the city when needed. From the study it was not clear if such a well-functioning horizontal network exists or not.

A city's flood resilience does not only depend on flood-protection infrastructure. Improvements to the wastewater treatment system, in particular, will be critical in avoiding public health issues. Biochemical oxygen demand (BOD) and dissolved oxygen (DO) are at critical levels in many canals, and pollution created by untreated water can create public health issues when a flood occurs. Similarly, uncollected solid waste in slums and informal settlements along the river and canals can be a source of concern, as floods can spread them throughout the city, causing severe environmental degradation and public health hazards. After the 2011 floods, in the month of December, the amount of solid waste generated dramatically increased to around 12 000 tonnes per day, from around 7 000 tonnes per day in November. This was mainly due to the damages to household furniture and materials (BMA, 2012). In addition, waste sometimes obstructs drainage pipes, compromising the efficiency of flood protection infrastructure. Improving the performance of wastewater and solid waste treatment performance will be a crucial part of increasing the BMR's resilience to floods while fostering green growth.

Transport also presents major infrastructure challenges that can affect the BMR's resilience to floods. Mass transit and non-motorised transport modes can help offset the road-centric development of the BMR. This has increased its vulnerability to floods, by destroying natural habitats and encouraging urban sprawl. Few wide roads are connected to the main arteries of the city in low-income communities, which exposes the urban poor to risk during floods and obstructs relief operations (Marome, 2014).

Such factors illustrate the need for infrastructure systems thinking. Assessing how different types of infrastructures interact with each other in case of disaster is a critical part of

identifying needs and adapting infrastructure, economic and social policies accordingly. To achieve this difficult task, local authorities in the BMR and the central government could consider developing other types of ICT management tools, relying on high-technology sensor networks that monitor all critical infrastructures in the region (energy, water, solid waste, flood defences, transport, etc.). Collecting data will help to study their overall performance on a day-to-day basis and in case of disaster. The Operations Centre of the city of Rio de Janeiro is a good example of a citywide data system integrating information on different types of urban infrastructure. It was developed by IBM and collates all data, input online, to identify trends and complex impacts of potential disasters, such as floods, fires and landslides. This can help decision makers select the most appropriate action and identify which urban areas need support.[4] The BMA and the Thai government could consider developing such technology progressively in the BMR.

Assessment of DRM governance structure

Mainstreaming DRM

The Thai government used to be the central decision maker in most of green growth opportunity areas, and its strategies and decisions significantly affect development in the Bangkok Metropolitan Region (BMR), especially in terms of spatial planning, infrastructure development, financing and policy instruments. The 1997 Decentralisation Action Plan, however, delegated some of the responsibilities to local governments. The BMA now has discretion over some important policy levers, especially in the areas of land use, wastewater treatment and solid waste management (OECD, 2015).

A consequence of the decentralisation reform in Thailand is the need for stronger co-ordinated actions between different levels of government. In regard to flood resilience, the Thai government has established major disaster prevention and relief guidelines for action at lower levels of government through the National Disaster Prevention and Mitigation Plan (2010-2014). However, for example a BMA project to build a pumping station has been blocked because it was not well co-ordinated with the central government (Department of Rural Roads and the Marin Department) who controls these areas. Such co-ordination between the national and local governments tends to be regulatory: in regard to flood resilience, for instance, the Thai central government has established major disaster prevention and relief guidelines – in particular the National Disaster Prevention and Mitigation Plan (2010-2014) – to be adapted at the local level (e.g. Bangkok Disaster and Prevention Management Plan). The same mechanisms are in place for spatial planning. However, there is a lack of collaborative approach and capacity-building strategies, reflected in the incomplete translation of national spatial plans at the local level and management failures between the national government and BMA during the 2011 floods.

Horizontal co-ordination

One of the obstacles to DRM in the BMR is the lack of co-ordination mechanisms on land use across provinces and municipalities to promote flood resilience, especially in terms of the preservation of natural drainage habitats and the location of industries. This could negate the policies of one local government or the Thai government. The following efforts could be taken in the five provinces of the BMR:

- Implement regional land-use plans in all local plans. The 2014-2018 Bangkok and Vicinities Development Structure Plan defines some land-use and transport strategies at the scale of the BMR (OECD, 2015a), and some of them may help to

improve the BMR's flood resilience. They include: 1) specific locations for industries; 2) low-density areas that can serve as flood channels or emergency water storage areas; 3) wetland conservation areas to protect coastal zones; and 4) extending the mass transit network. However, this is not legally binding. Public authorities should first make sure that other surrounding provinces in the BMR develop local spatial plans that are consistent with the 2014-2018 Bangkok and Vicinities Development Structure Plan. Metropolitan commissions on land use (OECD, 2015a) could assess to what extent the regional plan is translated into all local plans in the BMR and consider what action might be taken if not.

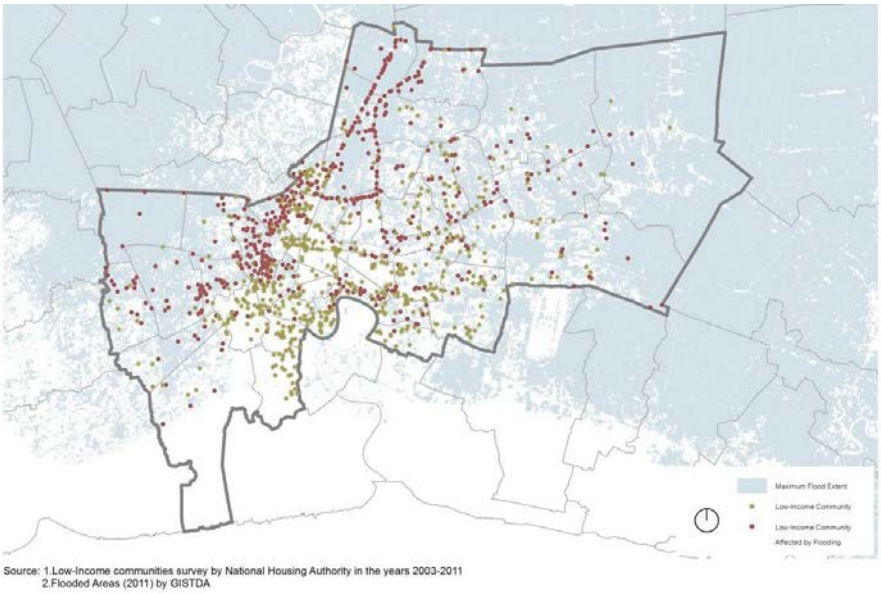
- Regulations for flood-resilient buildings in the BMR should be co-ordinated. Bangkok's Comprehensive Plan 2014-2018 provides tools that can be used to enhance flood resilience, such as the FAR Bonus System, minimum open space ratio (OSR), setback along rivers, canals and main roads, and control of building heights and sizes. However, these tools have only been adopted by the BMA, and all local governments in the BMR should be using them.
- Finally, zoning mechanisms should be used to restrict the location of firms in Pathum Thani and Samut Prakarn, where industries are highly exposed to floods because of their proximity to the Chao Phraya River. Local land-use controls should target the location of new industries, large commercial buildings and housing, in a consistent and coherent regional approach. Such land-use strategies would help mitigate losses and damages from flooding in the future.

The government, possibly with the assistance of metropolitan committees and advisory boards, could help municipalities achieve these goals, if they lack the requisite financial and technical capacity. They could also provide the political leadership necessary for this demanding enterprise (OECD, 2015a).

Stakeholder engagement

Floods in the BMR may entail both significant economic and social costs. In the 2011 floods, no fewer than 42 of the 50 districts of the city of Bangkok were under water, affecting around 1.8 million residents. Human damages are also likely to be high in case of future floods: in one scenario of severe climate change and continued current socio-economic development trends, and even with a 100-year flood protection system, the Aqueduct Global Flood Analyser estimates that around 54 600 people would be affected by inland floods in the BMR (around 35 500 in the city of Bangkok alone) and that around 144 500 people would be affected in 2030 (around 88 400 in the city of Bangkok alone). The 2011 flood also highlighted the vulnerability of the poor to extreme weather events: 73% of people within its communities of urban poor (i.e. 457 805 people) were affected by the disaster – a far higher share than for more affluent segments of the population (UN ESCAP, 2012). As explained earlier, low-income communities tend to settle in vulnerable areas such as canals and riverbanks (Figure 4.3). Floods disproportionately affect the urban poor in the BMR and deepen poverty and inequalities, resulting in weaker long-term economic growth. While such vulnerability can be explained by poor access to urban services, such as electricity, transport, and water supply and treatment, it also stems from a lack of efficient policies to directly protect these communities from floods. To increase the BMR's resilience to floods, it will be critical to enhance the preparedness and response capacity of local communities, especially the urban poor.

Figure 4.3. Low-income communities affected by the 2011 floods in the city of Bangkok



Source: National Housing Authority (2012), "GIS-assisted approach in housing development for low-income earners", GIS Section, Department of Housing Development Studies, presentation made to the delegation from SUDU, UN ESCAP, Bangkok.

One of the most important policy responses of the BMA is the Bangkok Disaster Prevention and Mitigation Plan 2010-2014 (BADPREMOP-2010-2014). This defines the actions of the Bangkok Fire and Rescue Department (BRRD), the lead BMA agency in charge of disaster relief in the city of Bangkok, and follows the guidelines of the National Disaster Prevention and Mitigation Plan 2010-2014. These plans particularly target pre-disaster preparation (e.g. improve public awareness, education and safety), incident management (e.g. evacuation to shelters) and post-disaster management (e.g. infrastructure reconstruction). These three types of actions are mostly top-down, while one of the most effective strategies to fight floods, which is not explicitly specified in the Disaster Prevention and Mitigation Operational Plan, is the direct involvement of these communities before, during and after a disaster. During the 2011 mega-floods, many residents volunteered to fight floods (Global Disaster Preparedness Centre, 2013). This encouraged the BMA to change its strategy and to co-operate more with the local residents, by going out into the field to the volunteers' camps, and discussing the flooding issues with local leaders in these camps. This co-operation provided remarkable help and human resources to fire fighters, for carrying supplies and helping the most vulnerable populations in the city (e.g. the elderly, the young and disabled).

The assistance provided by volunteers during the 2011 flood is a good example of the benefits offered by joint actions between local authorities and communities and individual citizens. Such contributions could have been used even more efficiently had their response been organised *ex ante* and their co-operation and collaboration been worked out in advance. Mechanisms to allow CSOs to participate in the design of disaster action plans should be reinforced, so that they can make contributions based on their knowledge and experience of practical and viable community-based responses to disasters. The important role that is played by communities and individuals acting as "first responders" was dramatically demonstrated in the Great Hanshin Earthquake of 1991 in Kobe, Japan, where

more than 27 100 people were rescued by their neighbours, as compared with only 7 900 by the Kobe Fire Department (IFRC). The Netherlands and the United States also provide some innovative practices of stakeholder engagement that Bangkok could replicate (OECD, 2015a).

Mobilising urban residents to fight floods and making them agents of resilience to floods in the BMR can be more easily implemented through district administrations, schools, churches and media. Local governments in the BMR can encourage the involvement of these civil society institutions/entities in more decentralised preventive strategies. Local communities can be helped to build greater resilience to floods by increasing their "social capacities" to self-organise, prepare for and respond to stresses and shocks (crisis), which is reported to be lacking in some communities (Marome, 2014).

Each of the 50 districts in the city of Bangkok has an elected mayor. The BMA could leverage its human and financial resources by encouraging the establishment of community-based resilience committees at the district level and providing them with capacity-building training. With additional technical and logistical support, they could carry out simple vulnerability assessments and develop threat or risk maps, and establish some priorities among actions to enhance their resilience. These could then be proposed to the BMA and other provincial governments or BMR-wide resilience commissions for approval and funding.

A major threat to flood resilience is a lack of social capital on the ground, which can lead to inaction when a disaster occurs. In the BMR, lack of information and interest among residents – partly owing to lagging levels of education – has been identified as a key social obstacle (Institute of Development Studies, 2007). Schools and churches (Buddhist *wat* and Muslim temples in Bangkok's case) are natural community centres, possessing several critically important physical assets and attributes in times of crisis, such as large open areas that can act as emergency shelters, food preparation operations and eating facilities, medical attention units and staff. Their organisational lines of authority and responsibility are already operational, and they are also an integral part of a community's social capacity or capital. The following measures could be implemented in schools and churches:

- School programmes and religious centres can raise awareness of flood risks, and include practical workshops to build knowledge on how to manage floods at the household and community levels. School education and capacity-building programmes on the management of floods, as well as making information on flood risks publicly available should complement these community-based workgroups or committees. Schools and churches can serve as efficient communication channels assisting district administrations, provincial and national governments, as well as local communities (e.g. deployment of early warning systems). Likewise, they can be critical "first responders" and "safe havens" to complement local authorities' action to protect local communities and assets in case of disaster; and
- Flood risk maps should be made publicly available and widely disseminated in schools, churches, and through other means such as simple posters, local newspapers, and social media. School and church communities can review and refine base maps showing physical infrastructure assets, elevation or proximity to other "risk factors" such as rivers, canals and the coast. The BMA and the 50 district administrations should train schools and churches in how to conduct simple flood-risk assessment and can replicate the project in other provinces of the BMR.

Local authorities should encourage and support the media in raising awareness about disaster risks. Topical urban issues in the BMR focusing on urban resilience can be publicly debated in multiple media outlets, such as radio shows, news articles, social networks and other digital and physical platforms. Local authorities should work more systematically with the media in workshops, training sessions and forums as new strategies to build resilience to floods are announced. Involving the media in disaster risk planning will also enhance a sense of community, a key element in building social capital and resilience to floods.

Main policy recommendations

- Conduct flood-risk assessment and mapping at the BMR. Develop maps of urban flood risk zones that more accurately reflect changing flooding threats (in terms of exposure and vulnerability) to inform policy makers, residents and businesses of the potential future impacts and possible flood protection/adaptation policies.
- Promote risk-sensitive land use and flood-resilient building regulations by combining regulatory and fiscal measures, in a co-ordinated way for the entire BMR.
- Enhance the use of eco-system based adaptation measures (e.g., urban parks, wetlands) to reduce the investment need for flood protection infrastructure.
- Complement the Flood Control Centre with state-of-the-art flood simulation tools, early warning systems and integrated data collection systems to analyse and disseminate information in real-time on changing conditions during times of crisis or urgent need.
- Partner with the private sector to develop private and public flood insurance mechanisms. Promote evaluation of the impact of disasters, which could be used for better assessment of future disaster risks.
- Enhance the preparedness and response capacity of local communities, especially the urban poor, through providing them with capacity-building training. Use existing community entities, such as schools and religious centres to raise awareness of flood risks and how to prepare and respond to flood at the household and community levels.
- Engage the media in the coverage of disaster risks and broadcast public interest messages, community events and information about flood risks and other impending threats.

Notes

[1] The Aqueduct Global Flood Analyser is a tool developed by the World Resources Institute, Deltares, the Institute for Environmental Studies, Utrecht University and the Netherlands Environmental Assessment Agency. However, this tool should only be a basis for reflection, as infrastructure is the main variable taken into account to calculate economic and human damages.
See: http://floods.wri.org/#/state/4000/Bangkok%20Metropolis,%20Thailand (last accessed 29 August 2018).

[2] Coastal Cities at Risk (CCaR): Building Adaptive Capacity for Managing Climate Change of Coastal Megacities (Vancouver, Manila, Lagos and Bangkok) is funded by the International Development Research Centre (IDRC) and three Canadian research councils.

[3] The 3Di Water Management software was developed by Deltares, the Delft University of Technology and Nelen & Schuurmans, in the Netherlands.

[4] www.epa.gov/jius/projects/rio_de_janeiro/rio_operations_center.html.

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Chapter 5. Cebu, Philippines

Chapter 5 describes the natural disaster risks facing Cebu (Metro Cebu). The chapter begins by examining the threat of natural disasters in Cebu, and how the metropolitan area can build greater resilience systematically and comprehensively through a variety of means.

This chapter is divided into three sections: 1) the natural hazards that pose the greatest risk to Cebu are identified; 2) the current state of DRM policy in Cebu is assessed; and 3) governance issues of vertical and horizontal co-ordination are discussed.

This chapter draws on the key findings of the OECD study "Green Growth in Cebu, Philippines" (OECD, 2017). It also benefitted from discussions held during the fifth Knowledge-Sharing Workshop, 'Creating a Sustainable and Resilient Cebu', that took place in Cebu (8-9 December, 2015).

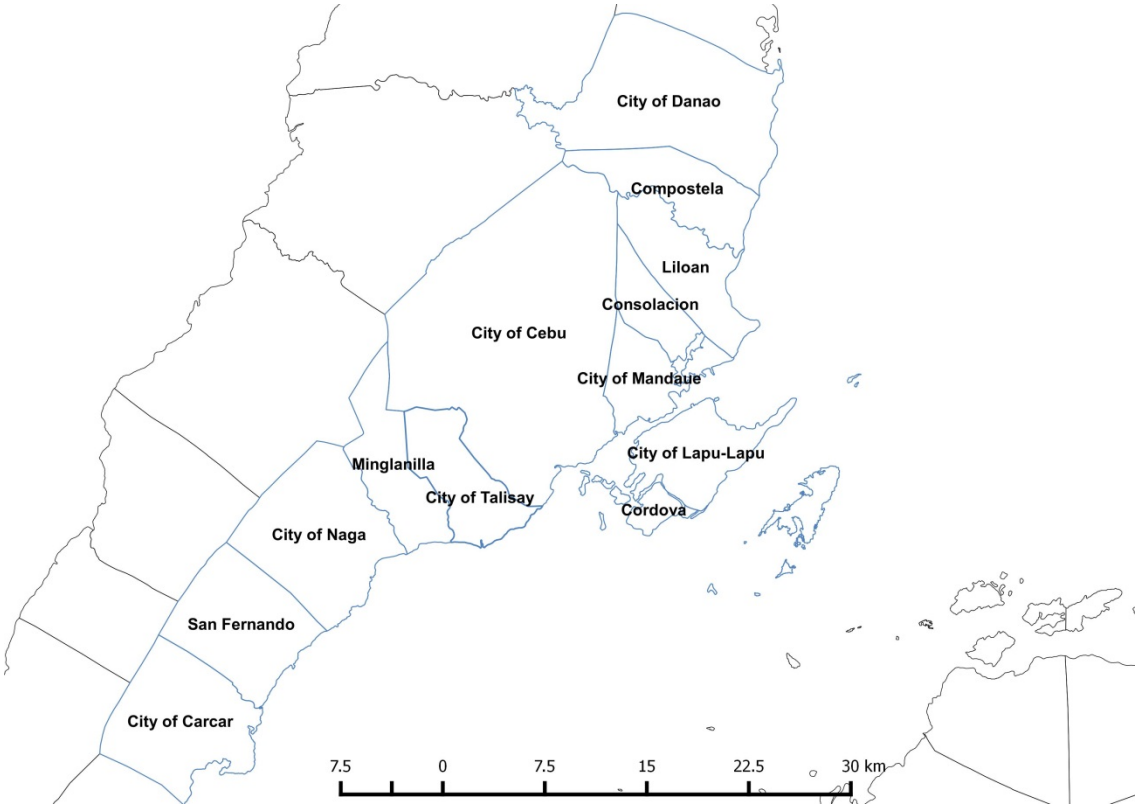
Main Points

- **Metro Cebu is located on an acutely high risk area which is consistently ranked among the most vulnerable countries in the world.** Its undulating topography in combination with heavy precipitation exposes it to severe flooding in low lying areas and landslides in steeply sloping zones. Cebu is also subjected to occasional typhoons. Longer-term, "slow-onset" climate change impacts include heat waves, sea level rise, water and food security issues, and saltwater intrusion into coastal aquifers and water wells. The metropolitan area also lies in close proximity to three fault lines and earthquakes are a major concern.
- All the 13 local government units (LGUs) in Cebu have taken steps to identify hazards and their potential impact as part of LGU's Disaster Management Plans, mandated by the Philippine government's Disaster Risk Reduction Management Act. In addition, **Metro Cebu's Roadmap Study for Sustainable Urban Development** has undertaken detailed studies to identify physical and environmental features which make it vulnerable to natural disasters and pose a risk to the metropolitan population, and developed a comprehensive set of hazard assessment maps. It could be complimented by a detailed vulnerability and risk assessment identifying a number of non-physical parameters, such as socio-economic and demographic variables, including at risk population. Such a framework is yet to be mainstreamed and integrated into urban development policies of Cebu province and of the 13 LGUs.
- **Investing in Metro Cebu's critical urban infrastructure, in particular in the water supply in the face of growing climate change and natural disaster threats is critical to the enhancement of DRM.** In addition, contamination from the inadequate construction and maintenance of residential septic systems and dumping of solid wastes into local water bodies threatens the potable water supply and exacerbates flooding risks. Critical urban infrastructure projects that achieve "co-benefits" across different sectors should be prioritised to ensure best value for taxpayers' money.
- Even though the Philippine Development Plan 2011-2016 prioritises LGUs' capacity building to improve their ability to deliver public services and accountability, the LGUs in Cebu still face great difficulties in undertaking infrastructure development that could enhance DRM. In particular, there is still a significant gap between LGU responsibilities on DRM mandated by the central government and their budget and capacity. **The Metro Cebu Development Coordinating Board (MCDCB) and Mega Cebu Development Authority (MCDA) are an opportunity to enhance metropolitan DRM planning and horizontal governance in Metro Cebu.**

Natural disaster risks

The Metropolitan Area of Cebu (Metro Cebu) is located on the central-eastern flank of Cebu Island and covers an area of 1 163 m² (Figure 5.1). It extends along a narrow 70-kilometre coastal strip of territory between mountain ranges that traverse the island's north-south spine and the Strait of Cebu. The City of Cebu lies at the centre of this metropolitan area and is the capital of the Province of Cebu, which is largely focused on the Island of Cebu, and covers an area of 4 944 km². In 2015, Metro Cebu was home to a growing population of 2.8 million people and is the second largest metropolitan area in the Philippines. By 2050, this population is expected to double (JICA, 2015).

Figure 5.1. Map of Metro Cebu by local government unit



Source: Global Administrative Boundaries (2016), available at: http://www.gadm.org/country.

Metro Cebu has persisted in the regional planning of the Central Visayas Administrative Region (Region VII) since the early 1980s (Mercado, 1998). Prior to the formation of the MCDCB in 2011, there was no formal basis for metropolitan planning and development. Today, seven city and six municipal LGUs form Metro Cebu. In economic terms, Metro Cebu is a regionally prominent and growing centre of commerce, trade, education and industry. During the last 20 years, Metro Cebu has transformed into a global hub for furniture-making, tourism, business processing services and industry. It is also the location of the Philippines' second largest airport and a regionally significant port.

The Island of Cebu lies in the centre of the Philippine archipelago. It is characterised by limestone plateaus, hills and mountain ranges reaching 900 metres above sea level. The island is equally characterised by long and narrow coastal plains (it is 196 km long, 32 km across at its widest point and covers an area of 4 500 km^2). In the City of Cebu, these low lying areas extend a few kilometres inland from the coast and represent about 8% or 25 km^2 of the total land area. Despite the small area, this land hosts approximately two-thirds of the city's population (Cebu City, 2010). This pattern appears to be repeated across the breadth of Metro Cebu's 12 other LGUs. Cebu is surrounded by a further 170 islands, the largest being Mactan Island which is located in close proximity to the east of Cebu City and connected via two large bridges (construction of a third bridge is anticipated in the near-term to alleviate peak-hour traffic congestion).

The Philippines is situated in an acutely high risk area and is consistently ranked among the three most vulnerable countries in the world according to the World Risk Report (UNU, 2015). For example, between 1995 and 2015, 274 disasters afflicted the country, the fourth highest total globally after the United States (472), China (441) and India (288) (UNISDR, 2015). Moreover, the financial impact these natural hazards impose is significant. Metro Cebu is afflicted by geophysical and climate-related natural hazards, and is characterized by a tropical climate of dry and monsoonal seasons. It regularly experiences severe flooding, especially after heavy precipitation during the wet season from June to November and seasonal tropical storms. On the one hand, Metro Cebu's topography is undulating and mountainous with heights reaching 900 metres above sea level. On the other hand, as already mentioned, low lying coastal land extending a few kilometres inland hosts a large proportion of the population. The challenge the local geography imposes, in combination with heavy precipitation, leads to severe flooding in low lying areas and landslides in steeply sloping zones as well, such as at the 'foot' of the Mananga Watershed (Marvette, 2014). Moreover, it should be noted that Cebu faces longer-term, 'slow-onset' climate change impacts including heat waves, sea level rise, water and food security issues, and saltwater intrusion into coastal aquifers and water wells.

Cebu is also subjected to occasional typhoons. In November 2013, Super Typhoon Haiyan (Yolanda**)** became a Category 5 typhoon, the strongest ever recorded at the time, with wind gusts in excess of 300 kilometres per hour and an associated storm surge that reached as high as 3.5 metres along some coastlines with more vulnerable coastal bathometric profiles (NDRRMC, 2013a)[1]. In Cebu, it made landfall twice in the north of Cebu Island with as many as 1 million people evacuated beforehand (UNISDR, 2016). As a country, more than 1.1 million houses were damaged, half of which were completely destroyed. It also killed over 6 300 people, left more than two million homeless, and affected over 13 million people in the Philippines (NDRRMC, 2013a). In total, over USD 12-15 billion in damages were recorded, which is small in comparison to other recent disasters in more developed countries due to the higher asset values. Nonetheless, the Typhoon Haiyan damage bill represented about 5% of the Philippines' total GDP in 2013 (Bloomberg, 2013). An equivalent level of damage to the United States of America's economy would amount to USD 850-900 billion. In terms of insured damages, an analysis by Kinetic Analysis Corporation estimated that only about 10-15% of the total losses in the Philippines were insured compared with about 50% for Superstorm Sandy (United States), which led to around $50 billion in economic damages (Bloomberg, 2013).

The metropolitan area also lies in close proximity to three fault lines including the North Bohol Fault which in addition to soft soil composition in certain quarters, exacerbate the metropolitan area's vulnerability to disaster that would otherwise be reduced if one of these two factors were not present (Silva, 2015). In 2013, Cebu experienced a magnitude 7.2

Bohol earthquake. Although the metropolitan area was not at its epicentre, it caused USD 2 billion in damages and affected 870 000 people (NDRRMC, 2013b). In the broader region of Cebu, the earthquake also damaged nearly 1 000 houses, in addition to local infrastructure and community facilities.

Assessment of DRM policies

Land-use policies

Cebu's DRM policy frameworks stand out as a model from which other Southeast Asian cities can learn, partly due to the strong legislative DRM measures the Government of the Philippines has promulgated in recent years. In 2009, the Philippines legislature introduced the Climate Change Act, followed by the 2010 Disaster Risk Reduction Management (DRRM), and the adoption of a Strategic National Action Plan for DRR (Executive Order No. 888). These legislative measures have led to the development of a DRRM framework focused on three core areas: i) strengthening the institutional capacity for DRM efforts; ii) mainstreaming and integrating disaster risk reduction measures into national, sectoral, regional and local development policies, plans and budgets; and iii) better management of the government's fiscal exposure to natural disaster impacts (World Bank, 2015a). As part of this national mandate, all the LGUs are required to develop their own Disaster Management Plans (DMPs) as a means to provide an organisational framework and clarify the roles and responsibilities of various local government agencies in the event of a natural disaster.

Despite such a well-articulated planning framework for DRM, it appears that LGUs in Cebu still have much to do. A major issue is to integrate DRM into their land use plans. In the Philippines, urban development is regulated by comprehensive land use plans (CLUPs) and legally binding zoning ordinances. While the development of CLUPs is a responsibility of Metro Cebu's 13 LGUs, there is a lack of capacity and political will to carry out such a task. As a result, many CLUPs and zoning ordinances in Metro Cebu have not been updated for a long time, thus not yet reflecting DRM approaches. At present, only a few LGU, including Lapu Lapu and Mandaue in Cebu Province, have submitted updated CLUPs to Cebu's Provincial Planning and Development Office (PPDO), which were forwarded to the National Economic Development Agency (NEDA) for final approval.

International communities have been supporting Cebu in this regard. In 2012, the Metro Cebu Development and Coordinating Board (MCDCB), along with the Japanese International Cooperation Agency (JICA) and the City of Yokohama (Japan), initiated the "Metro Cebu Vision 2050" and "Roadmap Study for Sustainable Urban Development in Metro Cebu". The primary focus of the initiative was the production of a blueprint to guide the city's sustainable development, and one of its main axes was to make it more resilient to natural disasters For example, the Roadmap proposes "urban limits" that will restrict land use in zones at risk of flooding or landslide. An important next step for the 13 LGUs in Metro Cebu is to reflect the proposed land use in the Roadmap into their CLUPs.

The Global Initiative on Disaster Risk Management (GIDRM) has supported a "risk-informed" land-use planning tool which incorporated GIS mapping capabilities in the LGUs of Abuyog and Leyte in the Eastern Visayas, and is currently being applied in Metro Cebu as well. This disaster risk assessment tool demonstrated its utility and added value by influencing Abuyog's Comprehensive Land-Use Plan (CLUP) which incorporated risk-based geo-hazard mapping into its final design. The elements of the proposed 20-year CLUP included disaster risk-informed locations for public transportation corridors and

transit hubs, diversionary periphery roads, as well as essential public infrastructure, schools and hospitals. It also considered public open space and buffer zones for rainwater drainage, sea level rise, and land-use zoning designations for different industrial, commercial, retail, and residential uses. This demonstrates the influence that such risk-informed mapping could have in terms of strengthening DRM efforts on the CLUP process more generally in Metro Cebu.

Further assistance from international communities would help gain political support among all 13 LGUs to design and implement a coherent and comprehensive spatial land-use plan taking DRM into account. The MCDCB would be the most logical location to house a GIS mapping/CLUP support unit to work with and serve the LGUs in the most cost-efficient and professional manner. This would also contribute to LGU capacity building. In addition to those physical attributes analysed and mapped by the GIDRM tool, Metro Cebu could also consider incorporating a number of non-physical parameters, such as socio-economic and demographic variables, including concentrations of highly vulnerable populations, as well as the location of insured vis-a-vis uninsured assets.

Water infrastructure

This study has found that investing in Metro Cebu's critical urban infrastructure, particularly ensuring water supply in the face of growing climate change and natural disasters threats, is critical to the enhancement of DRM. The provincial government has long been aware of the "quiet" crisis threatening its limited freshwater resources. However, these concerns have grown more acute in recent years as sea levels rise and groundwater over-extraction continues, compromising freshwater supplies. In addition, contamination from the inadequate construction and maintenance of residents' septic systems and from improper dumping of solid and liquid wastes into local water bodies has further threatened potable water supplies. This combined threat has resulted in freshwater being more susceptible to both natural disasters like storms and flooding as well as to long-term, slow-onset climate change, such as continued sea level rise and changes in precipitation patterns (longer droughts and more powerful deluges of rain).

In 1999, Cebu's University of San Carlos the Water Resources Centre requested assistance from the Royal Netherlands Embassy, which resulted in a joint project called the Water Remind Project (2003-2008). One of the main policies that emerged from that partnership was the Water Resources Management Action Plan for Central Cebu (2005-2030). Almost every critical issue raised in the WRMA Plan remains relevant today, and has been confirmed by the Metro Cebu Water District and JICA's more recent assessments of Cebu's water supply and sanitation systems in terms of supply and demand, and the investment projects needed to bring them back into balance. Among the more salient findings common to these assessments were the following issues:

- Degradation and contamination of both surface water and ground water supplies continues largely unabated. There is a growing gap or imbalance or over-drafting of over 150 000 cubic metres per day (m^3/day) or roughly 2/3 more than the current supply of potable water for the area's residents, businesses, and farmers.
- Fragmented water providers and lack of effective co-operation, collaboration and co-ordination between cities and municipalities in the province, which continues to be a critical obstacle to comprehensively addressing the challenges posed by growing water demand and climate change threats.

- Inadequate demand-side management measures have not significantly slowed down growing demand for potable water driven largely by rapid population growth in the province. These measures include: reducing water delivery system losses; installing household rainwater collection systems and other water-saving devices like faucets, showerheads and toilets; or marginal cost pricing schedules and not charging hook-up fees for new connections.
- Protection of critical watersheds and water resources in critical recharge areas is still lacking. There is little credible enforcement of existing land-use regulations and unregulated water abstractions from groundwater wells in these areas.

Since 2012, the MCDCB has consistently promoted the preparation of a master plan for flood control and drainage by region VII of the Department of Public Works and Highways as one of its top priorities. In 2015, the MCDCB presented a study on the "Impacts of Groundwater Extraction" and commissioned a further study to analyse the water tariff structure and existing institutional structures as the basis for policy recommendations moving forward. Likewise, JICA's three studies focused on a number of short-, medium- and long-term projects to address the future water needs of Cebu from the combined impacts of continued population growth, climate change and natural disasters:

- The *Sub-Roadmap for Water Supply*: this sub-roadmap called for the construction of new surface water impoundment dams and reservoirs, development of new, regulated upland groundwater wells, and use of recycled water and reductions in non-revenue water losses.
- The *Sub-Roadmap for Storm Water Management*: this sub-roadmap reiterated the MCDCB's request for an integrated flood control and drainage system master plan, the cleaning of rivers, creeks and drainage canals running through populated areas, and the construction of large water storage facilities.
- The *Sub-Roadmap for Wastewater Management*: this sub-roadmap called for the construction of seven septage treatment facilities stretching from Danao City in the north all the way to Carcar City at the southern end of Mega Cebu region. These treatment plants will handle the septic sludge collected from household septic tanks by vacuum trucks. JICA built the first demonstration plant in Cebu City and was trying to "turn over" the management of the plant to the Metro Cebu Water District over the past year, but there have been problems in consistently operating it properly.

In the long run, it is envisioned that Cebu (at least more populated areas) will construct and operate a centralized sewage treatment system over the next 15-35 years. However, the phased approach of building a cluster of septage treatment facilities over the next few years may be a more cost-effective, pragmatic and politically viable interim course of action for Cebu to take.

Disaster risk financing

Cebu lacks the adequate financial resources to meet the scale of the challenges posed by natural disasters, similarly to the other case study cities. Cebu relies heavily on tax revenue transfers from the central government and international donors to supplement internal budget allocations for green growth and DRM investments. Dedicated climate change funds, such as the Green Climate Fund and Adaptation Fund, are difficult and time-consuming to access with no track record of "direct funding" to subnational entities.

Pre-arranged contingency lines-of-credit from multi-lateral development banks have been deployed in the Philippines at the national level, and such instruments are fundamental to prepare for, and recover from, large-scale natural disasters in Cebu. In late 2011, the Government of the Philippines negotiated a USD 500 million Catastrophe Deferred Drawdown Option (CAT-DDO) loan with the World Bank that it could access in the immediate aftermath of a large-scale natural disaster (World Bank, 2015b). It was released following the devastating tropical storm *Washi* (known locally as *Sendong*). A second contingency funding agreement spread over a three-year drawdown period and renewable for up to 15 years was signed in late 2015.

The Government of the Philippines has almost tripled its DRRM Fund from about PHP 2.7 billion (USD 54 million) in 2006 to PHP 7.5 billion by 2013 (World Bank, 2015b). Moreover, the government has begun implementation of the Disaster Risk Financing and Insurance Strategy to establish more risk financial mechanisms, such as the USD 500 million contingent lines-of-credit, signed with the Japan International Cooperation Agency (JICA) in 2014, which was modelled on the CAT-DDO loan. The Philippines' Department of Finance (DoF) is also working to establish a subnational insurance pool to provide LGUs with immediate liquidity following large-scale natural disasters, and to design a property catastrophe risk insurance pool for homeowners and businesses. These are intended to deal with smaller and more frequent natural disasters and will complement the CAT-DDOs which are reserved for large-scale emergencies. The DoF is also setting up a social safety net system of emergency income and recovery assistance support to the poor, who are most vulnerable to natural disasters.

At the local level, the Disaster Risk Reduction Management (DRRM) Act in 2010 requires LGUs to establish a DRM contingency fund of at least 5% based on recurring sources of revenue. This fund is expected to complement national funds and be used for local-scale emergencies. However there is still a significant gap between LGU responsibilities and their capacity. In order to address the capacity gap for LGUs in Cebu, collaboration between the DoF and Cebu province should be pursued to create a metropolitan scale contingency fund. A VRA will be required to ensure effective co-ordination among all levels of government.

Microinsurance may also be a key element at the local level, especially for the poorest populations. In the Philippines, the industry is growing, reporting 31.1 million microinsurance beneficiaries in 2014, up from 19.8 million in 2012 and 2.9 million in 2009 (GIZ RFPI, 2015). The insurance providers responded effectively after Supertyphoon Yolanda (also known as Haiyan) in November 2013, paying out more than 100 000 microinsurance claims within the first three months, amounting to approximately half-a-billion PHP. The average amount per claim paid was PHP 4 777. What started only as a corporate social responsibility program by some insurance providers has proven it could also generate some profit for the companies. This microinsurance framework could be a source of inspiration for other countries and for the other case study cities.

Strategies to unlock finance for DRM are critical. The budget of the 13 LGUs in Metro Cebu is PHP 3.4 billion in total in 2014, of which only 31% account for local own revenue on average. There are opportunities to raise and diversify local revenues, in particular tariffs and user charges that can simultaneously promote green growth and DRM objectives. In addition, the national government's transfers should be better aligned with DRM objectives as necessary contributions towards urban resilience. Attracting private investment should also be emphasised: FDI inflows have been lower in the Philippines than in all other countries of the Southeast Asian region, in particular because of the strong restrictions

imposed by the government, which could be loosened at the subnational level to encourage green growth and DRM related investments.

It is not known precisely what percentage of Cebu's climate-resilient infrastructure investments are being made with local sources of private finance or through domestic capital markets. However, it is clear that Cebu's political and community leadership understands the importance of forming public-private partnerships, and is actively embracing collaborative actions and building coalitions between the private and public sectors with full civil society engagement for that purpose, as evidenced by the continuous dialogue taking place among local stakeholders in the government, private sector and civil society represented on the MCDCB. The MCDCB can function as a catalyst to increase the banking and investment communities' awareness of the role they can play in supporting climate-resilient investments and initiatives.

Assessment of DRM governance structure

Metro Cebu's cross-cutting approach brings together central and local government, as well as civil society and private stakeholders, as part of its green growth agenda which incorporates a broad plan to build DRM. The Roadmap Study for Sustainable Urban Development in Metro Cebu sets out concrete and comprehensive measures to enhance DRM, and has been supported by international partners. Cebu's highly collaborative working relationships between the public and private sectors, CSOs and NGOs, allow it to respond in a more holistic and integrated manner to prepare for and respond to the expected and unexpected impacts of natural disasters.

The Philippines' cities and municipalities serve as the primary planning and implementing unit of government policies, plans, programmes, and activities. The 1991 *Local Government Code* delegated to LGUs the responsibility for delivery of basic services that previously had been the responsibility of the national government, as well as considerable discretion over local taxes. It granted LGUs regulatory powers and increased available financial resources. In terms of DRM, LGUs are also acknowledged as first responders. Efforts to enhance governance and LGUs capacities are continuing: the National Economic Development Agency's Philippine Development Plan 2011-2016 has an entire chapter dedicated to good governance and the rule of law. It prioritises empowering LGUs via capacity building to improve their ability to deliver public services and promote public accountability.

In practice however, the governance system is plagued with problems and LGUs in Cebu have faced great difficulties in undertaking sustainable growth and infrastructure development that could foster urban green growth and DRM. There is a significant gap, in particular, between LGUs' responsibilities, their budget and capacity, and legal authority still largely held by the national government in key green growth opportunity areas.

Vertical and horizontal co-ordination

The Philippines has made a concerted effort to align national and local planning through the Disaster Risk Reduction and Management Council (DRRMC). The DRRMC oversees national and local government efforts to build DRM against natural disaster and was born out of an international partnership between the World Bank and the Government of the Philippines. It is a working group of various government departments and non-government organisations administered by the Office of Civil Defense. The Council's organisation is divided along the four aspects of DRRM: i) disaster preparedness, ii) (immediate) response,

iii) prevention and mitigation, and iv) rehabilitation and recovery. The council has adopted the UN's community-based "Cluster Approach" within its DRRM framework focused on three key objectives to: (a) strengthen the institutional capacity for DRRM efforts; (b) mainstream and integrate DRRM measures into national, sectoral, regional and local development policies, plans and budgets; and (c) better manage the government's fiscal exposure to the impacts of natural disasters.

At the same time, more than 80 provincial Offices for Disaster Risk Reduction and Emergency Management complement these local and national efforts to mitigate the potential effects of the various natural hazards and vulnerabilities that might affect the province by: assisting the implementation of measures to preserve life and property and further minimise casualties and damage; responding and managing the needs of affected populations and local jurisdictions during emergencies; providing a recovery system aimed to return the province to "normal" as early as feasibly possible after a natural disaster.

The DRRMC assists and co-ordinates with local government DRRM offices at the municipal, city and barangay level. In the City of Cebu, the Cebu City Disaster Risk Reduction Management Office (CCDRRMO) co-ordinates its activities and plans with the MCDCB through the Research, Program & Organizational Development (RPOD) unit within the Ramon Arboitiz Foundation Inc. (RAFI), which organizes and convenes meetings of appropriate sub-committees, "focus area-based committees," and the full executive committee. Both the MCDCB and RAFI/RPOD have institutionalised disaster risk reduction/management and climate change adaptation as core focus areas in recent years. These initiatives to enhance DRM governance through the MCDCB and RAFI/RPOD in tandem with local DRRM offices are a positive development, although in this nascent form, it is too early to assess the results achieved from this initiative. The recognition of the on-the-ground role of local government as first-responders in the event of disaster has led to the establishment of equivalent DRM offices in nearly 1 500 LGUs across the country. Moreover, the initiative has allocated specific financial budgets and staff resources. The central task of this local office is to prepare a local DRM plan as part of efforts to mainstream disaster planning, prevention and response efforts (Government of the Philippines, 2011).

LGUs in Cebu have faced great difficulties in undertaking sustainable growth and infrastructure development that could foster urban green growth and enhance DRM. There is a significant gap, in particular, between national policy objectives and concrete action taken by LGUs on the ground. There is a lack of sectoral national policy frameworks, resulting in an absence of explanation of the role to be played by LGUs as well as the resources to do so. In parallel, the translation of existing national legislation and policy frameworks at the local level is relatively inefficient, characterised by an over-reliance on regulatory approaches rather than outreach, collaboration, and capacity building.

Strengthening the legislative mandate of the regional metropolitan body

There is a lack of horizontal policy co-operation and co-ordination between Metro Cebu's 13 LGUs. Metro Cebu's rapid expansion has exacerbated and highlighted several challenges associated with the provision of critical urban services, environmental management and DRM. There appears to be no easy conduit to horizontal integration and information sharing between existing LGU planners which would better co-ordinate CLUPs across LGU boundaries. This has resulted in many isolated initiatives and policies in critical green growth sectors that have not addressed the metropolitan scale of Metro Cebu's growth, and also led to incoherent policies across jurisdictions.

The challenges associated with horizontal co-operation among LGUs seem to have been a major driver in the formation of the **Metro Cebu Development and Coordinating Board (MCDCB),** a consortium of the 13 LGUs of Metro Cebu, regional line agencies of the national government, private sector representatives and civil society organisations (Box 5.1). The MCDCB has been successful in developing a strong and coherent regional vision – synthesised in the JICA Mega Cebu Roadmap study – and serving as a strong advocate to the national government as regards capital funding, policy implementation, and LGU capacity building. While it is still early to assess the extent of the MCDCB's collaborative planning and trust amongst LGUs, the MCDCB continues to actively demonstrate success in collaborative dialogue and advancing plans and projects in a way that co-ordinates, but does not prejudice the autonomy of affected LGUs.

Box 5.1. The Metro Cebu Development Coordinating Board (MCDCB)

The **Metro Cebu Development Coordinating Board (MCDCB)** is a co-ordinating body for metro-wide planning and development that was created on April 1, 2011 through a Memorandum of Agreement (MOA). It is a consortium of the 13 LGUs composing Metro Cebu (7 cities -Cebu, Danao, Mandaue, Lapu-Lapu, Naga, and Carcar and 6 municipalities - Compostella, Liloan, Consolacion, Cordova, Minglanilla, and San Fernando), regional line agencies of the national government, private sector representatives and civil society organisations. The key objectives of the MCDCB are to:

- Act as a co-ordinating body and platform for inter-jurisdictional challenges and responsibilities;
- Be a platform for inter-jurisdictional co-ordination between the public and private sectors and local and national governments;
- Be a launch pad for collective action and impact (recognising the importance of collaboration in developing policy and priority coherence, improving capacity, etc.); and
- Be a vehicle for regional, national and international co-operation.

The MCDCB model is unique in its explicit engagement with, and leadership from, the private sector and civil society. This model of including both the private sector and civil society at the board-level of a regional organisation can be seen as a means to institutionalise innovation, accountability and transparency. The private sector offers resources and is a main driver of economic growth and in bringing in technology and innovation.

Having the private sector and the civil society at the table as a co-chair sends a clear message in terms of integration and in providing an environment conducive to business, investment and community. The fact that the idea for co-ordination stems from the private sector also facilitates broad local government engagement in that project ownership is seeded more broadly, rather than with one or two local governments or officials. The MCDCB has also undertaken a strong branding and outreach programme, with brochures, videos and other tools. However, there are some questions as to the role of the private sector and civil

society in establishing public policy where elected officials must be responsible for implementation (e.g. zoning, parking restrictions, etc.).

Source: OECD (2017), *Green Growth in Cebu, Philippines*, OECD Green Growth Studies, OECD Publishing, Paris, https://doi.org/10.1787/9789264277991-en..

Currently missing is a metropolitan policy-making entity to co-ordinate the efforts and resources of the myriad stakeholders in Metro Cebu with the legal mandate and authority to compel the 13 LGUs and regional or national public agencies into compliance. That co-ordination needs to occur at a metropolitan area scale for a number of reasons, including the limited resources and capabilities of most LGUs individually, and the geographic scale, severity, and long-term impacts and costs associated with climate change and natural disasters.

However, the financial resources and power of MCDCB are limited and prevent further benefits emerging from this promising governance initiative. Currently, operations of the MCDCB are supported through non-specific financial contributions from the member LGUs as well as through grants, donations, national government appropriation, and other sources. In addition, LGUs are still the units in charge of adopting the CLUP, and MCDCB only pushes them to follow through. There is only a Memorandum of Understanding (MoU) between MCDCB and LGUs, but not a regulatory relationship. Because LGUs cannot afford a planning department staffed by professional planners, and therefore cannot fulfil the obligations to complete a CLUP, the impact of the support of MCDCB to prepare CLUPs has been limited so far.

In 2015, the MCDCB prepared and submitted a bill to create the Mega Cebu Development Authority (MCDA). As of November 2018, the bill has been revised several times and is still under discussion in the national Congress. The bill is informed by the Metropolitan Manila Development Authority created in 1975 and influenced by the regional district model created through British Columbia's *Local Government Act* (Parts 6, 8 and 13). The main purposes of the creation of MCDA are: *i)* to recognise a more institutional approach to metropolitan and integrated development planning; *ii)* to foster co-operative relations between and among metropolitan and surrounding cities and towns; *iii)* to ensure active participation by the private, business, and civil society sector; and *iv)* to implement a national government-approved Metropolitan Cebu Roadmap and other subsequent and related metro-wide roadmaps and plans. If the bill is enacted, MCDA would administer the affairs of MCDCB.

The draft Mega Cebu Development Act will enable the MCDA to assume the planning function primarily for the area of Metro Cebu through the development of a dedicated office in charge of technical research, development and planning. This co-ordinated planning function will enhance planning capacity and allow the Mega Cebu 2050 Vision priorities to be identified and advanced. The MCDA would be governed by the Mega Cebu Development Board. The Chair of the Board would be elected among the Governor and Metro Cebu mayors on an annual basis.

The bill is structured to ensure there is no loss of autonomy for local government units. A similar approach was undertaken in British Columbia, where the legislation guiding the role and authority of regional districts around regional planning clearly speaks to a collaborative relationship, but authority over land use planning at the local level. The "soft" relationship is both successful in terms of partnership and collaboration and shared vision, but challenged by an inability to require the vision to be implemented. If the MCDA

approach is not efficient, alternative options could be explored to improve implementation of metropolitan policies. In Iskandar, service level agreements have been set up by the Iskandar Regional Development Authority (IRDA) to encourage collective action into concrete projects on the ground (see Section 0).

While MCDA will surely be a powerful tool to enhance horizontal governance in Metro Cebu, the drafting and development process of MCDA should also be an opportunity to tackle vertical and financial governance issues. The draft legislation still reflects a disconnect between a required relationship with the national government in terms of the dependencies on that level of government to implement LGU priorities (e.g. approvals, inclusion of Mega Cebu development plans and investment programmes in the Philippines Development Plan and Public Investment Programme) and the level of authority granted to national level officials in the proposed MCDA administrative structure (i.e. a Director of the Regional Office sits on the Board "as may be necessary to pursue the mandate and scope of services of MCDA" with one vote). It is not clear where the value proposition is for national government buy-in to the MCDA as proposed in the bill.

Stakeholder engagement

There is room for improvement for engaging NGOs, local citizens and businesses for DRM. While NGOs and urban communities in the Philippines are quite active in general, there are very few measures and training initiatives which cover topics related to DRM. This is leading to a lack of public awareness about available assets and procedures to follow during an emergency.

Main policy recommendations

- Develop a comprehensive VRA and asset inventory to incorporate non-physical parameters, such as socio-economic and demographic variables, including concentrations of highly vulnerable populations, as well as the location of insured vis-a-vis uninsured assets.
- Assist the 13 LGUs to reflect risk-informed or geo-hazard mapping commissioned by initiatives like the GIDRM or donors like JICA into their CLUPs and other urban development plans and strategies.
- Link water infrastructure investment with solid waste policies in order to achieve "co-benefits" across different sectors.
- Collaborate with the DoF and Cebu province to create a metropolitan scale contingency fund.
- Build on the successful activities of MCDCB and strengthening the legislative mandate of the metropolitan body for DRM planning and horizontal governance in Metro Cebu by establishing the Mega Cebu Development Authority.
- Assist the 13 LGUs in building capacity to effectively access the growing quantity of private funds, including international climate funds.
- Explore local private finance by raising the banking and investment communities' awareness of the role they can play in supporting climate-resilient investments and initiatives.
- Increase fiscal transparency of local governments by disclosing fiscal situations in an internationally comparative way.

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Chapter 6. Hai Phong, Viet Nam

Chapter 6 examines the threat of natural hazards to Hai Phong, Viet Nam, and how the government can build greater resilience to them. The chapter is divided into three sections.

The first section examines the "natural hazards" that pose the greatest risk to Hai Phong. It identifies and presents the risks which require the most urgent adaptation and mitigation actions.

The second section assesses key policies and activities that are currently being implemented in Hai Phong to increase the city's resilience. It also proposes strategies and recommendations using the "systems thinking" approach that can be applied to increase the resilience of critical urban services and functions before, during, and after disasters.

The third section focuses on governance and analyses a number of public engagement and communication issues making important recommendations in that regard. The policy assessment particularly focuses on Hai Phong Port.

This chapter draws on the key findings of the OECD study "Green Growth in Hai Phong, Viet Nam" (OECD, 2016). It has also benefited from discussions held during the fourth Knowledge-Sharing Workshop 'Green Growth in Port Cities' in Hai Phong (24-25 June, 2015).

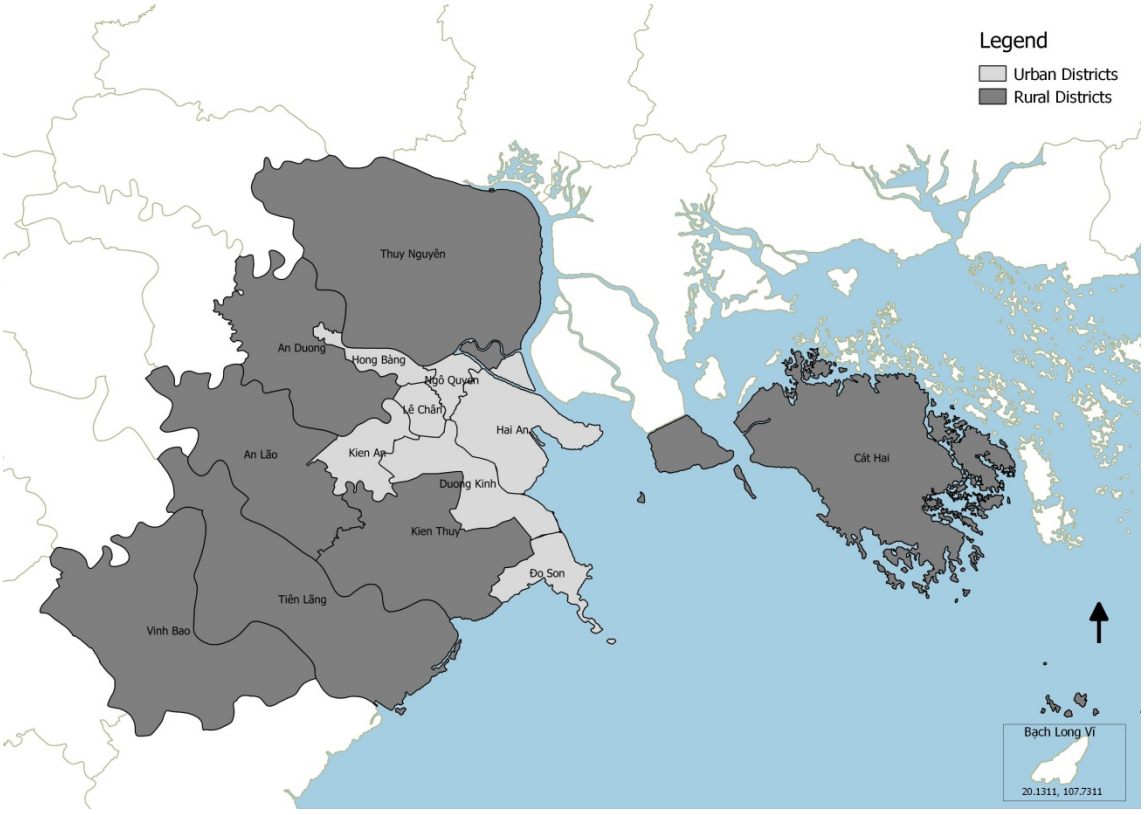
Main Points

- The city and port of Hai Phong are vulnerable to climate-induced risk such as **tsunamis, flooding, ocean storm surge** as well as a longer-term threat of **sea level rise.** By 2070, under a business as usual scenario more than 4.7 million of the population and a high proportion of the city's assets will be exposed to coastal floods. Previous disasters such as Son Tinh Typhoon in 2012 had a devastating impact on the city estimated at VND 1 000 billion (around USD 330 million, PPP). Given Hai Phong's economic importance in the region, adaptive capacities for resilient urban planning, infrastructure management and emergency response should be an overarching objective for the local government and port authorities.
- **Hai Phong port lacks a comprehensive and integrated floodwater management plan or strategy.** Hence, building preparedness and response capacities in the port is crucial. Ensuring that land-use and infrastructure planning takes into consideration future downscaled climate change projections for Hai Phong is equally important. Institutional synergies need to be created to improve the knowledge and resources of all stakeholders.
- **Hai Phong lacks a Local Resilience Action Plan (LRAP)** and should **mainstream one** into the city's normal planning and budgeting processes as well as via transfers from the national government.
- Promoting interconnectedness of climate-resilient infrastructure, critical public functions, and land-use planning in **a holistic integrated "systems thinking" manner** should be explored. This increases the adaptive capacity and resilience of Hai Phong to prepare for and recover from disasters and climate change, while shifting development toward urban green growth pathways.
- Expanding Hai Phong's financial resources will promote sustained financing and investment of the DRM strategy. **Opportunities exist for the city to explore new insurance modalities and innovative financing** to ensure investments in climate-resilient infrastructure and to cover the costs of recovery, rebuilding, as well as indirect economic losses and damages incurred. "Soft" institutional capacity must complement "hard" DRM measures. This includes participation of a broad spectrum of stakeholders in a transparent process of meaningful, open engagement and collaboration in resilient efforts. Currently, in most cases, the local government and its citizens are simply informed of decisions already made at much higher levels of government that are more distant from the situation and which may not adequately consider unique local circumstances and preferences or needs.

Natural disaster risks

With 1.96 million inhabitants, Hai Phong is the third-largest urban area in Viet Nam. Hai Phong's city government has the status of a province, along with the other four large cities in Viet Nam (Ha Noi, Ho Chi Minh City, Can Tho and Da Nang). Hai Phong is divided into 15 administrative units (7 urban districts, 6 rural districts and 2 island districts) (Figure 6.1Figure). The unit of analysis in this report is Hai Phong City.

Figure 6.1. Map of Hai Phong by district



Source: Based on GADM database. Available at: http://gadm.org/.

Hai Phong is located at the mouth of the Cấm River along the northern extremity of the Red River Delta Basin. Given its location and surrounding topography, the city has a history of flooding going back centuries. Natural disaster risk is a potentially critical obstacle to green growth in Hai Phong. In 1881, the city was almost destroyed by a typhoon that killed 300 000 residents. An extensive system of dikes and canals has been built to contain the Cấm River and other rivers in the area to irrigate the rich rice-growing delta. Thus, for centuries flood control has been an integral part of the Red River Delta and Hai Phong's public policy.

Floods are becoming increasingly frequent and more destructive as population growth and large tracts of natural hinterland are developed. Among cities with populations greater than one million, Hai Phong is among the top 10 coastal cities with highest population exposure

to coastal floods in the world, with 794 000 persons being exposed as of 2007, while it is projected that more than 4.7 million will be exposed by the 2070s, under a scenario taking into account climate, subsidence and socio-economic changes. While Hai Phong is not among the top 20 cities with the most exposed assets, it is nevertheless among the top 15 cities with the highest proportional increase (from the current situation) in exposed assets by the 2070s, under the same scenario (Hanson, *et al.*, 2011).

Hai Phong lies directly along one of the most frequent paths for Pacific typhoons that originate in and around the Philippines and reach the Asian mainland through the Gulf of Tonkin. Severe tropical cyclones are expected to take place every 5 or 10 years in Hai Phong, and the annual total number of storms is on the rise (City of Hai Phong, 2015). In 2012, the Son Tinh typhoon caused Hai Phong a loss of property estimated at VND 1 000 billion (around USD 330 million, PPP), and the destruction or damage of many businesses and infrastructure, including 63 wrecked ships and 8 collapsed marine management stations. This typhoon was the most severely devastating disaster in Hai Phong over the past ten years but the city also suffered from similar disasters in 2005, 2008, 2009, 2010 and 2011, which bore impacts on the port facilities. For example, the 2008 storm overturned 202 containers and destroyed 2 ship cranes (City of Hai Phong, 2015).

Hinterland areas that once retained rainwater run-off and allowed it to infiltrate into the soil and groundwater have been urbanised. Downstream of the city of Hai Phong, drainage systems have not been sufficiently developed to deal with the increasing run-off water. During the process of rapid urbanisation, many vulnerable settlements and households have been established in flood-prone areas in the city, such as along drainage canals, creeks, rivers, or in low-lying areas. Moreover, many natural coastal defences such as mangrove forests and estuary wetlands have disappeared, mainly due to activities of local communities such as shrimp aquaculture.

The presence in the port of harmful substances, materials and critical facilities such as oil, hazardous waste in containers, sludge, poses an additional risk factor linked to floods and storms. The intensity of climatic events and the lack of proper treatment and handling of such materials create a risk of environmental contamination during floods and storms.

Assessment of DRM policies

Local Resilience Action Plans in the port

This assessment has found that Hai Phong, particularly its port, lacks appropriate resilience measures. Indeed, because of its importance in the regional economy and the infrastructural developments, the low resilience of Hai Phong port to typhoons and floods could result in severe economic repercussions in the region. Similarly, port activities can also increase the vulnerability of the city: for instance, unregulated or uncontrolled ship-generated wastes, port operations (e.g. inadequate temporary storage and pre-treatment of stormwater run-off from port terminals), and land reclamation for port development projects can be factors of risk. The 2012-25 Environmental Conservation Programme of the City of Hai Phong features a project of an estimated budget of VND 4 billion to strengthen communication systems to warn vessels in case of typhoons. However, no comprehensive emergency response strategy exists, and little is known about preparedness plans for staff.

The assessment nonetheless found a few interesting programmes related to increasing local resilience, including a partnership among the City of Hai Phong, the City of Seattle (United States) and Peace Winds America, an international NGO. The City of Seattle is a historical

sister city of Hai Phong, and the partnership between the two cities has been established within the framework of the Sister Cities Disaster Preparedness Programme of USAID, which aims to increase business resilience and public-private co-ordination on disaster risk planning. The project will conduct risk assessments, preparedness planning, hazard mapping, and business continuity trainings and consultations. It is expected that more than 2 000 businesses will engage with civil authorities in substantive planning and training activities until end of 2016 (USAID, 2014). It is therefore a timely opportunity to include private port stakeholders working on port facilities but also all businesses whose activities are port-related.

For these individual programmes to function more effectively, it is important to prepare a local resilience action plan (LRAP) to increase the port's adaptive capacity. The LRAP should be a joint effort by the central government, the local government and relevant port authorities and operators. It should address Hai Phong port's unique challenges. The following are key issues to be considered:

1. Reducing exposure to risks by making projections of future potential threats and damages using downscaled global climate change models. Early warning systems should be set up in each port terminal and triggered by weather forecast and also sensors such as gauge stations in the Cam Ca River. Response capacities should also be developed to ensure the economic resilience of the port. In this regard, port companies should develop business continuity plans to minimise the impact of disasters on their activities;
2. Building flexible infrastructure such as semi-permeable surfaces in each terminal. Hai Phong port currently lacks resilience strategies incorporating adaptive infrastructure and could consider integrating several design concepts into any new commercial and industrial development projects larger than one acre in dock and maintenance areas of the port. These concepts may include the use of pervious surfaces (permeable pavements and surface structures), and the planning of land slopes and gradients to ensure drainage or retention in designated zones (OECD, 2014). Similar options should be explored in the port of Hai Phong, and integrated as requirements for building permissions;
3. Tracking the purchase of all hazardous materials in the port, and ensuring their safe and responsible use, storage, and final disposal with a "cradle-to-grave" manifest system that tracks possession of these materials to affix responsibility and liability. Qualified personnel should be trained to contain accidental releases of hazardous chemicals and other substances and containment plan could be set up jointly between the City of Hai Phong and port authorities/operators, so that both parties share resources and co-ordinate emergency response in case of disaster;
4. Providing the equipment, training, and other resources available and on-site to effectively prevent or control any contingency from turning into a "human-made" disaster. The local government and the port authority should train emergency response staff and revise emergency response plans on an on-going basis. The protocols and procedures should reflect changing risks and be based on experience gained in running mock emergency response drills. Periodically, the plan should be reviewed by an independent third party to ensure that it captures all of the main expected threats but is flexible enough to respond effectively to unexpected threats/risks; and

5. Establishing unencumbered access to top port management – accompanied by external review or shared responsibility – for the safe operation of the port, and its most immediate recovery from a disaster like a typhoon.

Land-use policies

The geographical characteristics and rapid urbanisation trend of Hai Phong pose a critical challenge on land use. The entire Red River Delta region including Hai Phong, backed by the steep rises of the forested northern highlands to the west and north, has low elevations averaging about three metres above sea level. In terms of sea-level rise and storm surge, recent assessments show that over 70% of the Red River Delta region's surface area used for residential, commercial and industrial purposes is at risk of a 5-metre high flood by 2050 (Neumann, *et al.*, 2015; OECD, 2016). In addition, Hai Phong has a high density of rivers averaging 0.6 to 0.8 km per 1 km^2; storms can increase damage to infrastructure or create floods by increasing water level in the numerous waterways.

It is observed that recent urban development has expanded from the south of Cam River to the south-east and west as well as north-west towards Ha Noi. Most of the inner-city areas are filled up by urban land use. It is estimated that 475 square kilometres of new land is required for urban development to accommodate 1.5 million new urban residents in the next 10 years (OECD, 2016). An effective land-use policy is needed to enhance city resilience by steering development in Hai Phong away from risk-prone areas.

The City Master Plan of Hai Phong, targeting 2050, guides the city's land use through the Detailed Planning and Zoning Regulations. If such a plan is to be effective, legal assurance is needed that the city master plan is aligned with all the long-term thematic and sectoral plans and strategies. However, mechanisms to ensure such alignment are not very clear. For instance, Hai Phong has a long-term Flood Control Master Plan to 2025. Although it has strong influence on long-term land use planning and zoning codes in critical areas for groundwater recharge and retention of surface water run-off, no co-ordination mechanisms are found between the two master plans.

Urban infrastructure

The local government and the port authority are currently implementing several measures to build resilience of the port-city to typhoons and floods, including:

- Construction of dikes and pumps along the coast or the rivers. For the period 2012-25, 14 dike/embankment renovations or construction projects of an estimated total budget superior to VND 3 000 billion have been listed within the environmental protection programme of the City of Hai Phong;
- Construction of retention ponds in the city to retain stormwater and prevent flooding of inhabited urban areas (including port areas); and
- Creation of a system of anchorage under port cranes, to ensure their stability during a storm. For the period 2012-25, VND 65 billion has also been committed to renovate river ports and seaports, including construction of safe anchorage for larger ships during storms.

Currently, only one project of VND 5 billion has been listed in the 2012-25 Environmental Conservation Programme to prepare for climate change and sea level rise in Hai Phong. Public and port authorities should ensure that land-use and infrastructure planning at the port takes into consideration future downscaled climate change projections for the Hai

Phong area and northern Viet Nam. Such planning should assess the combined risks for sea level rise, storm-surge levels and tidal levels for the interior sections of the old port located along the river).

Currently, a monitoring network of river or stream gauge stations measures the water surface level as well as the discharge or flow of water. In addition, a network of early warning system (EWS) would be installed along the six major rivers that flow into or near Hai Phong. Gauge stations can be fully automated, capable of sampling water quality, and be linked up to satellites and data processing/communication centres via telemetry. Such capabilities are being developed with donor assistance to track storm systems in the western Pacific Ocean. It is not known whether they are being developed to monitor inland run-off from the mountainous areas to the west of Hai Phong.

Assessment of DRM governance structure

Horizontal and vertical co-ordination

Hai Phong is one of the five provincial cities of Viet Nam directly supervised by the national government, leading to complex governance arrangements for DRM. In general, the features of the local administrative system in Viet Nam suggest that it is a highly hierarchical system, with lower levels of government co-ordinated through the central government. In the case of Hai Phong, the governance structure is even more complex as Hai Phong port authority, which is directly managed by the central government, plays a key role in developing and implementing the city's DRM policies (OECD, 2016). .

This assessment has found that there is a lack of knowledge and resources among public and private stakeholders who should do what in order to buildg the resilience of the Hai Phong port. For example, the lack of national-level planning to help federal and state coastal managers develop adaptation plans is a barrier to effective resilience. Considering its authority in port development and its knowledge of coastal resilience issues in the whole country, the central government of Viet Nam should play a leading role in encouraging and supporting the adoption of a local port resilience action plan. Other plan-based strategies that can be reinforced include data storage plans, emergency responses and recovery plans, and work-to-ID funding streams. These plans often involve practices such as drills and event reconstructions, simulation of post-storm actions, and storm preparations (OECD, 2014).

The creation of disaster units in each terminal of the port is a promising initiative. Although detailed information on the function and co-ordination mechanisms of these disaster units was not available within the scope of this study, they can connect a wide range of stakeholders related to DRM in Hai Phong port and facilitate much broader co-operation and co-ordination.

On a broader spatial perspective, the study also found that there is a lack of co-ordination mechanisms between the city of Hai Phong and surrounding provinces on DRM. Cross-border cooperation is especially important to prepare for and respond to flood risks at the Red River Delta Basin including Hai Phong. The national government, with the support of provinces and province-level cities, could develop the concept of functional urban areas in Viet Nam and a metropolitan planning framework to build synergies. The Ministry of Planning and Investment and relevant national ministries can help build mechanisms for collaboration across levels of government to improve the strategic metropolitan planning framework. Hai Phong could also consider creating a metropolitan planning institute to

coordinate across sectors and levels of government. Such an institute could serve as the regional planning authority, and could be charged with preparing long-term plans, providing technical assistance, proposing integrated metropolitan development projects and preparing mechanisms for evaluation (OECD, 2016).

The study also found that lack of skills and incentives, and of any formal mechanism for working together, is a major challenge to establishing and strengthening horizontal linkages across agencies. For example, the 2009 Law on Urban Planning does not specify any procedure for cross-sectoral co-ordination of urban planning at the city level. The authority responsible for urban planning is requested to collect comments from relevant stakeholders, but no clear incentive or mandate is in place to engage in integrated urban planning. Another constraint for establishing inter-sectoral linkages is the capacity of staff with the skills to conduct cross-sectoral planning. Line ministries tend to be predisposed towards controlling and/or monitoring inputs, rather than processes and outcomes (OECD, 2016).

Disaster risk financing

Hai Phong lacks the adequate financial resources to meet the scale of its resilience needs and will need to include a financial component to pay for the necessary investments. So far, Hai Phong has used traditional financing instruments and approaches to pay for public amenities and service improvements, such as "balance sheet" funds from city and municipality coffers, transfers from the provincial and central governments, and concessional financing from international donors, such as the JICA, ADB and World Bank. Hai Phong is allowed to keep only 15-20% of the local taxes it collects from residents and businesses in the city, and none of the customs revenues collected from port duties. The rest goes back to central government coffers where it is then redirected and used to meet the needs and demands of citizens across the entire country. Since the city of Hai Phong has very strict limits on its authority to impose taxes locally to generate revenues, it must depend mostly upon transfers from the central government, and international donor financing acquired through projects negotiated by central government agencies.

The most likely means for Hai Phong to obtain additional DRM funds may be through leveraged private sector funds incentivised by public sector involvement via various risk mitigation instruments like public-private partnerships (PPPs). However, aligning public and private sector interests can be difficult and it might be more pragmatic and practical for cities like Hai Phong to investigate emerging and innovative forms of financing, (Table 2.5), such as financing from national or regional development banks through "green bonds," or with socially motivated "social impact investors" interested in forming joint green investment projects with the city, or through the creation of community savings groups, which then "federate" or aggregate into larger, self-sustaining micro-financing mechanisms to obtain greater economies of scale and better financing rates and terms from local banks and private lenders. As regards the financing of the resilience to disasters, it may also comprise more *ex-ante* parametric insurance policies to insure investments in climate-resilient infrastructure and to cover the costs of recovery and rebuilding, as well as for indirect economic losses and damages incurred.

Hai Phong's range of freedom when it comes to changing policies or programmes is strictly limited by central government authorities to redirecting its own local budget items. Measures could include increasing funds to clean out drainage canals or to initiate public awareness-raising campaigns to inform citizens about the public health benefits of maintaining household septic systems for instance, but these choices would all come at the expense of other local programmes and expenditures. Catalysing informal public-

private partnerships with local business leaders is important to consider. City governments like Hai Phong should act as interlocutors or "honest brokers" facilitating the creation of new, innovative associations and relationships with civil society and the private sector.

Stakeholder engagement

The top-down approach taken for most decision-making processes in Viet Nam does not lend itself well to the multi-dimensional and largely unexpected impacts of climate change and natural disasters. Information about "on-the-ground" impacts in real-time is lacking, and this requires open lines of two-way communication from the affected areas to response teams acting on that information. The current governance approach in non-emergency situations consists of "one-way" communication which inhibits innovative and more nuanced responses to issues that are better tailored to local conditions, preferences and needs.

In Hai Phong, the city implemented an action plan between 2013 and 2015 to raise public awareness about DRM through community participation. The action plan was based on a national project, the National Strategy for Prevention and Mitigation of Natural Disasters with the Vision 2020, which aims to mobilise resources to ameliorate disaster response, prevention and mitigation and to minimise loss to human life, property and damage to natural, cultural and environmental assets (City of Hai Phong, 2015). Presently, however, in most cases, the local government and its citizens are simply informed of decisions already made at much higher levels of government, which may not adequately reflect local preferences and needs.

For Hai Phong to be more successful in building better DRM, it will be necessary for a broader spectrum of representatives to participate in a transparent and meaningful stakeholder process. Any such initiative should encourage ordinary citizens and leaders from civil society organizations, and communities to participate more fully in the design, implementation and maintenance of public resilience efforts. There are many advantages that could be gained by adopting a more collaborative approach of actively engaging citizens in making decisions, rather than just having lower levels of government agencies carry out decisions made by others at higher levels of government who are removed from the unique local conditions, perspectives, and preferences. Although Hai Phong officials cannot unilaterally change many of these governance processes, they can encourage the central government to continue to expand its current policies of allowing participation among agencies at the local levels as well as other stakeholders in the community, civil society, and the private sector.

Main policy recommendations

- Develop a Local Resilience Action Plan to identify and spatially map the most exposed and vulnerable people, places, and public assets and critical services, for both the port and the city.
- Take into consideration future downscaled climate change projections into land-use and infrastructure planning at the port, such as the rise of sea levels and storms intensity.
- Check the important port infrastructures and assets for hazardous substances and set up a containment plan.
- Train the emergency response staff, regularly revise the emergency response plan, and set up emergency response systems with real-time monitoring.
- Include plans for adaptive management of infrastructure, such as the use of pervious surfaces (permeable pavements and surface structures), and the planning of land slopes and gradients to ensure drainage or retention in designated zones.
- Develop the concept of functional urban areas and a metropolitan planning framework. It is especially important to address flood risks at the Red River Delta Basin including Hai Phong.
- Create metropolitan planning institute to coordinate across sectors and levels of government.
- Involve citizens and leaders from the private sector, civil society organisations, and local communities to participate more fully in the initial design, prioritisation, implementation, and maintenance of public investments and resilience efforts.
- Develop business continuity plans for port companies to minimise the impact of disasters, and form public-private partnerships with shipping, operating and other port companies.

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Chapter 7. Iskandar, Malaysia

Chapter 7 describes the natural disaster risks facing Iskandar. The chapter begins by examining the threat of natural disasters in Iskandar, and how the city and metropolitan area can build greater resilience to them, systematically and comprehensively through a variety of means.

This chapter is divided into three sections: 1) the natural hazards that pose the greatest risk to Iskandar are identified; 2) the current state of DRM policy in Iskandar is assessed; and 3) governance issues of vertical and horizontal co-ordination are discussed.

This chapter was informed by discussions held during the 2nd Knowledge-Sharing Workshop, 'Spatial development strategies in Iskandar Malaysia: how to plan, manage and maintain local assets under rapid urbanisation', that took place in Johor Bahru, Malaysia (November, 2014).

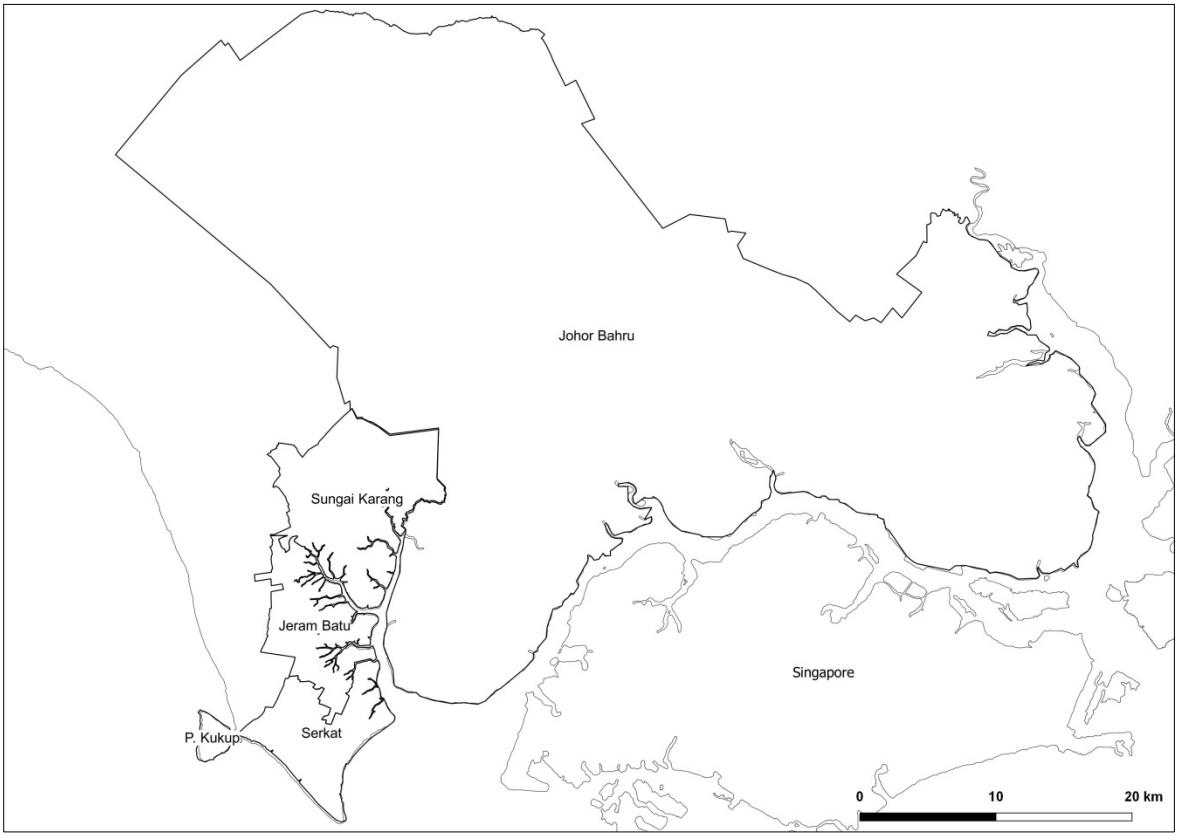
Main Points

- **Iskandar is vulnerable to periods of heavy precipitation and flooding, as well as episodes of trans-boundary air pollution**. Iskandar experienced major flooding from heavy rains caused by Typhoon Utor in 2006-07 which led to almost half a billion dollars (USD 489 million) in damages. Flash flooding is also a recurring challenge.
- The land area covered by natural resources is declining. In particular, the loss of coastal mangrove forests exacerbates Iskandar's natural risk factors. **Coastal mangrove stands declined by 33% between 1989 and 2014 and can be largely attributed to pressure from encroaching urban development and rising pollution.** Coastal habitat loss is leading to increasing erosion which poses a major threat to two of Iskandar's three internationally renowned RAMSAR wetlands, while the third is affected by industrial development.
- **The rapid urbanisation of Iskandar is characterised by spatial development challenges brought about by large investment in the real estate sector, urban sprawl, low-quality urban infrastructure, and degradation of local natural resources**. To address these challenges, investment in high-quality urban infrastructure and the preservation of natural resources in coastal and suburban areas must be ensured.
- **Although hazard identification studies were conducted in Iskandar, no comprehensive vulnerability and risk assessment (VRA) has been undertaken.** The prioritisation of a VRA must be complimented by investment in critical urban infrastructure to achieve multi-dimensional "co-benefits". Initiatives like the Segget River restoration project enhance attractiveness, quality of life and DRM.
- **Strengthening the role of the Iskandar Regional Development Authority (IRDA) and establishing a dedicated local government agency for DRM within it would lead to greater vertical policy alignment than at present.** Such an agency could also work to ensure the implementation of DRM policies which would produce better outcomes.
- Singapore is Malaysia's main economic partner and total bilateral trade and direct investment between them reached USD 1.7 billion in 2014. In consideration of the range of shared environmental challenges, **Singapore and Iskandar should improve existing cooperation and propose joint solutions to enhance DRM, especially regarding port activities.**
- The Sensitive Environment Framework prepared by IRDA was created to address the need to raise public awareness. **The framework should be translated into actions on the ground** given its comprehensive approach of involving NGOs by targeting different institutions and stakeholder groups.

Natural disaster risks

Iskandar is located on the southern tip of the Malay Peninsula along the Strait of Johor and in close proximity to the South China Sea and the Straits of Malacca. It incorporates the Johor Bahru administrative district and the sub-districts (Mukim) of Jeram Batu, Serkat, Sungai Karang and Kukup Island (located in Ayer Masin) within the Pontian administrative district (Figure 7.1). Roughly three times the size of Singapore, Iskandar covers an area of 2 217 km² with 64 kilometres of coastline.

Figure 7.1. Map of Iskandar



Source: Iskandar Regional Development Authority (2015a), "Answers to the OECD case study questionnaire", internal document, unpublished.

As the fastest growing urban region in Malaysia, Iskandar is also one of the most economically dynamic regions too. In the context of fast economic growth driven by significant investment in the manufacturing and real estate sectors, urban sprawl is rapidly expanding into green field areas, while its population is forecast to increase from 2.0 million in 2015 to 3.1 million by 2025 (IRDA, 2015b). While this presents further economic growth opportunities, the magnitude and speed of change also creates significant challenges vis-a-vis the city's DRM. None more so than Iskandar's expanding built environment which in some cases has damaged precious natural resources that act as a buffer to natural hazards.

Iskandar is vulnerable to periods of heavy precipitation and flooding, as well as episodes of trans-boundary air pollution. Over the new-year period in 2006-2007, Iskandar

experienced major flooding from heavy rains caused by Typhoon Utor, which also struck the Philippines and Viet Nam shortly beforehand. These floods led to almost half a billion dollars (USD 489 million) in damages (Chan, 2012). Flash flooding is also a recurring challenge and inundated Iskandar's downtown in Johor Bahru most recently at the end of 2015 (Straits Times, 2015). It is worth noting that unlike other cities in this study, Iskandar's proximity to the equator actually mitigates the risk of typhoons. Furthermore, Peninsular Malaysia and the broader Southeast Asian region experienced significant transnational air pollution in 1999, 2005, 2006, 2009, 2013 and 2015 (Tajudin, *et al*., 2015). Trans-boundary haze in Iskandar has been linked to large forest and peatland fires in neighbouring Borneo and Sumatra (Indonesia) which exacerbate already poor air quality levels (Gaveau, *et al.*, 2014).

Iskandar is endowed with valuable environmental resources and services, such as large agricultural tracts, wetlands and forested land. Many of these assets are located in coastal areas, which account for 19.6% (434.28 km^2) of Iskandar's land (according to the demarcation established in the Comprehensive Development Plan). These include wetlands and rivers, and adjoining ecosystems rich in flora and fauna. For instance, Iskandar is home to the protected Dugong species, which reside near the mudflats off the Sungai Pulai River Estuary and are supported by an abundance of sea grass (Khazanah Nasional, 2006). Iskandar is also home to three of Malaysia's six RAMSAR wetland sites: the Sungai Pulai, Pulau Kukup and Tanjung Piai. Forest reserves and mangroves are very important natural assets as well, which can be found all along the coastline, and cover 8% of Iskandar's territory (18 369 ha). Their rich biodiversity provides a range of valuable co-benefits to local communities, local businesses and the economic health of Johor state. Most importantly they protect the coastline from erosion, flooding and salt water intrusion. They also support offshore fisheries; filtrate impurities from water supporting aquaculture; harbour rare and endemic species, such as transitory migratory birds; and support freshwater fishing industries. Indeed, it is estimated that 35% of the value of commercial fisheries in Johor state is dependent on maintaining healthy mangroves (Khazanah Nasional, 2014).

The land area covered by these crucial natural resources which contribute to Iskandar's flood resilience is in decline. For the most part, their destruction can be attributed to pressure from encroaching rapid urban development and rising pollution. As a result, there remains an air of uncertainty over their long-term preservation, especially in regard to the mangroves. For example, natural areas, such as forest reserve and mangroves, declined by 10% between 2005 (20 376 hectares) and 2015 (18 369 hectares) (Khazanah Nasional, 2006; IRDA, 2015b). Moreover, between 1989 and 2014, stands of coastal mangroves have declined by 33% (Kanniah, *et al*., 2015), which is a major source of concern among local authorities and populations. The loss of coastal habitat has led to increasing erosion in Iskandar, further accentuated by ship wakes emanating from maritime traffic in the Malacca Strait (Khazanah Nasional, 2014). The loss of coastal territory through erosion poses a major threat to two of Iskandar's three internationally renowned Ramsar wetlands (Tanjung Piai and Pulau Kukup). Their shorelines have retreated by more than 300 metres in the last three decades (IRDA, 2011a).

The Pulai River Estuary, which forms the basis of the Sungai Pulai Ramsar wetland, is the largest intact riverine mangrove forest in Peninsular Malaysia and covers an area of 9 126 hectares. However, in 2009, 913 hectares were de-gazetted and lost to a petrochemical hub, while a further 242 hectares of these mangroves are clear felled annually on a rolling 20-year basis. More than 80% of the Suingai Pulai site is less than 20 years old and shows signs of lower recovery rates (Khazanah Nasional, 2014). Sungai Pulai wetland is further

jeopardised by Iskandar's expansive physical growth and projects such as the Port of Tanjung Pelepas, which has narrowed the river mouth by 50%, bearing important hydrological implications (Khazanah Nasional, 2014;IRDA, 2015a).

Changes in water quality endanger the seagrass meadows that support large tracts of riverine mangroves and endangered species such as the seahorse, pipefish, dugong and sea turtle. Commercially important fish, crabs, prawns, and invertebrates such as sea stars, sea cucumbers, anemone, etc., that thrive in the seagrass beds are affected as well (Hangzo, *et al*., 2014). Another source of concern is the numerous land reclamation projects which narrow the Straits of Johor and may affect ship routes. Preserving natural coastal (and suburban) natural resources has therefore become critical to ensure long-term green growth in Iskandar.

Urbanisation has also created some social challenges in these natural areas. A study reported that the fishermen who have lived in Danga Bay for more than 30 years state that the water has become dramatically polluted as a result of land reclamation along the banks, such as the construction of apartment complexes. This has resulted in a decline in aquatic fauna which the fishermen have relied on for their livelihoods over many generations (Nasongkhla, *et al*., 2013).

Assessment of DRM policies

The rapid urbanisation of Iskandar is characterised by spatial development challenges, such as large investment in the real estate sector, urban sprawl, low-quality urban infrastructure, and degradation of local natural resources. These spatial issues already contribute to a range of socio-economic and environmental problems, which will undermine the metropolitan area's DRM and compromise long-term urban green growth if nothing is done. To address these spatial development challenges, investment in high-quality urban infrastructure and the preservation of natural resources in coastal and suburban areas must be ensured. Managing the rapid urbanisation of Iskandar through more effective land use planning stands out as the tool by which to anchor other urban policies and is one of the metropolitan area's most important objectives as it strives to enhance its DRM.

Vulnerability and risk assessment

While Iskandar's guiding vision to develop a "strong and sustainable metropolis of international standing" has influenced numerous cross-cutting measures, the study has found that the current policy frameworks have paid little attention to DRM.

No comprehensive vulnerability and risk assessment has been undertaken in Iskandar. Although some hazard identification studies have been completed, the assessment process has not been comprehensive and does not link hazards to at-risk and vulnerable populations. For instance, Iskandar has identified drainage and stormwater management as major hazards with the potential to negatively affect the economic performance of Iskandar. The *Drainage and Stormwater Management Plan: Blueprint for Iskandar Malaysia* aims to: support and improve existing public policy related to drainage and stormwater management to an international standard; and develop a master plan to mitigate floods in Iskandar. However, this sectoral assessment considers neither other hazards, nor those populations potentially at risk. Although the Johor Port Authority's Green Port Policy Strategy 2015-2020 for Tanjung Pelepas includes air, water quality, eco-system and waste management standards, it does not appear to focus on resilience at all.

It is an urgent task for Iskandar to carry out a complete vulnerability and risk assessment, identifying all the different hazards threatening Iskandar, as well as the zones at risk and the vulnerable populations, in order to increase Iskandar's preparedness for and awareness of natural disasters.

Land-use policies

The continued loss of natural environments and coastal mangroves in Iskandar is a critical issue because it erodes the city's natural defences against flooding. This remains a persistent challenge, as it is in many other fast-growing cities in Southeast Asia. Urban areas in Iskandar Malaysia increased by 53.5% between 2000 and 2010 (an annual growth rate of 6.7%), from around 271 km^2 to 416 km^2.[1] Iskandar's natural and agricultural land is disappearing quickly, while urban land characterised by low-density development patterns is expanding rapidly (OECD, 2016). Low density development is the determining factor behind the urban region's poor transportation links because urban sprawl makes it harder to provide public transport access to a larger share of the population. Much of this new development is taking place in the north-eastern suburbs along highways, resulting in high levels of traffic congestion, lost productive time for commuters and elevated pollutions levels.

Iskandar's *Shoreline Management Blueprint* is a detailed document intended to guide policies for coastal management, containing six objectives: *i)* to conserve, protect and enhance the natural beauty of the coastline; *ii)* to maintain and improve, where necessary, the environmental health of in-shore waters affecting the coast; *iii)* to facilitate and enhance the enjoyment of these areas by citizens; *iv)* to identify areas at risk from coastal erosion, marine pollution and other negative environmental impacts; *v)* to take account of the social, economic and cultural needs of the numerous communities that live along Iskandar's coast; and *vi)* to take account of the need of agriculture, fishery and forestry activities (IRDA, 2014e). Another important issue noted by this Blueprint is the preservation of Tanjung Piai National Park, a rich wetland and mangrove forest.

Several other strategies have sought to address the issue of coastal management in Iskandar. Within the Resource Optimisation and Low Carbon chapter, the Comprehensive Development Plan 2014-2025 (CDP-ii) noted the importance and necessity to protect and enhance natural areas by rehabilitating degraded Environmentally Sensitive Areas, especially mangrove forests and seagrass beds. They recommended achieving this by gazetting parks and public open spaces, improving river water quality and protecting marine life ecosystems along the Straits of Johor. One of the "Five Big Moves" of the CDP 2014-2025 is devoted to implementing these strategies. Coastal protection zones and biodiversity buffer zones (including RAMSAR sites) are included in the Spatial Management Plan of the CDP-ii. The CDP-ii also recommended the creation of an Environment Trust Fund, which is currently being developed by the Environment Department of the Iskandar Regional Development Authority (IRDA).

The Low Carbon Society Blueprint also recommended strengthening law enforcement of illegal mangrove clearing, to set up mangrove species audit measures and regeneration programmes in mangrove areas (UTM Low Carbon Asia Research Centre, 2013). *The Strategic Framework for Sensitive Environments in Iskandar Malaysia* – although it is without the status of a guideline and has no legal value – promotes the creation of a range of tools to more efficiently monitor sensitive environments of coastal zones in Iskandar (e.g. GIS maps, survey, research programme), involve civil society (environmental NGOs) in the planning and management of coastal areas and resources, and create a trust fund from

local and international donations to support forest restoration and landscape protection programmes.

The proposed polycentric development of Iskandar could also be a model for spatial development in other fast-growing Asian cities. The CDP-ii's compact urban development strategy promotes higher density, non-motorised transport modes and the renewal of the Johor Bahru urban centre (brown-field development) to guide sustainable land use. Similarly, the Blueprint envisions compact development that could feasibly support integrated public transportation between key nodes located in the five flagship zones. However, the CDP-ii also states that such a development strategy should be incorporated into the planning process to ensure its implementation. The Johor state government and the five local authorities have the urgent task of ensuring their vision and strategies are incorporated into legally binding plans that control future development patterns based on the Malaysian Town Planning Act. At present, local land-use and development plans in Iskandar do not describe effectively how they would accommodate the region's increasing population as forecasted in the two CDPs and Blueprints. For example, local authorities could provide clearer planning guidance and the necessary instruments in local plans for this purpose.

Private companies are increasingly involved in the protection of coastal lands in Iskandar. For instance, some have developed mangrove preservation projects and public awareness-raising programmes about the importance to preserve these environmental resources and supported mangrove regeneration projects involving students and schools to plant mangrove trees.

Urban infrastructure

Iskandar's policies for preventing floods lack co-ordination with policies to improve river water quality. Iskandar's rivers are considered to be among the most polluted in Malaysia because Iskandar's wastewater treatment system has not been able to keep pace with the rapid population growth. As of 2005, there were 797 treatment plants across Iskandar (KN, 2006), although most of them were small and old. Johor state's 363 km-long sewer network pales in significance when compared to Selangor's 1 698 km network, Penang's 1 412 km network, or Kuala Lumpur's 2 034 km network. As a result, several areas lack adequate services. For example, in Johor Bahru, while the population equivalent demand for wastewater treatment was equal to 577 413 people, the treatment capacity was only adequate for 175 720 people (Khazanah Nasional, 2006). Consequently, untreated domestic wastewater is discharged into the drainage system, and then into rivers and lakes.

Solid waste disposed from squatters and informal settlements located along riverbanks are also a serious problem. Johor state authorities report that 11 tonnes of rubbish are retrieved from local rivers each month (Gasper, 2010). This is exacerbated by contaminants found on the streets, alleys, parking lots – on any surface that washes off with the rainwater – especially the first rains of the monsoon which often deliver a "toxic shock" to rivers and streams, resulting in massive damages to the area's ecosystems.

The Segget River restoration project is a symbolic initiative that forms part of wider flood mitigation measures. The project seeks to ensure that core urban areas are not affected by 100-year flood levels, to clean up the once heavily polluted river, to improve floodwater management and to enhance attractiveness of Johor Bahru's urban centre and quality of life (ADB, 2016). In the 1990s, the Segget River, formerly a conduit for trade in Johor, was heavily polluted due to poor wastewater management and had been paved over by a 1.5km-long road. However, a project to remove the road, clean the river and provide waterfront

recreation space for local citizens is already underway, supported by the federal government as an Entry Point Project. Continuing such pilot projects will help to build citizens' support for such green investments. The continuation of these pilot projects will help to build citizens' support for investment in critical urban infrastructure and is applicable in other cities in Southeast Asia.

Another major infrastructure project aiming to achieve "co-benefits" is the proposed USD 14 billion High Speed Rail (HSR) corridor between Kuala Lumpur and Singapore via Iskandar. Future investment in large scale projects, such as the Kuala Lumpur-Singapore High Speed Rail link, presents an opportunity to take the lead by incorporating long-term DRM planning into new infrastructure projects. The 350 km link will cut travel times between the two cities from 3-4 hour connections by plane to less than 90 minutes (MoTS, 2015). Transporting 66 000 passengers daily (or 24 million annually based on modelling from Malaysia's Land Public Transport Commission), the rail connection has the potential to largely increase transport capacity between Iskandar and Singapore, while diminishing travel times for commuters. Although the project has been put on hold, such infrastructure would benefit Malaysia and Iskandar in the long-term both environmentally and economically.

Assessment of DRM governance structure

Horizontal and vertical co-ordination

In Iskandar, there is no dedicated local government agency co-ordinating DRM, which would be required to support such a pathway. Instead, Malaysia's National Security Council co-ordinates DRM efforts through the National Disaster Management and Relief Committee which is also present at regional and district levels of government (CFEDMHA, 2016). However, co-ordination mechanisms between national and local government appear weak with no reference to how Iskandar's five local municipal governments could contribute to DRM efforts. The National Disaster Management Agency (NADMA) was established in 2015 under the Prime Minister's Department, taking over the responsibility for disaster management from the National Security Council. While NADMA functions as a focal point for Malaysia's disaster management, co-ordination mechanisms between national, state and local governments remain unclear with no reference to how Iskandar Malaysia's five local municipal governments could contribute to DRM efforts.

Aligning policies across the different levels of government, not only between the IRDA and local authorities, but also with state and federal governments, is a necessary condition to develop DRM in Iskandar. IRDA is only a planning agency with little legal authority and lacks the financial and human resources to carry out a potential role as a co-ordinating entity. In parallel, local authorities also lack the technical, financial and human resources capacities. Therefore, the leadership and financial support of state and federal government levels is needed to implement all of the decisions, activities and investments associated with a green growth strategy.

Malaysia's federal government already exerts a strong influence over regional strategies. The CDP-ii, in particular, integrates the strategies of the National Physical Plan and the Johor State Development Plan. The National Physical Plan is itself co-ordinated with the economic and social strategies of the federal government (e.g. Ninth, Tenth and Eleventh Malaysia Plans). The federal government has also elaborated complementary plans and strategies that relate to green growth, although it has not directly adopted the concept of green growth. The National Green Technology Policy (NGTP), started in 2009, marked a

turning point in the country's sustainable growth and development strategies. One of its many initiatives was to showcase Putrajaya and Cyberjaya as pioneer green cities. In line with the NGTP, the Low Carbon Cities Framework (LCCF) was initiated to provide a framework to achieve sustainable development that would subsequently reduce carbon emissions (UTM and Asia Low-Carbon Centre, 2012). The document can be used by all stakeholders, in settlements of any size, whether new or existing cities, townships or neighbourhoods, to measure the impact of their development decisions in terms of carbon emissions reductions (KeTTHA, 2011).

The actual translation of these strategies from the national level to the local level has sometimes been difficult according to IRDA. While the 11th Malaysia Plan places significant emphasis on green growth, there is still a lack of clarity about how it will cascade down to regional and local plans. The document does not explain how green growth strategies can be implemented at the local level; it is instead envisioned only as a national challenge and lacks any analysis or proposed role for the local dimension of adopting a green growth pathway. Furthermore, there is a lack of focus on the myriad dimensions of DRM. In this context, it is difficult for regional and local authorities to understand clearly how to integrate national green growth strategies into their plans and strategies, or how to enhance local DRM.

In some cases, national policy frameworks are not comprehensive enough to foster green growth initiatives at the local level. The LCCF sets broad goals without providing detailed plans for each of the green growth sectors. For example, Malaysia lacks a clear national transport policy framework. Even though low carbon mobility and public transportation are acknowledged as important objectives in several national policy guidelines, there is no specific and detailed implementation plan for it taking root at the local level. In addition, the lack of clear national stimulus or financial support is an obstacle to green growth at the local level. IRDA has experienced difficulties securing financing for several important infrastructure projects, such as the development of its public transportation networks. From this perspective, the federal government should strengthen national green growth policy frameworks by detailing the role of cities and local governments in their implementation, which would help align policies and secure financing at the local level.

An interesting lever to ensure the translation of national strategies into local projects already exists in Malaysia: the Entry Point Projects (EPP), which allow regional and local authorities to submit development projects in some key policy sectors, with the possibility to receive funding from the national government. However, this initiative does not cover critical sectors such as transport. The national government should expand the areas covered by the EPP and ensure DRM sectors are included, using the 11th Malaysia Plan as a reference. Since local authorities often lack the technical and human capacities to implement policies contained in the CDPs, the federal government could assist regional and local authorities with technical aspects. Technical assistance programmes could be set up to help the five local authorities achieve the visions of the national strategies which should be translated concretely in the CDP-ii.

Strengthening the role of Iskandar Regional Development Authority

The study recognises a unique role that the Iskandar Regional Development Authority (IRDA) has been playing in economic development at the metropolitan scale, and potential expansion of its role in pursuing green growth and improving DRM.

The IRDA was established as a statutory body under the IRDA Act of 2007 (Act 664) and was appointed as the development authority for the Iskandar Malaysia Economic Region.

It was created at the same time as the Northern Corridor Implementation Authority and the East Coast Economic Regional Development Council. These economic regions were part of the Ninth Malaysia Plan (9th MP) to tackle development imbalances throughout the country (MLIT, 2015). While economic considerations stand at the core of its mission, DRM and floodwater management are two particularly important areas of policy focus. IRDA's main functions are to:

- Establish national policy directions and strategies that have a direct impact on the development with Iskandar;
- Co-ordinate the performance of development activities carried out by government departments and agencies in Iskandar;
- Plan, promote, and facilitate to stimulate and undertake the development in Iskandar; and
- Act as the principal co-ordinating agent on behalf of government agencies in relation to receiving, processing and expediting the required approvals (Government of Malaysia, 2012).

IRDA represents a joint and co-ordinated approach between state, federal and local governments, and it is co-chaired by the Prime Minister and the Chief Minister of Johor. IRDA's mandate includes implementing the vision and objectives of Iskandar in its efforts to become a metropolis of international standing. An important contribution of IRDA has been in assisting Khazanah Nasional (Malaysia's Sovereign Wealth Fund) in the development of the Comprehensive Development Plans (CDPs) for Iskandar that translates national and state spatial developments plans (National Physical Plan and State Structure Plan). IRDA has developed a great number of initiatives – 649 in total – recommended in the 24 blueprints. For instance, the Low Carbon Society Blueprint alone contains 12 actions and 281 programmes, and IRDA's Transportation Blueprint 2010-2030 proposes 84 strategies.

However, IRDA's impact on the development of Iskandar may not be as high as envisioned by the IRDA Act of 2006 because implementation at the local level is a critical obstacle. In part, this is because local authorities are relatively autonomous in the way they choose to implement national, state or regional development strategies, based on local finance and capacities. Another factor complicating efforts to implement plans and blueprints harmoniously in Iskandar is the fragmented and uncoordinated actions of the five local governments. This is an important obstacle to address, but it is also the justification for the existence of IRDA, whose purpose represented an experiment and attempt to co-ordinate spatial and economic development and growth in the region.

In the context of rapid urbanisation and economic growth with their associated externalities, IRDA's role should be strengthened, in particular in relation to supporting the five local governments, in order to pursue a green and resilient pathway. Specifically, IRDA's mandate could include stronger green and resilient aspects in alignment with the current national strategies of the 11th Malaysia Plan.

Disaster risk financing

Fiscal decentralisation is not advanced in Malaysia. The proportion of total tax revenue collected by local governments is very low at around 3.3% in 2013, while on average in OECD federal countries the share is around 7.6%. State governments in Malaysia do not collect any revenue, while on average in OECD federal countries they collected around

16.5% of total tax revenue in 2013. The Malaysian central government collects 95.2% of total revenue, leaving little responsibility to subnational levels of government.

In order to boost subnational financial resources and increase subnational capacity to undertake more DRM investment, the national government should consider structural reforms of the financial system. In 2013, total tax revenues only represented 16.9% of Malaysia's GDP, while this share is around 34% on average in OECD countries. The share has been decreasing slowly over time: in 1991, it was around 21% (OECD, 2015c). Indeed, Malaysia has a narrow tax base: only 1.8 million individual taxpayers paid tax in 2013, while 6.4 million were registered. Likewise, of the 508 150 companies registered that are supposed to pay tax, only 107 043 did so in 2013 (OECD, 2013). In addition, social security contributions are almost absent of tax structures, in particular, while taxes on income and profits account for 68.6% of total tax revenue in 2013. On average, social security contributions, taxes on income and profits and general consumption taxes accounted for respectively 26.2%, 33.6% and 20.2% in the 34 OECD countries in 2012. Strengthening social security contribution systems could not only help to balance finance but also to address poverty issues in the country. Continuing current efforts to increase the capacity and efficiency of the fiscal administration is also a key issue (OECD, 2015c).

Cross-border co-operation with Singapore

Iskandar is located in a highly strategic geographic context next to Singapore. This proximity creates significant cross-border dynamics, resulting in major socio-economic and environmental opportunities and challenges. Indeed, Singapore is Malaysia's main economic partner and total bilateral trade and direct investment between Singapore and Malaysia has been increasing fast, reaching around USD 1.6 (2013) and USD 1.7 billion (2014) (IRDA, 2015a). Singapore's investment in Iskandar accounted for 16% of FDI in Malaysia in 2013. One of the most important cross-border dynamics between Iskandar and Singapore are the gas and water pipelines that cross the Johor Strait to supply Singapore, not to mention the number of daily border crossing trips which stood at 245 000 in 2007 and are expected to increase by nearly 60% (reaching 386 000 daily trips) by 2025 (IRDA, 2011b). While these cross-border dynamics provide economic opportunities, they generate environmental challenges, especially in relation to natural resources, such as water, because the environmental impact of development in Iskandar extends much further than its physical territory. Activities in Johor's ports put tremendous stress on local marine biodiversity and fauna and flora of the Johor Straits on both sides of the border. The Straits' mangrove forests are affected by erosion emanating from development pressure and ship wakes. In addition, due to rapid urban development and growing industrial activities, the air surrounding Iskandar and the Straits is poor, while most of the rivers in Iskandar are polluted.

In consideration of the range of shared environmental challenges, Singapore and Iskandar should improve existing cooperation and propose joint solutions to enhance DRM in the larger cross-border metropolitan region. One promising policy example is the plan to extend Singapore's Mass Rapid Transit (MRT) system into Tanjung Puteri in Johor Bahru and upgrading cross border taxi and bus services. The High Speed Rail linking Iskandar and Kuala Lumpur would also extend to Singapore, and should bring more fluidity to commuting flows (DBS Asian Insights, 2013). There are other existing forms of co-operation specifically focusing on environmental issues. Since 2013, the environment ministers of both countries have collaborated to improve the overall water quality of the Straits of Johor and prevent chemical and oil spills. In the area of biodiversity conservation, they agreed to continue exchanging data on the status of the ecology and morphology in

and around the Straits of Johor (Hangzo, *et al*., 2014). However, there is room for improvement to extend such collaboration to enhance urban resilience.

A concrete area where such complementarity could yield high benefits is in port activities. The ports of Johor and Singapore taken together represent the busiest port in the world. Such co-operation could include training and knowledge sharing about how to green port activities (e.g. green bunkering programmes, on-shore power supply, etc.). Bilateral co-operation should also place strong emphasis on DRM in the ports. Existing environmental co-operation programmes in or around the Johor Straits have been mostly reactive measures designed to be deployed after a crisis has occurred (Hangzo, *et al*., 2014). More extensive and proactive measures are needed for better DRM.

IRDA should form a strategic local partnership with Singaporean authorities to address their locally-specific concerns and challenges because at present, such a partnership only occurs between the government of Malaysia and its Singaporean counterpart (e.g., the HSR). This prevents the development of horizontal governance networks with IRDA and other subnational stakeholders. Government authorities in Singapore and Iskandar should therefore work together to resolve the environmental issues facing the region and extend activities to include DRM to enhance preparation, response and prevention planning.

Stakeholder engagement

Local communities and citizens could play a larger role in the policymaking and implementation processes such as awareness-raising campaigns to foster and support DRM initiatives. The Low Carbon Society Blueprint (LCSB), which discusses the need for more public awareness-raising efforts through public outreach measures, such as: enhancing school children awareness-building programmes, displaying green education catalogues in shopping centres, hosting periodic low carbon society workshops to involve a diverse set of stakeholders, diffusing low carbon policies and progress updates through mass media outlets (UTM-Asia Low Carbon Centre, 2012).

The Sensitive Environment Framework prepared by IRDA was created to address the need to raise public awareness. This document recommends involving the Green Earth Society, the Malaysia Nature Society, KIKO Iskandar, and other NGOs and NPOs to reach out to a wider audience in promoting and disseminating information on IRDA's Green Growth Agenda. It also proposed using the Iskandar Malaysia Regional Centre of Expertise on Education for Sustainable Development (RCE Iskandar Malaysia), which is led by the Universiti Teknologi Malaysia (UTM). The RCE would engage diverse stakeholders, such as schools, universities, NGOs, media, museums, botanical gardens, state bodies, local businesses, civil society groups, local communities and individuals working in education or in other spheres of sustainable development (i.e., economic growth, social development and environmental protection) with the objective of educating the public on sustainable development matters. The Sensitive Environment Framework also promotes the production of public awareness literature, such as Iskandar's 'Low Carbon Lifestyles' brochure and the Low Carbon Society Blueprint for Iskandar Malaysia Booklet 'Actions for a Low Carbon Future.'

The Sensitive Environment Framework should be translated into actions on-the-ground by targeting many different institutions/stakeholder groups. The RCE would be particularly useful in collecting data and creating analytical reports on the environment and green growth, but more efforts should be made to improve communications and diffuse information to a wider audience. For instance, the RCE could develop a strategy to involve

the media more significantly as an active and important stakeholder group given their high capacity to reach out to many citizens.

Main policy recommendations

- Complete a comprehensive assessment of Iskandar's natural areas and assets, including an analysis of the impacts of urbanisation and development in recent years and of the decline of these assets and the measures to prevent the latter; land use strategies to protect natural resources should be integrated into the local planning system.
- Carry out a complete vulnerability and risk assessment, identifying all the different hazards threatening Iskandar, as well as the zones at risk and the vulnerable populations, in order to increase Iskandar's preparedness for and awareness of natural disasters.
- Incorporate DRM into the local land use planning system, as well as the proposed polycentric development of Iskandar aiming to increase density, renewing Johor's city center and promoting non-motorised transport, into the local planning process to ensure its implementation, as stated in the CDP-ii.
- Promote investment in critical urban infrastructure that prioritises multi-dimensional outcomes and integrates and synergises varied sectoral goals, such as waste water and solid waste treatment, in order to respond to population growth.
- Reinforce national green growth policy frameworks by detailing the implementation role of cities and local governments as well as establishing dedicated local government DRM agencies.
- Strengthen the role of the Iskandar Regional Development Authority, in particular in relation to supporting the five local governments, in order to pursue a green and resilient pathway that enhances DRM.
- Set up technical assistance programmes and capacity building exercises with the five local government authorities in order for them to achieve the national and regional visions contained in the CDPs under the same banner.
- Improve existing cooperation with Singapore to propose joint solutions to enhance DRM in the larger cross-border metropolitan region.
- Enhance engagement with local communities and citizens on policy making by translating the Sensitive Environment Framework into on-the-ground action and through entry point projects like the Segget River restoration.

Notes

[1]The figures presented in this sentence do not include urban areas in the Pontian District, which is partly included in the official territory of Iskandar Malaysia.

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