78607

World Bank LAC
opportunities for all

Resilient Coastal Cities
The Economic, Social and Environmental Dimensions of Risk

June 2013

Caribbean Knowledge Series

Authors: This material has been prepared by Javier Sanchez-Reaza, Senior Urban Specialist (LCSDU), Sustainable Development Department, The World Bank, and André Carletto, Consultant (LCSDU), Distaster Risk Management, Sustainable Development Department, The World Bank.

The Caribbean Knowledge Series is an occasional series that presents World Bank knowledge in an accessible format. It is meant to assist knowledge sharing across the region and trigger policy dialogue on topics relevant for the Caribbean

This note was prepared to support the participatory policy dialogue in the context of the Caribbean Growth Forum (CGF). The CGF is an initiative facilitated by the Compete Caribbean Program, the Inter-American Development Bank, the World Bank and the Caribbean Development Bank, with the support of the Canadian International Development Agency, the United Kingdom's Agency for International Development, CARICOM Secretariat, the University of the West Indies, the European Union and Caribbean Export. It aims to facilitate a multi-stakeholder dialogue to identify practical solutions for the growth challenge in the Caribbean. To learn more about the CGF methodology and progress in each Caribbean country visit: http://caribgrowth.competecaribbean.org/

Visit the entire "Caribbean Knowledge Series" collection at: http://worldbank.org/lac

Design & Concept by Room Grupo Creativo | www.room.com.do
Cover Photo: iStockPhotos

Caribbean Knowledge Series

Resilient Coastal Cities
The Economic, Social and Environmental Dimensions of Risk

Coastal cities are at risk

Urbanization and exposure to risk

Natural geographic advantages have historically attracted human settlements to rivers and coasts. Almost one-quarter of the world's population lives within 100 km distance of the coast and less than 100 m above sea level (Small and Nicholls, 2003). The Intergovernmental Panel on Climate Change (IPCC) argues that 60% of the world's largest metro-regions (with over 5 million people) are located within 100 km of the coast, including 12 of the world's 16 cities with populations greater than 10 million. The attraction to the coast is so strong that people are willing to give up living space to be near the coast. As a result, population densities in coastal regions are about three times higher than the global average.

However, these cities are particularly at risk of natural hazards. It has been argued that around 360 million urban residents live in coastal areas that are particularly exposed as they lie in grounds lower than 10 meters above the sea level (Satterthwaite and Moser 2008). This number is growing rapidly. Lall and Deichmann (2009) have estimated that given demographic dynamics, population exposed to cyclones will more than double by 2050 to nearly 700 million people.[1]

Such an increase in exposure to risk can partly be explained by rapid urbanization of coastal cities that accelerated dramatically during the 20th century and can arguably be associated to:

I- **Saltwater intrusion into surface and ground waters has been exacerbated** due to both the enlargement of natural coastal inlets and the dredging of waterways for navigation, port facilities, and pipelines

II- **Increasing shoreline retreat and risk of flooding** of coastal cities due to degraded coastal ecosystems by human activity, as has been documented in the cases of Thailand (Durongdej, 2001; Saito, 2001), India (Mohanti, 2000), Vietnam (Thanh et al., 2004) and the United States (Scavia et al., 2002).

Factoring in climate change

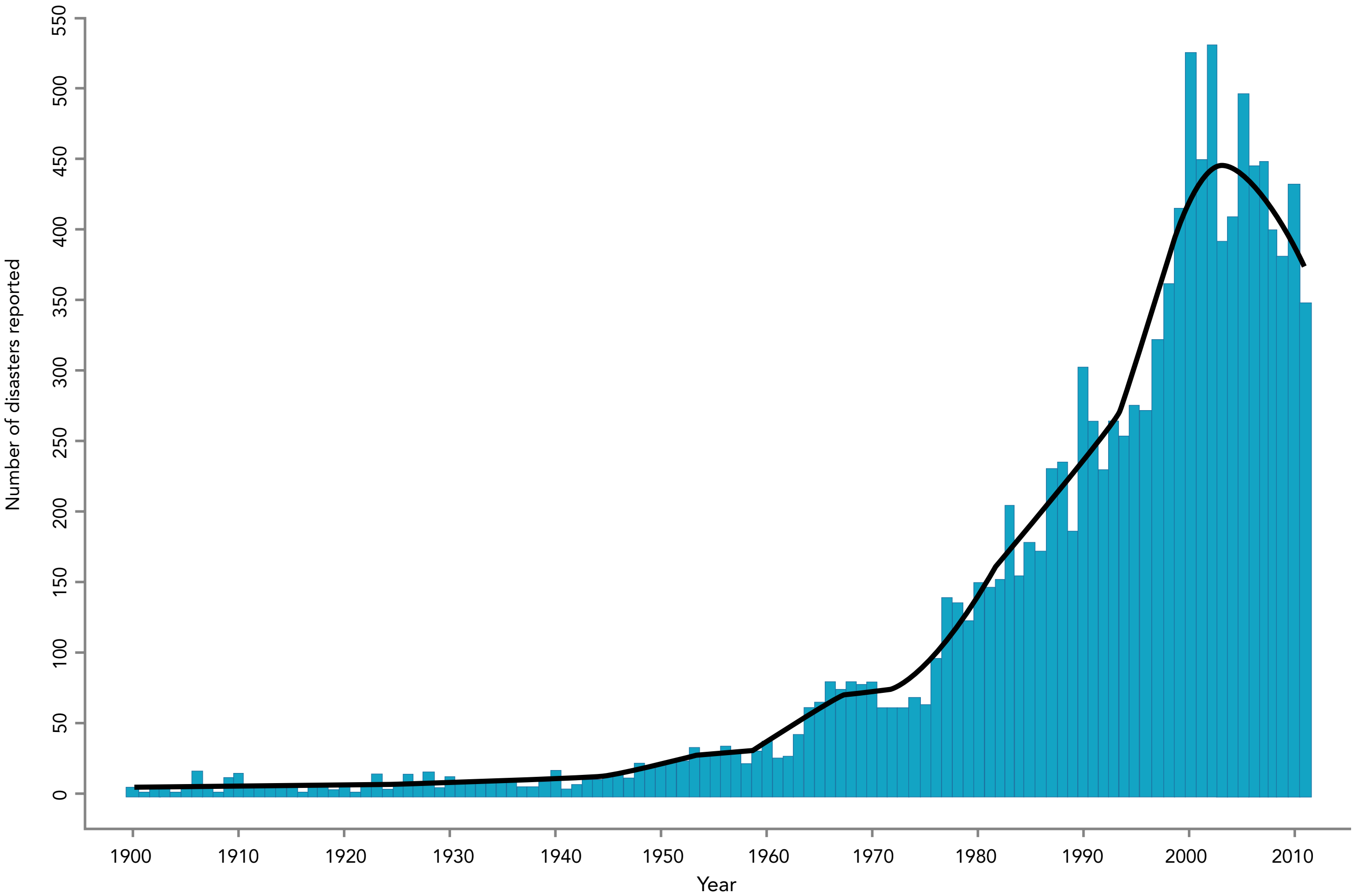
Coastal cities need to quickly prepare for climate change consequences, which further increase their vulnerability to extreme weather events. Over the next 100 years, sea levels will rise up to 59 centimeters (IPCC, 2007). Peak sea levels, which are most relevant for coastal planning –as they characterize storm surges– may be rising even faster. These estimates are relevant because sea level rise will result in significant land erosion. For example, a low-IPCC scenario such as a 1 ft (30 cms) sea level rise in the US would erode up to 30 meters of shoreline in New Jersey and up to 120 meters in California (OECD, 2008; Ruth and Rong, 2006). With such sea level increases and land erosion, flood protection systems could be under strain. The case of New Orleans is an important early warning of what would be needed to protect population and assets at risk in coastal areas. In Europe, 70% of the largest cities have areas that are particularly vulnerable to rising sea levels. Moreover, most of these cities can be found in areas that are less than 10 meters above the sea level. Based on average annual increases in population living in vulnerable areas estimated by McGranahan et al (2007), China alone would now have more than 93 million people living in low-elevation areas. As this number rises according to such annual projections, it could reach

[1] Lall and Deichmann (2009) also warn of an increase in population at risk of an earthquake: from 370 million in 2000 to 870 in 2050.

280 million by 2050. That is larger than the entire US population in 2000 or around seven times the entire Caribbean region. The number of natural disasters that have been reported worldwide has increased dramatically from only a few dozen at the beginning of the 20th century to hundreds of them, particularly after the 1980s (Figure 1). Coastal cities are now increasing vulnerable to sea-level rise and have already experienced more severe and frequent wind storms.

There are definite costs for the environment when extreme weather events take place, but economic and social consequences of such events are particularly important in cities. Many coastal cities in the developing world are at risk due to climate change, extreme weather events and the lack of proper planning. In particular, planning can help increase resiliency to such events by adapting their responses on the basis of experience in disaster risk reduction.

Figure 1: Natural Disasters Reported 1900-2011



EM-DAT: The OFDA/CRED International Disaster Database -www.emdat.be- Université Catholique de Louvain, Brussels - Belgium

Economic impact of disasters

Throughout the last century, mankind has been effective at developing the tools to limit the number of casualties as a result of natural disasters, but has been less successful at curving their economic impact. In addition to human losses and asset damages that result in loss of output, natural hazards also have an indirect economic impact by disturbing the productive system: assets, infrastructure and linkages that firms need to 350 billion compared to the few dozen billion US dollars in the 1970s. In fact, every few years since the Kobe earthquake in 1995, a single catastrophic event will take place that will multiply the amount of economic damages. Yet, all these estimations fall short of the actual impact due to the indirect consequences of these events.

From an economic standpoint floods are one of the most costly and damaging disasters, and will pose a critical problem to policy makers as they increase in frequency and severity. The frequency and severity of flooding has generally increased in the last decade compared to the pre-1980 period. In addition to being more frequent, they are more severe. Floods with discharges exceeding 100-year levels are much more frequent (OECD, 2008; Kron and Berz, 2007). Severe precipitation events are predicted to cause a greater incidence of flash flooding, particularly in urban settings (IPCC, 2007). With severe levels of precipitation, there is a need to evaluate existing water treatment infrastructure along with water transport systems, and to develop systems designed to cope with excess precipitation or an influx of seawater. The City of London Corporation, for example, has identified "hot spots" vulnerable to flooding, where it plans to install new sustainable drainage system and invest in maintenance to accommodate the expected rise in the volume of precipitation (OECD, 2008). In Sub-Saharan Africa, adapting new and existing infrastructure for urban wastewater treatment systems has been estimated to cost between 2 and 5 billion dollars per year. In Toronto, similar improvements were valued at around USD 9 billion annually (OECD, 2008). In addition to the obvious structural damages and loss of life that they can cause, floods can short-circuit transformers and disrupt energy transmission and distribution, paralyze transportation, compromise clean water supplies and treatment facilities, and accelerate spread of water-borne pathogens (OECD, 2008; Ruth and Rong, 2006; IPCC, 2001).

Socio-economic models of future flood damage in cities (e.g. Boston or London) independently predict vast increases in spending in response to damages resulting from climate change in the absence of adaptive infrastructure changes (OECD, 2008; Kirshen et al., 2005; Hall et al., 2002; and Choi and Fisher, 2003). Adaptation and mitigation measures are already been applied in many parts of the world. Some of these measures, such as dykes, can be argued to be cost-effective; but they could also bring about unintended consequences. Coastal infrastructure protecting against storm surges, such as sea walls, could damage local landscapes, ecosystems and beaches, which may impinge on the tourism industry. Fisheries may also suffer. Infrastructure to reduce coastal flooding can damage coastal ecosystems on which, according to Hallegatte et al (2008), 90% of fish species depend during at least one stage of their life cycle.

The urbanization of poverty phenomenon has resulted in concentration of large numbers of the poor in urban areas. These groups are especially vulnerable to climate change and extreme weather events. Poor city residents tend to locate in the most vulnerable locations and housing construction materials are not robust. The consequences of surging seas, wind storms, and flooding are much more dramatic in these areas (OECD, 2010). Recent OECD work shows that a 50-cm sea level rise, factoring in socioeconomic development, could result by 2070 in a tripling of the population at risk of coastal flooding and a tenfold increase in the amount of assets exposed. Such an increased exposure translates in almost doubling the cost of assets at risk in terms of GDP: from 5% of GDP in 2008 to 9% of GDP in 2070. However, for Lall and Deichmann (2009) urban agglomerations by their own nature –being the places where wealth and skills tend to concentrate—can mitigate some of the risks: after all, higher income countries tend to have lower life losses. Wealthier societies could also mean, according to Lall and Deichmann (2009), better housing quality, institutions that are able to enforce risk mitigation measures, and economies of scale can be achieved in risk control measures because these can benefit a larger population. More often than not, social capital is a key ingredient in disaster-risk management (DRM). As climate change will demand greater local-government capabilities, social capital becomes increasingly important to build more resilient cities.

Vulnerability in the Caribbean

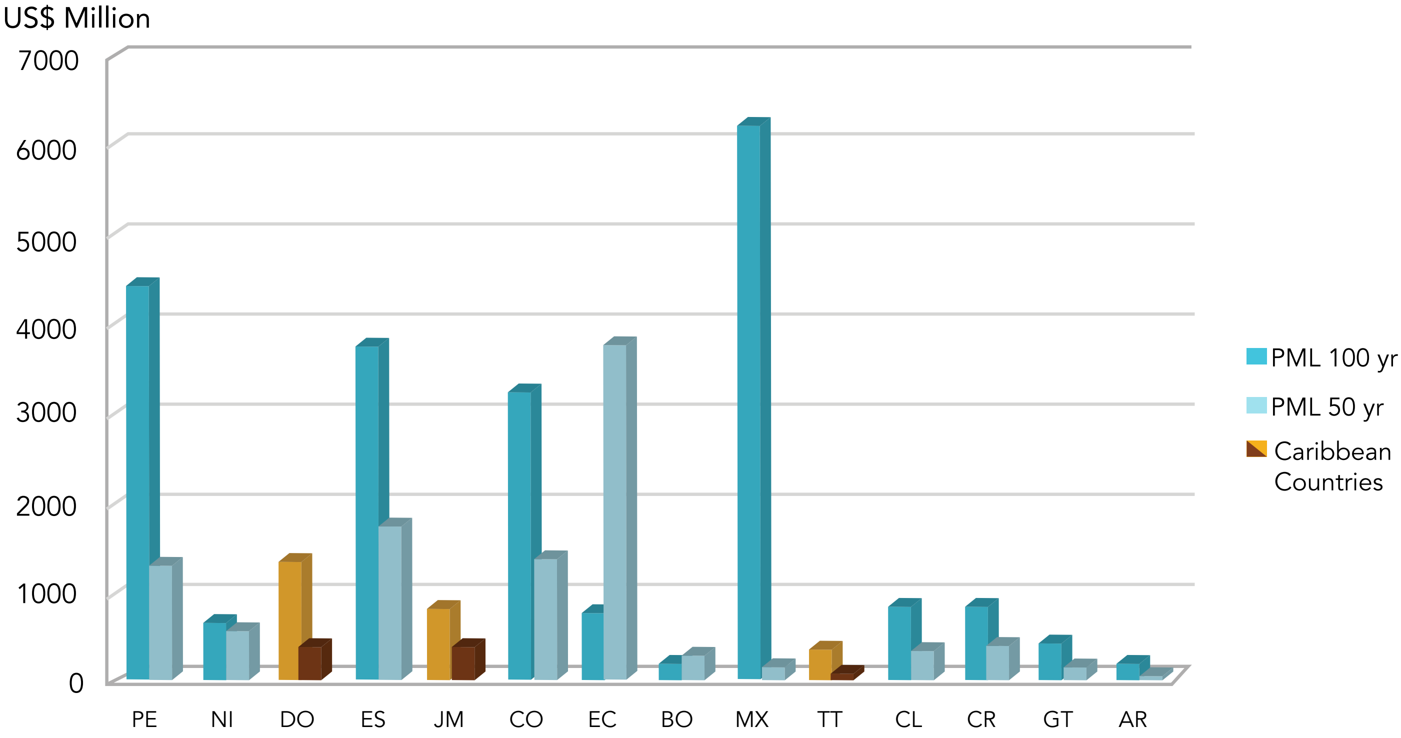
The Caribbean population and assets are among the most exposed to natural disasters in the world. For instance, over 96% of Jamaica's population and GDP are located in risk-prone areas to at least two hazards. According to the World Bank (2005), Jamaica is the third most exposed country to at least two hazards in the world. Similarly, Grenada has over the last two decades lost 9% of GDP annually to natural hazards (World Bank, 2012). The problem is particularly acute in Haiti and the Dominican Republic where losses as a proportion of population and GDP size, have been the greatest in the region.

Every year, Caribbean countries experience losses as a result of natural disasters as they are particularly prone to earthquakes and meteorological-related hazards (i.e. flooding, high winds and landslides). Although less common than the latter, earthquakes represent the biggest threat in terms of population and asset losses from a single event. That is particularly the case in Antigua and Barbuda, Haiti, the Dominican Republic and Jamaica. Meteorological-related events such as flooding, high winds and landslides intensify during the rainy season (June to November) through hurricanes and tropical storms. Each year, at least one major hurricane and several tropical storms sweep across the Caribbean. Such events have the potential of destroying lives, livelihoods, infrastructure and economic activity. Climate change is expected to worsen the threats for the Caribbean by making these events more acute in addition to accelerating above-mentioned challenges such as sea-level rise and coastal erosion. It is estimated that if current trends continue, between USD 350 and 870 million will be lost each year only in the Eastern Caribbean sub-region. The World Bank (2012) has estimated that the entire Caribbean has lost USD 9 billion between 2007 and 2011, which is more than twice the size of the economy of Barbados or seven times that of Antigua & Barbuda. Coastal cities in the region are therefore particularly exposed to meteorological hazards, climate change and in some cases earthquakes.

The calculation of the Probable Maximum Loss (PML) for countries in Latin American and the Caribbean with higher exposure to natural hazards by Cardona (2007) presents the estimation of the value of the largest loss from a disaster[2]. In the case of Dominican Republic, Jamaica, and Trinidad & Tobago (Figure 2) Cardona (2007) estimates for 50 and 100 years, with an 18% and 5% probability of occurrence, considerable losses for these countries vis-à-vis the size of their local economy.

[2] Potential losses were calculated using a model that takes into account different hazards (which are calculated in probabilistic form according to historical data on the intensity of past phenomena) and the actual physical vulnerability of the elements exposed to such phenomena. This analytical and predictive model is not based on historical measures of losses (deaths and number of people affected), but rather on the intensity of the phenomena.

Figure 2: Probable Maximum Loss in 50 & 100 years



Source: Cardona, 2007

Improving resiliency

What is city resilience?

Because economic and human densities amplify risk and change the economics of disaster risk reduction strategies, urban disaster risk management is different than any other type. Lall and Deichmann (2009) argue that an increasing number of people and assets are exposed to natural hazards in dense urban areas. Economic and human density can amplify risk and change the economics of disaster risk reduction strategies (Lall and Deichmann, 2009). A disaster resilient city therefore, attempts to minimize risks by favoring neighborhoods with organized services and infrastructure that adhere to sensible building codes; without informal settlements built on flood plains or steep slopes because no other land is available. To be more resilient, cities need to take steps to anticipate and mitigate the impact of disasters, incorporating monitoring and early-warning technologies to protect infrastructure, community assets and individuals, including their homes and possessions, cultural heritage, environmental and economic capital. Cities also need to take steps to develop systems to quickly respond to crises and restore services after a disaster.

Resilient cities require social capital and adequate institutional arrangements. People need to be empowered and participate, decide and plan their city together with local authorities. A resilient city is run by an inclusive, competent and accountable local government that is concerned about sustainable urbanization and that commits the necessary resources to develop capacities to manage and organize itself before, during and after a natural hazard event (e.g. Box 1 on accountability in the Philippines). Local authorities and population in a resilient city understand their risks and develop a shared, local information base on disaster losses, hazards and risks, including who is exposed and who is vulnerable. Such a form of governance must also act to reduce greenhouse gas emissions to address climate change at its roots (ISDR, 2012).

Box 1. Accountability: The Case of the Philippines

The Mindanao Summit on Disaster Risk Reduction and Geo-Hazard Awareness in Cagayan do Oro City was called by two Philippines Government senators after a devastating tropical storm hit Mindanao and nearby areas. It brought together a range of government and civil society stakeholders to discuss how to reduce disaster risks. They identified specific legislative, communication, planning, and response priorities for disaster risk reduction, among them creation of a disaster response and an accountability rating system for local government units.

Source: Jha, Miner and Stanton-Geddes (2013)

What tools for resiliency?

Building resilience in a city requires an integrated approach based on the four dimensions of resiliency: environmental, economic, social and institutional (Figure 2). To be resilient, a city must not only face environmental hazards, but protect and integrate key ecosystem services, as well as develop economic, social and institutional resiliency. As part of the adaptation and mitigation efforts to address environmental challenges, the city should work on increasing the adaptive capacity of buildings and critical infrastructure, including water and power supply systems, and to develop an emergency preparedness capacity. The system should have in place a plan for economic recovery after a disaster, while also diversifying the economy when possible, to lower the risk of economic crisis. Social inclusion programs could be coupled with land-use planning to address vulnerable groups' exposure to risks. To allow for this, the system would need an institutional set up that allows for participation, as well as an urban risk assessment and a robust decision making process that is based on cost-benefit assessments valuing social and environmental aspects and takes into account risk and longer time horizon. Plans would be developed on the basis of social participation and empowerment so that social capital can become a source of resiliency. To be effective, urban resiliency strategies should incorporate partnerships with other levels of government as well as with other cities (e.g. see the case of Mozambique in Box 2).

Figure 3: Dimensions of Resilience

Box 2. Participatory planning in Mozambique

In Quelimane City, Mozambique, local informal communities partnered with the City Council and several international organizations (Cities Alliance, World Bank, DANIDA, UNICEF, WaterAid) to work on upgrading communities that are particularly affected by cyclical floods because of a high water table and heavy rains. City and communities worked together to formulate a participatory urban development strategy for informal neighborhoods, where about 80 percent of the population live, taking into account water and sanitation conditions.

The participatory planning process led to joint action to improve conditions in densely populated peri-urban slum belts. The City Council made an in-kind contribution of US$100,000 by providing office space, equipment, a meeting room, technical/administrative staff, and vehicles. The community provided an in-kind contribution of US$150,000 by providing subsidized labor, conducting awareness campaigns, forming operational management teams, and reducing plot sizes or, in extreme cases, moving to another area. UN-HABITAT, the World Bank, DANIDA, UNICEF, and WaterAid together contributed US$440,000 in cash and in kind. Other in-kind contributions totaling US$30,000 were secured from a state water supply institution and a private firm that made its trucks available on weekends in exchange only for payment for the fuel and the driver.

The results achieved through these combined efforts included a City Council that was better equipped to work with informal settlements; construction of two community centers; cleaning of 10 km of drainage channels with 1 km paved; widening and improvement of 20 km of unpaved roads; installation of 10 new water points in the most densely populated areas; and construction of 20 rainwater collection systems and four public lavatories—all mainly through planned labor-intensive activities. The endeavor also produced greater government and community awareness of water, sanitation, and drainage maintenance issues and improved planning for sanitation and expansion of the water supply network to densely populated peri-urban slum belts.

Source: Jha, Miner and Stanton-Geddes (2013)

Mitigation, adaptation and environmental measures

Mitigation and adaptation policies need to be employed complementary to each other to address risk and climate change. There is a significant distinction between climate change mitigation and adaptation. Mitigation efforts aim to prevent further climate change. Adaptation involves readjusting life to the reality that a certain amount of climate change will inevitably occur. An effective climate change policy for cities however needs to include both, and they need to be approached in an integrated manner. Adaptation is necessary to address impacts resulting from global warming that would occur even in the most optimistic IPCC-assessed carbon stabilization scenarios. In the long run, in the absence of mitigation actions, natural and human systems' capacities to adapt would be exceeded. Early mitigation actions are indispensable to reduce the magnitude of climate change and can, at the same time, be associated to adaptation needs.

Public investment in flood protection is one of the most important adaptation tools for coastal cities, but they should be carefully planned so as not to impact the natural environment. Some of the most well-known examples include Venice (Box 3), New Orleans, Helsinki or Rotterdam. However, these investments have triggered a debate as they can lead to the destruction of ecological resources in order to protect the built environment. Instead, parks and natural spaces can be used. However, more often than not, the need for horizontal co-ordination – in addition to the vertical co-ordination required with regional and national governments in charge of environmental management – hinders the use of ecological preservation as a tool for adaptation since these parks and natural spaces frequently fall outside city boundaries,. Natural resource policies, and in particular wetland protection and urban forestry programs can also play an important role in adaptation by providing natural buffers for storms, in addition to mitigation benefits by removing CO2 from the atmosphere. Local government DRM plans are increasingly taking into account potential impacts and vulnerability assessments. The Finnish cities of Espoo and Helsinki have mandated that new planned areas be 2.6 metres above sea level, and that the lowest floor level of new buildings be 3 metres above sea level (Voutilainen, 2007).

Box 3. Adaptation: The Case of Venice

The approved plan to protect Venice, MOSE (Modulo Sperimentale Elettromeccanico, or Experimental Electromechanical Module), involves the construction of 79 gates at three lagoon inlets. When waters rise 1.1 meters (43 inches) above "normal", air will be injected into the hollow gates, causing them to rise, blocking seawater from entering the lagoon and thereby preventing the flooding of Venice. At the Malamocco inlet, the walls of the MOSE project are being built just like the original walls in Venice. But workers are driving 125-foot-long steel and concrete pilings into the lagoon bed, instead of wooden pilings. When the giant doors are at rest, they will be lying invisible to Venetians and tourists on the bottom of the inlet channel. Each gate will be up to 92 feet long, 65 feet wide, and will weigh 300 tons. Depending on the type of tides, there are different ways to manage the gates. They are flexible: they can close one inlet and not the other, depending on sea tides, wind and rain. There is no need to close the whole lagoon allowing a continuous exchange of water from the open sea to the lagoon.

Source: Prasad et al (2009)

Another important set of mitigation and adaptation actions that are becoming increasingly relevant are those aimed at addressing increasing levels of precipitation as a result of climate change. London and Venice are redesigning their urban storm-water drainage system giving consideration to the change in frequency and intensification of rainfall. Tokyo is designing urban holding ponds under roads and parks to temporarily hold runoff water to avoid flash floods. Jakarta has recently initiated a programme to construct a major storm-water drainage canal system known as the East Canal to provide adequate drainage to the eastern half of the city. Physical protection from typhoons and rising sea water levels is provided by Vietnam's extensive system of dikes (Box 4).

Box 4. Nam Dinh Province, Vietnam.

A range of disaster risk management measures have been identified for Nam Dinh according to the draft Second National Strategy and Action Plan including:

- Protect existing upstream forest watersheds to reduce downstream floods;
- Build large- and medium-scale reservoirs upstream on big rivers to retain flood water;
- Strengthen dike systems to be able to resist flood levels;
- Build flood diversion structures;
- Clear floodways to rapidly release flood water;
- Strengthen dike management and protection works to ensure the safety of the dike systems;
- Construct emergency spillways along the dikes for selective filling of flood retention basin; and
- Designate and use flood basins to decrease the quantity of flood water flow.

Source: Prasad et al (2009)

Resilient infrastructure and service provision

As cities develop, it is essential to evaluate infrastructure and service improvements through a climate change lens so as to promote long-term mitigation, adaptation, and poverty alleviation. Cities that focus on provision of basic urban services to the poor tend to do so in an integrated manner. Reducing infrastructure vulnerability to climate change impacts poses a key challenge for local and regional transportation authorities. Preventing disruptions due to flooding is chief among these concerns. It is vital for cities to clearly assess and plan for sea-level rise, storm-surge and other storm impacts that exceed existing 100-200-year plans (OECD, 2010). Below-ground transportations systems are particularly susceptible to water damage. Coastal cities' public transportation systems are at risk, particularly regarding flooding due to storms and rising sea levels. Extreme heat can also damage roadways, bridges, and rail lines that were designed for lower temperatures. But resilient infrastructure alone is not sufficient to provide uninterrupted service delivery. Coastal cities need to also work on improving resiliency in services. Building resiliency requires: I- advanced drainage systems that can alleviate flooding during intense storms; II- healthcare services; III- warning systems; IV- transport infrastructure allowing citizens to evacuate in response to risk.

Resilient local economies.

As cities compete globally to attract private sector investments, skills and talents, slum growth, insecurity, and vulnerability to natural hazards can become location decision factors. Urban policies aimed at reducing inequality, reducing poverty and managing risks can be growth-enhancing policies as well. In particular, an important adaptation strategy for local governments is to provide new shelter options for the poor to avoid settlements on marginal land that not only fosters slum growth but also often exposes already vulnerable population groups to live in risk-prone areas. Providing better settlement options for vulnerable population serves the dual purpose of immediately providing them with a safer living environment and contributing to more resilient neighborhoods and cities in the longer term.

Land-use planning.

Land-use planning tools can contribute to disaster risk management in coastal cities. On the one hand, land-use planning can be used to favor more compact urban developments that reduce intra-urban trips and commuting times. In turn, such compact arrangements result in lower GHG emissions, less traffic and more productive urban centers. High-density development can also be the result of land-use planning efforts which have been associated to a decrease in GHG emissions (OECD, 2010). On the other hand, land-use planning can be a powerful DRM tool. Coastal cities threatened by sea-level rise or sea water intrusion as a result of a tsunami or storm surge are turning to land-use planning through regulation or market incentives Singapore, for example, has decided to increase the ground level in all reclamation programs to factor the likely increase in sea-level due to climate change (Box 5). Similarly, Chile has set a line along the coast, prohibiting development under a certain threshold and requiring minimum heights in lower floors for all other risk-prone areas in coastal cities. The City of London has also factored sea-level rise in the redesign of Thames Barrier flood control system. Shanghai has a flood control project: a two-phase project that is designed to regulate water flow in the region to reduce flooding and provide a platform for water quality monitoring. In the US, rolling easements have been introduced to discourage development of coastal areas by granting a public right-of-way to a narrow portion of coastal property, which migrates inland as the shore erodes. This prevents coastal land owners from erecting structures to block sea level rise and transfers the impact of sea level rise to the private land owner (Titus and Narayanan, 1996). The most immediate impact of the policy would be to discourage new coastal development in areas vulnerable to coastal flooding.

Box 5. Singapore's Taps Strategy

Singapore's Four National Taps Strategy aims at ensuring the country has enough water to meet its future needs. The first tap is the supply of water from local catchments. This consists of an integrated system of 14 reservoirs and an extensive drainage system to channel storm water into the reservoirs. The Marina Barrage, when completed in late 2007, will turn Marina Basin into Singapore's 15th reservoir with a catchment area of about 10,000 hectares (or one-sixth of Singapore's land area). Dams will also be constructed across Sungei Punggol and Sungei Serangoon and when completed in 2009, will create a new catchment area of over 5,000 hectares. Collectively, these projects will increase water catchment areas from 50 percent to 67 percent of Singapore's land area by 2009, fulfilling one of SGP 2012 targets on clean water.

The second tap, imported water from Johor, supplements Singapore's needs. The third tap, NEWater or high-grade reclaimed water also supplements Singapore's needs. Thanks to advanced membrane technologies, treated effluent from the water reclamation plants is processed to produce high-grade reclaimed water of drinkable quality. NEWater is supplied from three plants with a combined capacity of 21 million gallons per day. A fourth plant at Ulu Pandan doubles the current supply.

Recent technological advances have made Singapore's fourth tap, desalinated water, an affordable source. The first desalination plant at Tuas started operations in September 2005 and can supply a maximum of 30 million gallons per day of drinking water.

Source: Prasad et al (2009)

Progress and Challenges for a more Resilient Caribbean

In recent years, countries in the Eastern Caribbean sub-region have made substantial progress in strengthening their disaster risk management capacity, but more can be done particularly in the area of risk reduction. A Mid-Term Review study on the Caribbean Implementation of the Hyogo Framework for Action (HFA) was conducted in 2011 by UNDP, and concluded that the region has made good progress in disaster risk management. Achievements have been made in the following areas: hazard mapping and its application to development planning; monitoring and warning systems and preparedness; development of institutional and legal frameworks; community-based disaster management programs; public information and dissemination; and recognition of the importance of forecasting climate change effects to disaster risk management. Caribbean countries have also joined the world's first pooled insurance facility Caribbean Catastrophic Risk Insurance Facility (CCRIF), successfully transferring their catastrophic risk.

But while these recent improvements in disaster risk management are encouraging, Eastern Caribbean nations still lack the required capacity to assess the full financial implications of disaster impacts. A better understanding of the economic and financial impacts of disasters would provide critical information without which it, sound ex-ante risk reduction cost-benefit analysis or risk reduction strategies cannot be developed (World Bank, 2012). One of the primary challenges to ensuring an effective recovery and identifying future risk mitigation activities is capturing sectoral-specific damages and losses following a disaster event. In the Eastern Caribbean context, the National Disaster Organizations (NDO) or similar institutions are mandated with coordinating all post-disaster damage and loss assessments. NDOs are also mandated with the legal, institutional and operational aspects of disaster prevention, mitigation and the coordination of emergency response, recovery and rehabilitation following a disaster event. However, there remains a strong dependency on external partners to define and implement comprehensive post disaster assessments such as the Damage and Loss Assessment (DaLA)[3] or Post Disaster Needs Assessment (PDNA). Further, in most cases, relevant agencies do not understand what is expected from them in order to effectively conduct the DaLA and/or PDNA and how information generated from these assessments relates to sector-specific assessments and recovery strategies (World Bank, 2012).

Conclusions

Many coastal cities around the globe are stepping up to the challenge of adapting their infrastructure to the threat posed by growing natural hazards, as well as putting in place mitigation policies to reduce GHG emissions. However, a smaller number of governments have adopted an integral approach to disaster risk management. Such an integral approach incorporates not only environmental aspects, but also economic and social aspects of resiliency. Successful policies that rest on an integral approach however, require solid institutional arrangements that promote citizen participation, empower neighborhoods to propose changes to policy making and foster the accumulation of social capital. At the end, the risk that these policies aim at reducing stem from individual and community-level actions and behaviors and probably can only be resolved there: at the community level.

Strong regional leadership and consistency of approach, national leadership, policy-level support, cross-disciplinary linkages, analysis and quantification of impacts, committed personnel and availability of technical skills will be needed to further develop disaster resilience in the region.

[3]The Damage and Loss Assessment (DaLA) Methodology was initially developed by the UN Economic Commission for Latin America and the Caribbean (UN-ECLAC) in 1972. It has since been improved through close cooperation of WHO, PAHO, World Bank, UNDP, Inter-American Development Bank, UNESCO and ILO. This methodology is adaptable to multi-hazard events and provides to the Governments the instrumentation to conduct a post disaster needs assessment and prioritize the recovery and reconstruction planning process. Although the tool assesses all sectors, its main application is on the on socio-economic and environmental impacts of disasters. The DaLA is a globally recognized and applied tool to determine the financial resources required to achieve full recovery and reconstruction.

Bibliography

Cardona, O. D. (2007). "Indicators of disaster risk and risk management report", IADB: Program for Latin America and the Caribbean, accessed on line on 9 May 2013 at http://www.iadb.org/exr/disaster/IDEA_IndicatorsReport.pdf?language=EN&parid=6]

Choi, O. and A. Fisher (2003) "The impacts of socioeconomic development and climate change on severe weather catastrophe losses: mid-Atlantic region MAR and the US", Climatic Change 58: 149-70.

Durongdej, S. (2001) "Land use changes in coastal areas of Thailand", Proceedings of the APN/SURVAS/LOICZ Joint Conference on Coastal Impacts of Climate Change and Adaptation in the Asia – Pacific Region, 14-16 November 2000, Kobe, Japan, Asia Pacific Network for Global Change Research, 113-117.

Hall, B., Motzkin, G., Foster, D.R., Syfert, M. and J. Burk (2002) "Three hundred years of forest and land-use change in Massachussetts, USA", Journal of Biogeography 29: 1319-35.

Hallegatte, S. (2012) Modeling the Roles of Heterogeneity, Substitution, and Inventories in the Assessment of Natural Disaster Economic Costs", Policy Research Working Paper 6047, The World Bank.

Hallegatte, S., F. Henriet and J. Corfee-Morlot (2008) "The Economics of Climate Change Impacts and Policy Benefits at City Scale: A Conceptual Framework", OECD Environment Working Paper Series, No. 4, OECD Publishing, Paris.

IPCC (2001) IPCC Third Assessment Report: Climate Change, Inter-Governmental Panel on Climate Change, accessed online on 22 April 2013 at http://www.grida.no/publications/other/ipcc_tar/

IPCC (2007) IPCC Fourth Assessment Report: Climate Change, Inter-Governmental Panel on Climate Change accessed online on 22 April 2013 at http://www.ipcc.ch/publications_and_data/ar4/wg2/en/contents.html

ISDR (2012) How to Make Cities More Resilient: A Handbook for Local Government Leaders: A contribution to the Global Campaign 2010-2015, ISDR, Geneva, accessed online on 23 April 2013 at http://www.unisdr.org/files/26462_handbookfinalonlineversion.pdf

Jha, A. K.; Miner, T. W. and Stanton-Geddes, Z. (2013) Building Urban Resilience : Principles, Tools, and Practice, World Bank, Washington, D.C.

Kirshen P., Ruth, M. and W. Anderson (2005) "Climate change in Metropolitan Boston", New England Journal of Public Policy 20(2): 89-103.

Kron, W. & G. Berz (2007) "Flood disasters and climate change: trends and options - a (re-) insurer's view" in Lozán, J.L., Graßl, H., Hupfer, P., Menzel, L. and C. Schonwiese (eds.) Global Change: Enough Water for All?, Wissenschaftliche Auswertungen/GEO Hamburg, 268-73.

Lall, S. and U. Deichmann (2009) "Density and Disasters: Economics of Urban Hazard Risk", Policy Research Working Paper 5161, The World Bank.

McGranahan, G. et al (2007), "The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones", Environment and Urbanization 19(1): 17-37.

Mohanti, M. (2000) "Unprecedented supercyclone in the Orissa Coast of the Bay of Bengal, India". Cogeoenvironment Newsletter. Commission on Geological Sciences for Environmental Planning of the International Union on Geological Sciences, 16: 11-13.

Moser, C. and D. Satterthwaite (2008) "Towards pro-poor adaptation to climate change in the urban centres of low-and middle-income countries", IIED/ GURC Working Paper No 1, Human Settlements Discussion Paper Series, Climate Change and Cities 3, University of Manchester.

OECD (2008) Environmental Outlook to 2030, OECD Publishing, Paris

Ruth, M.R and F. Rong (2006) "Research Themes and Challenges" in M. Ruth (ed.), Smart Growth and Climate Change, Edward Elgar, Cheltenham, UK.

Prasad, N., Ranghieri, F., Shah, F., Trohanis, Z., Kessler, E. and R. Sinha (2009) Climate Resilient Cities: a Primer on Reducing Vulnerabilities to Disasters, The World Bank, Washington, DC.

Saito,Y. (2001) "Deltas in Southeast and East Asia: their evolution and current problems" in Proceedings of the APN/SURVAS/LOICZ Joint Conference on Coastal Impacts of Climate Change and Adaptation in the Asia – Pacific Region, 14-16 November 2000, Kobe, Japan, Asia Pacific Network for Global Change Research,185-91.

Scavia, D., Field, J. C., Boesch, D. F., Buddemeier, R. W., Burkett, V., Cayan, D. R., Fogarty, M., Harwell, M. A., Howarth, R. W., Mason, C., Reed D. J., Royer, T. C., Sallenger, A. H., and J. G. Titus (2002) "Climate Change Impacts on U. S. Coastal and Marine Ecosystems", Estuaries 25(2): 149-64.

Small C. & Nicholls R.J. (2003). "A global analysis of human settlement in coastal zones". In Journal of Coastal Research,19, No. 3 584-599

Thanh, T.D., Saito, Y., Huy, D.V., Nguyen, V.L., Oanh, T.K.O. and M. Tateishi (2004) "Regimes of human and climate impacts on coastal changes in Vietnam", Regional Environmental Change 4:49-62.

Titus, J.G. and V. Narayanan (1996) "The risk of sea level rise: A delphic Monte Carlo analysis in which twenty researchers specify subjective probability distributions for model coefficients within their respective areas of expertise", Climatic Change 33: 151-212.

Voutilainen, O. (2007) "How do Finnish cities respond to climate change", presented at the OECD workshop on "Competitive cities and climate change: challenges and opportunities", 30 November 2007.

World Bank (2005) Natural Disaster Hotspots–A Global Risk Analysis, The World Bank, Washington DC.

World Bank (2012) "The Caribbean Region: Strategic Engagement Framework for Disaster Risk Management and Climate Resiliency FY13-15", June 2012.

worldbank.org/lac

World Bank LAC
opportunities for all

Caribbean Knowledge Series