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RESOURCE GUIDE

REGIONAL CLIMATE LEADERSHIP ACADEMY:

INCREASING THE CLIMATE RESILIENCE OF INFRASTRUCTURE SERVICES IN CITIES ACROSS LATIN AMERICA AND THE CARIBBEAN

MARCH 2014

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Cover Photo: Tin huts on the Ozama River, Santo Domingo, Dominican Republic. Joanne Potter, ICF International, 2013

REGIONAL CLIMATE LEADERSHIP ACADEMY

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ACRONYMS

4PCCD	Public Private Partnerships for Climate Compatible Development
ADN	National District's City Council (Dominican Republic)
AMDGO	Albay Millennium Development Goals Office
AMOR	Mozambican Recycling Organization
AP5	Area 5 an informal region in Rio
APSEMO	Albay Public Safety and Emergency Management Office
AVSI	Italian NGO
BNDES	Brazilian Development Bank
CAASD	Santo Domingo's Water and Sewage Corporation
CAF	Corporación Andina de Fomento
CAFTA	Central America Free Trade Agreement
CIDA	Canadian International Development Agency
CCA	Climate Change Adaptation
CCRD	Climate Change Resilient Development
CDKN	Climate Development Knowledge Network
CDM	Clean Development Mechanism
CIMPACT-DST	Climate Impacts Decision Support Tool
CIRCA	Centre for Initiatives and Research on Climate Adaptation
CLA	Climate Leadership Academy
CPC	Maputo Climate Change Planning Committee
CRIS	Climate Resilient Infrastructure Services program
DARD	Department of Agriculture and Rural Development (Hue, Vietnam)
DGODT	National Office of Territorial Planning and Development (Dominican Republic)
DOC	Department of Construction (Hue, Vietnam)
DONRE	Department of Natural Resources and Environment (Hue, Vietnam)
DRR	Disaster Risk Reduction
EBP	Estruturadora Brasileira de Projetos
ECCO	Environment and Climate Change Outlook (Trujillo, Peru)
ECDBC	Colombian Low Carbon Development Strategy
ECLEDS	Enhancing Capacity for Low Emission Development Strategies
ELLA	Evidence and Lessons Learned for Latin America
ENSO	El Niño Southern Oscillation
ESCI	IDB's Emerging and Sustainable Cities Initiative
ESSALUD	Health Social Insurance (Trujillo)
FEDOMU	Dominican Federation of Municipalities
FLACSO	Latin America Faculty of Social Science
FONAG	Quito Fund for the Protection of Water
FUNAB	Mozabique's Environmental Fund
GDP	Gross Domestic Product
GIWA	Global International Waters Assessment

HPI	Hue Planning Institute
IDB	Inter-American Development Bank
IDDC	Instituto de Desarrollo Comunitario (Veron-Bavarro)
IDDI	Instituto Dominicano de Desarrollo Integral (Dominican Republic)
INGC	Mozambique National Institute for Disaster Risk Management
ISC	Institute for Sustainable Communities
ISET	Institute for Social and Environmental Transition
IMHEN	Vietnam Institute of Meteorology, Hydrology, and Environment
INVEMAR	Institute of Marine and Coastal Research (Santa Maria, Colombia)
JICA	Japan International Cooperation Agency
LAC	Latin America and Caribbean Region
LGU	Local Government Unit
MICOA	Mozambique Ministry of Environment
MINAM	National Ministry of the Environment (Peru)
NGO	Non-governmental Organization
ONAMET	National Meteorological Office (Dominican Republic)
PAPD	Participatory Action Plan Development
PDRRMC	Provincial Disaster Risk Reduction and Management Council (Albay)
PPP	Public Private Partnership
PRONATURA	Natural Resources Inventory and the National Environmental Fund (Santo Domingo)
REDD	Reducing Emissions From Deforestation and Forest Degradation
RFP	Request for Proposals
SEDALIB	La Libertad Potable Water and Sewerage Services Corporation (Trujillo)
SNIP	National System of Public Investments (Peru)
UCCRN	Urban Climate Change Research Network
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UN-ISDR	United Nations Office for Disaster Risk Reduction
USAID	United States Agency of International Development
USAID/EGE	USAID Peru's Economic Growth and Environment Office
USEPA	United States Environmental Protection Agency

INTRODUCTION

As small and medium sized cities across the region are undergoing rapid population growth and increased private sector investment, the localized impacts of climate change are throwing urban development efforts off balance. Climate change not only presents a "wicked challenge"[1] for the cities of the Latin America and Caribbean region (LAC), but it also brings a rare opportunity for transformation. This is an opportunity to overcome historical challenges associated with planning, management, and – in many LAC countries – corruption. Integrating climate considerations into ongoing planning and decision making and improving the climate resilience of infrastructure is not just an opportunity to improve the durability and functionality of a city's physical assets, but is also a pivotal chance to rapidly accelerate socially equitable and sustainable development.

The following Resource Guide illustrates the stories of city leaders and local champions from across LAC and the world who are working to achieve this vision.

ABOUT THIS RESOURCE GUIDE

This Resource Guide represents a synthesis of information selected for the practitioners participating in the regional Climate Leadership Academy (CLA) on *Increasing the Climate Resilience of Infrastructure Services in Cities across Latin America and the Caribbean.* It is intended to help practitioners in cities and metropolitan areas resolve local challenges related to managing urban infrastructure to improve climate resilience.

This Resource Guide showcases promising practices and provides efficient access to some of the very best information and resources available. It is not an exhaustive compilation of available information – a near-impossible task given the growing volume of international studies, reports, websites, books, and blogs on the topic of climate resilience. Still, this document reflects an effort to identify, compile, vet, and synthesize useful information on innovative policies, programs, and practices being deployed around the world.

This Resource Guide was developed under the USAID Climate Resilient Infrastructure Services (CRIS) Program, which is working with developing country cities and USAID Missions to increase the climate resilience of physical infrastructure and the services it provides. CRIS aims to develop, test, and disseminate innovative approaches that build resilience while supporting smart, lasting development. CRIS is part of the Climate Change Resilient Development (CCRD) project, which integrates climate into development decision making, with the goal of helping developing countries withstand the impacts of climate on their development goals and investments. This Resource Guide summarizes and builds upon the concepts and approaches explored by the CRIS program and CCRD project.

This Resource Guide includes:

- This Introduction that characterizes the background and context faced by LAC city leaders as they work to build climate resilience into municipal infrastructure services. This section focuses on interrelated challenges in LAC and presents the themes that have emerged from the "Needs-Wants Inquiry" conducted with each of the workshop city teams.

1 "Wicked challenge" (sp. problema perverso) is a social planning term used to describe issues that are difficult (and sometimes impossible) to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize or understand. The term "wicked" is used to denote resistance to resolution, rather than evil. Moreover, because of complex interdependencies, the effort to solve one aspect of a wicked problem may reveal or create other problems.

- Case Studies that discuss how various local government practitioners across the world have made progress on adapting city infrastructure and systems to climate change and surmounting associated social, political, financial, and environmental challenges.
- Resource Lists that direct practitioners toward topic-specific sources of information – studies, reports, articles, and websites – that we believe are most likely to help improve, expand, and accelerate adaptation and resilience efforts.

For additional information on the themes identified in this guide, as well as information about climate change adaptation specific to particular infrastructure types, see *Addressing Climate Change Impacts on Infrastructure: Preparing for Change.*[2]

1.0 THE CHALLENGES OF DEVELOPING CLIMATE-RESILIENT INFRASTRUCTURE SERVICES IN AN URBAN SETTING

In their daily work to develop cities that are able to withstand global changes, municipal leaders operate within a complex web of interconnected socioeconomic and political processes and actors. City leaders are tasked with determining how best to meet the needs of their city's residents, present and future. Infrastructure services – transportation, water provision, waste management, energy provision, communications, flood control, shelter, and even maintaining a community's cultural heritage – are fundamental to achieving development priorities, such as poverty reduction, economic development, and improved public and environmental health. In other words, designing, building, maintaining, and operating infrastructure services – including sociocultural and political enabling environments – that are able to withstand and grow stronger in the face of climate- and non-climate stressors relates directly to how well a city is able to provide social and economic benefits for its people.

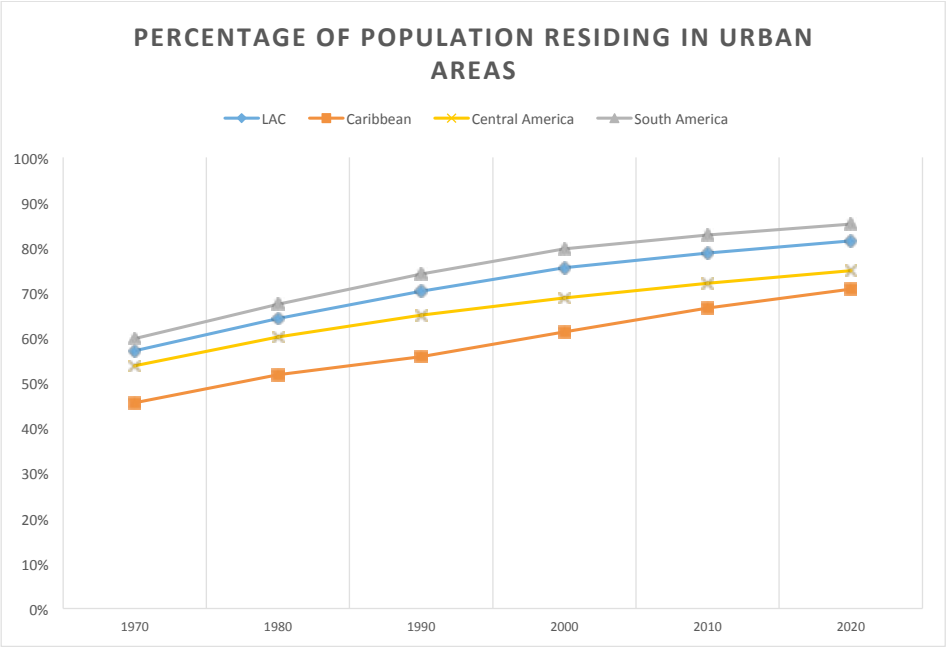
Yet the pace of urban growth in developing countries and the cross-cutting impacts of climate change threaten infrastructure investments and the reliability of services. Unless it is climate resilient, infrastructure (which is often expected to last for decades, if not longer) may fail to provide intended services and undermine development objectives.

Developing climate-resilient infrastructure requires addressing interrelated challenges in the LAC region. These trends include issues both within and outside the direct control of any given municipal leader, including:

- Rapid population growth is driving rapid infrastructure expansion, but many maintenance and operations decisions are being made without considering future climate conditions as *managers lack the necessary information, technical knowledge, and capacity.*
- Because most infrastructure systems are built to last for decades, *designing to historical standards won't be adequate under future climate conditions.*
- Meanwhile, short-term *electoral cycles can foster disincentives* for city leaders trying to invest in improvements that will only prove out over the long-term.
- To effectively incorporate climate considerations into the lifecycle of any given infrastructure system, *city leaders need to improve their process for coordination, collaboration, and governance across multiple sectors.*
- Local, regional, and national government *actors are facing financing deficits that constrain their ability to implement needed adaptation measures.*

2 USAID. (2013, December). *Addressing climate change impacts on infrastructure: preparing for change.*

- City *leaders need to determine the relative value of different adaptation options* (such as "hardening" ports infrastructure, for example) and how these measures could save money over the life of a system, despite potentially increased short-term costs.



Meeting Demands for Infrastructure Services in the Context of Rapid Population Growth and Urban Expansion

Today, LAC is the most urbanized region in the world, with 80% of the population living in cities. By 2050 it is estimated that nine out of ten Latin Americans will live in cities.[3]

The historic high rate of urbanization in the region is due to the fact that big cities are the drivers of the LAC national economies. In 2007, of the 16,000 cities in LAC, the 198 largest generated $3.6 trillion, or 60% of total GDP.[4] Impressively, just the 10 largest cities in LAC produced a total GDP of $1.7 trillion in 2007 – 30% of the region's total.[5] The high concentration of investments in these large cities has been a powerful driver of immigration in the past few decades. Also notable, 60 of the 77 most populated cities in LAC are located near the coast.[6]

Historically, LAC migration patterns have been driven by the growth of the biggest cities. However, trends now illustrate a decrease in the relative growth of mega-cities, in favor of smaller, second and third tier cities.[7] Half of the urban population across the region – approximately 200M people – now live in cities with a

3 UNHABITAT. (2012, August). *The state of Latin American and Caribbean cities 2012: Towards a new urban transition*. ISBN Series 978-92-1-133397-8.
4 Cadena, A. Remes, J., Manyika, J., Dobbs, R., Roxburgh, C., Elstrodt, H.P., Chaia, A., Restrepo, A. (2011, August). *Building globally competitive cities: The key to Latin American growth*. McKinsey Global Institute. Retrieved from: http://www.mckinsey.com/insights/urbanization/building_competitive_cities_key_to_latin_american_growth.
5 Jordán, R. (2013, January 7). *Urban sustainability in Latin America and the Caribbean* [inter-sessional presentation]. Economic Commission for Latin America and the Caribbean. Retrieved from: McKingsey & Company, 2011. http://unctad.org/meetings/en/Presentation/cstd2013_Jordan.pdf
6 ECLAC (2009, Octubre). Urbanización en perspectiva. Observatorio *DemoFigure, América Latina y el Caribe*, Año IV (no 8). Centro Latinoamericano y Caribeño de Demografía, División de Población de la Comisión Económica para América Latina y el Caribe. Santiago de Chile. Publicación de las Naciones Unidas.
7 Ijjasz-Vasquez, E.J. (2013, January). *Inclusive green growth in Latin America and the Caribbean*. Washington DC: World Bank. Retrieved from: http://documents.worldbank.org/curated/en/2013/01/17682842/inclusive-green-growth-latin-america.

population of less than one million inhabitants.[8,9] These second and third tier cities face another challenge, as they generally have inadequate leverage for negotiating with or overseeing the incoming investors. While new private sector investments present a great opportunity, without the technical and political capacity to effectively channel the investments, the recurring result is often a relaxing of environmental and zoning regulations – and the ensuing expansion of vulnerable infrastructure and settlements.

Adapting to the Cross-Cutting Impacts of Climate Change

In the context of climate change, "business-as-usual" strategies used by city practitioners are becoming ineffective which may have detrimental implications for safety, quality of life, and economic performance. Unfortunately, both rapid-onset and gradual impacts of climate change are only expected to worsen in the future.

Sea level rise across LAC averages approximately 3mm per year since the 1980s.[10] This is producing coastal erosion, higher saline intrusion in aquifers, and more frequent flooding in low-lying coastal areas.[11] In addition, changes in rainfall patterns and the rapid retreat of Andean glaciers are well documented. Tropical storms and hurricanes are expected to become more frequent and/or more severe,[12] and, in some cases, are occurring in areas where they were previously unknown.[13]

Although the occurrence of destructive natural phenomena in LAC cities is not new, the frequency and geographical distribution of extreme weather events has evolved as a result of global climate change, and the resulting economic damages are inextricably linked to economic and population growth trends. When critical infrastructure – and, thus, critical services – are disrupted by severe weather events, cascading impacts can affect part or all of a city, throwing into disarray the social and economic activity and the health and quality of life of the city residents. Between 1970 and 2009, the economic damage from natural disasters associated with extreme climate events in LAC was estimated at US$214.8 billion.[14]

2.0 EMERGING FRAMEWORKS FOR CLIMATE RESILIENT INFRASTRUCTURE AND URBAN SYSTEMS

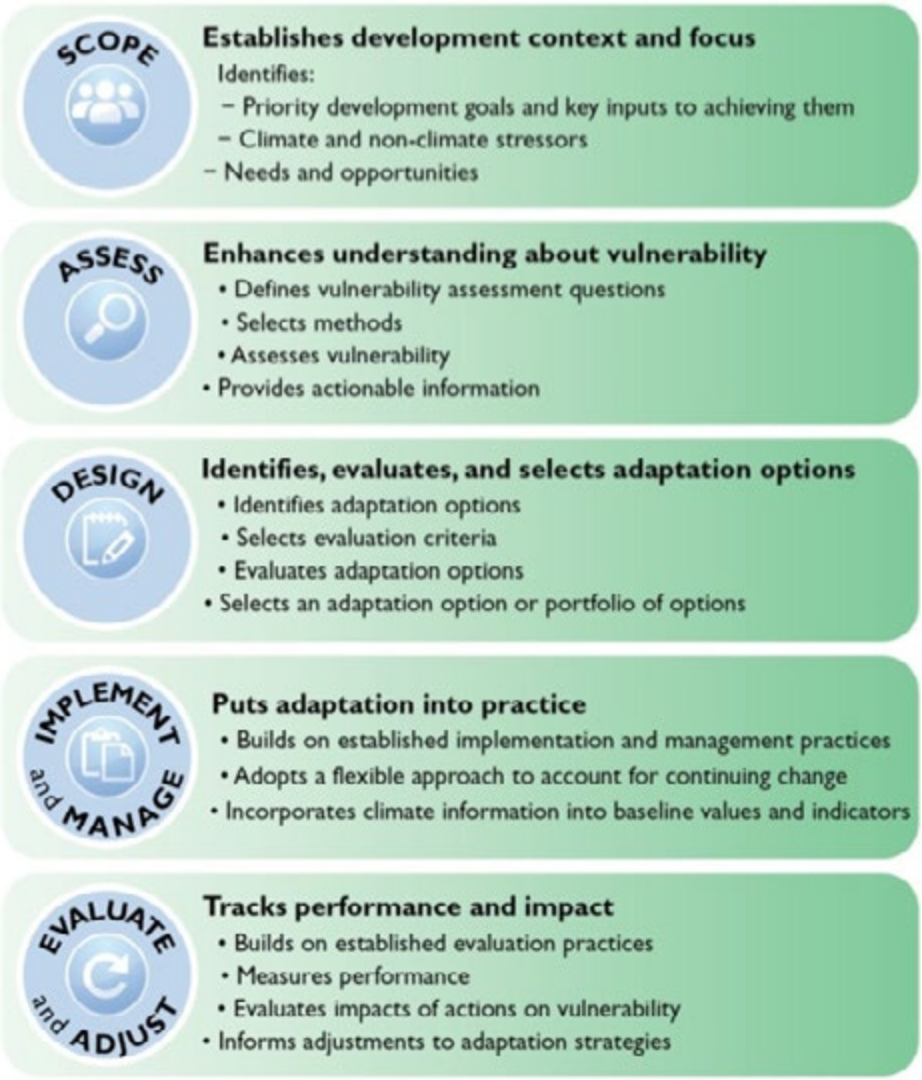
Clearly, the challenges faced by LAC coastal cities to improve the climate resilience of their infrastructure are cross-cutting and interdisciplinary. They require new approaches and levels of coordination beyond those currently applied.

One of the most important investments a city can make today is to develop integrated, cross-disciplinary strategies for urban development that will incorporate climate considerations with the tools and methods that mitigate social and environmental risks.

Climate Resilient Development Framework

USAID's *Climate-Resilient Development: A Guide to Understanding and Addressing Climate Change* presents a framework for the systematic inclusion of climate considerations in development decision making, using a development-first approach. The framework's objective is to support the development process by assisting practitioners in identifying, evaluating, selecting, implementing, and adjusting actions to reduce climate

8 Compared to the 14% residing in mega-cities
9 UNHABITAT. (2012, August). *The state of Latin American and Caribbean cities 2012: Towards a new urban transition.* ISBN Series 978-92-1-133397-8.
10 De la Torre, A. and Fajnzylber, P. (2008, October 16). *Equity and efficiency in the greenhouse: Climate change and Latin America* [powerpoint presentation]. World Bank. Retrieved from: http://www.cepal.org/dmaah/noticias/noticias/6/34276/cc12_bancomundial_delatorre.pdf.
11 De la Torre, A. and Fajnzylber, P. (2008, October 16). *Equity and efficiency in the greenhouse: Climate change and Latin America* [powerpoint presentation]. World Bank. Retrieved from: http://www.cepal.org/dmaah/noticias/noticias/6/34276/cc12_bancomundial_delatorre.pdf.
12 De la Torre, A., Fajnzylber, P. y Nash, J. (2009). Desarrollo con menos carbono. *Respuestas latinoamericanas al desafío del cambio climático.* Banco Mundial.
13 One example is Cyclone Catrina, which hit the coast of Brazil in March 2004- the first recorded hurricane system in the South Atlantic.
14 Zapata, R. (2010, Diciembre 16). *Desastres y desarrollo: El impacto en 2010* (Cifras preliminares). Unidad de Evaluación de Desastres, DDSAH, CEPAL. Boletín no2. Retrieved from: http://www. eclac.org/desastres/noticias/noticias/2/42102/Desastres2010_ WEB.pdf



vulnerabilities and improve development outcomes.

The framework's "development-first" approach is structured to identify development goals and determine the key inputs and enabling conditions[15] required to achieve those goals. It accounts for a range of problems – including impacts from climate variability and change – that might undermine the achievement of desired development outcomes. The framework is organized into a five-stage process for planning and implementing climate-resilient development initiatives. The framework is presented below.

3.0 WHAT WE HEARD FROM YOU

Cities have been proactive agents on their own behalf, building knowledge, capacity, and technical skills to improve their ability to build local climate resilience. Through their participation in this workshop, they are working to deepen their internal resources and access to external technical support.

To better understand how city leaders in LAC viewed the challenges and opportunities related to building climate resilient infrastructure services, workshop organizers interviewed each team participating in this regional Climate Leadership Academy (CLA). These interviews revealed five "big ideas," and formed the foundation of the learning objectives for the CLA program.

15 Inputs are physical, environmental, social, economic, political, and cultural goods and services that support development and enabling conditions are broader political, economic, cultural, or social conditions that may influence whether development goals are achieved.

Comprehensively Integrating or "Mainstreaming" Climate Change Adaptation into Planning Processes Is Difficult, But Necessary. While participant cities differed in their approach to identifying risks, evaluating alternatives, and taking action to address climate change, nearly all of them asserted that integrating climate concerns into planning and operations is critical for long-term success. Participating city teams suggested a wide range of operational and strategic planning systems and processes that needed to account for climate risk information, including urban development and land use planning, environmental review processes, related laws and regulations, and engineering and construction standards.

Building the Climate Resilience of Local Infrastructure Services Depends on Inter-disciplinary Collaboration & Effective Governance. Urban climate impacts are wide-ranging, affecting all sectors, populations, and levels of government. Effectively working on climate change adaptation involves numerous agencies and stakeholders, some of which may operate outside the city's purview. Cities must therefore collaborate effectively with their counterparts across municipal departments, in neighboring municipalities, national government, civil society, and the private sector, as well as their predecessors in the municipal government. While this kind of coordination and alignment is not easy, it enables cities to take advantage of diverse knowledge and skills, and helps adaptation efforts persist even through elections and other transitions.

Building Climate Resilient Infrastructure Accelerates Socially Equitable and Sustainable Development Efforts. Participating city teams are experiencing a wide range of non-climate stressors, including increasing energy prices, poverty, epidemics, and civil insecurity. Climate change threatens to exacerbate these existing vulnerabilities; in many cases, local severe weather and changing climate have already resulted in widespread damages to city assets and residents. Typically, these impacts tend to disproportionately affect poor populations, and limit their ability to lift themselves out of poverty.

Understanding climate risks and vulnerabilities, direct versus indirect climate impacts, and identifying local climate change adaptation solutions for critical infrastructure systems is critical. Knowing and understanding these impacts will improve the public services that advance existing sustainable development and improve social equity efforts.

Financing Infrastructure Resilience Remains Problematic, Particularly in the Face of Rapid Growth & Urbanization. Participating cities are facing myriad, seemingly unmanageable challenges related to rapid population growth and urbanization, not the least of which are severe resource constraints for the construction, operation, and on-going maintenance of critical infrastructure systems. In concert with the damages inflicted by climate change – including the gradual loss and degradation of roads, homes, water provision, sewage, flood control and sanitation networks – non-climate stressors make planning for infrastructure improvements exceedingly difficult. The political and social challenges associated with urbanization and infrastructure projects require priority attention, alongside efforts to address climate vulnerabilities. This often entails taking advantage of existing resources and infrastructure investments underway to ensure that infrastructure managers and city leaders are maximizing the benefits of individual infrastructure development choices to build long-term resiliency.

CASE STUDIES

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CASE STUDY SUMMARY: KEY THEMES AND LESSONS LEARNED

OVERVIEW

The cities and communities highlighted in these six case studies face a wide variety of climate-related threats that interact with non-climate stressors (such as rapid population growth and urbanization, inadequate provision of current infrastructure services, and informal settlements in high risk areas) to exacerbate existing vulnerabilities. These six cities and communities, like the teams participating in this regional Climate Leadership Academy (CLA), confront a range of challenges in adapting their city infrastructure and systems to climate change, including:

- Insufficient awareness and motivation at the community and municipal level to take action on climate change
- Limited technical knowledge and capacity related to climate change
- Need for more effective collaboration across city departments and between the municipal government and other stakeholders, such as civil society, the private sector, and the national government
- Lack of access to locally relevant and actionable climate information
- Inadequate financial resources to implement needed adaptation measures

The case studies describe how these entities have overcome the above social, political, technical, and financial challenges to make progress on increasing the resilience of their city infrastructure and systems to climate change. Several key lessons emerge from the case studies:

- **Building the climate resilience of local infrastructure services requires effective multi-disciplinary and inter-institutional collaboration.** Creating partnerships with relevant stakeholders enables cities to build broad support around resilience building efforts, take advantage of diverse knowledge and skills, and obtain needed financial resources to address the complex and wide-ranging impacts of climate change. A number of cities highlighted in the case studies, including Hue, Quito, Maputo, and Michoacán, organized workshops that engaged diverse stakeholders to identify the high priority vulnerabilities and adaptation actions for their communities. These workshops promoted cross-departmental coordination among city agencies and built close collaborative relationships between the municipal government and its partners from civil society, the private sector, academia, and the national government. In another example, the city of Rio de Janeiro developed a unique public-private partnership with EBP, a special purpose company that has provided much-needed staffing capacity and technical expertise to help the municipality identify private sector investors for public infrastructure projects and get

these projects off the ground.

- **Local community participation is key.** A participatory approach that engages the local community can generate local buy-in and support for the municipality's plans and actions, empower community members to contribute their local knowledge and capacity, and create a sense of enthusiasm in the community. Engaging the most vulnerable populations can also ensure that they directly benefit from the resilience building efforts. In Maputo, the municipal government has partnered with the residents of the Chamanculo neighborhood – many of whom live in poverty and do not have access to basic infrastructure services – to develop a community plan that addresses water supply, sewage, and drainage issues and has been integrated into the municipality's plans. This integration has empowered the community and increased their support for the municipality's strategies, while the partnership has laid the groundwork for long-term collaboration between civil society and the local government on urban resilience issues. In Quito, a key success factor for the development of the city's Climate Change Strategy and Action Plan was city-level administrative reform that increased the participation of community groups and non-governmental organizations in municipal decision making. Quito has also focused on capacity building to increase residents' resilience to climate change, especially for vulnerable communities who live in informal settlements on steep hillsides or in the urban periphery.

- **Leveraging existing processes and resources helps save precious time and resources.** The case studies show that it is almost always easier to build on something that already exists than to start from scratch. In the Hue case study, the project team utilized the relationships, processes, and momentum of an existing stakeholder group assembled to advise an earlier vulnerability assessment. In Maputo, the project team used existing research on climate change impacts in the region and information about the local context from an urban upgrading plan underway for the project's pilot neighborhood. As another example, Quito employed existing studies on climate-related risks rather than conducting a separate vulnerability assessment for the city's Climate Change Strategy. Both Quito and Albay also built on earlier disaster preparedness and environmental management experience to develop climate change adaptation strategies. By building on existing processes and knowledge, these cities were able to more quickly move to implementing adaptation actions to increase resilience.

- **Mainstreaming climate change and adaptation considerations into planning processes is critical for long-term success.** The case studies suggest that climate risk information needs to be incorporated into existing planning systems and processes to build long-term resilience to climate change. In Quito, the city aligned adaptation efforts with existing sustainability and environmental concerns to reduce climate change vulnerabilities in an integrated manner, while the city of Albay integrated adaptation into the city's existing disaster preparedness strategy as part of an effort to mainstream climate change adaptation into virtually every facet of local government. In Hue and Maputo, climate change information has been incorporated into select communities' urban development plans.

The creative approaches taken by the communities described in the following case studies demonstrate a variety of strategies that other cities may find useful as they work to increase the climate resilience of their infrastructure and neighborhoods. These case studies illustrate the strength and resourcefulness of today's cities in meeting the challenges of a changing climate.

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CASE STUDY

PURSUING PARTICIPATORY CLIMATE CHANGE ACTION PLANNING IN MOZAMBIQUE

Chamanculo C, Maputo, Mozambique. Photo Credit: Wiki Media

THE CHALLENGE

Situated in the southernmost coastal section of Mozambique, the capital city of Maputo faces serious threats from climate change including sea level rise, erratic rainfall patterns, and increased flooding. As is the case in much of Southern Africa, average annual rainfall in Maputo is declining and the period between rain events is expected to become more prolonged. Once common periods of lower intensity rainfall are being replaced by shorter, more intense bursts of rain, and more severe tropical storms are linked to increased flooding in Maputo. [1]

Many of the dense, urban neighborhoods, or *barrios*, are ill-equipped to handle such flooding and many residents – 44% of whom live in poverty and do not have access to basic infrastructure services – exacerbate the problem by releasing wastewater into the streets and blocking the passage of water with sandbags and household waste. Continuous urban densification and a lack of comprehensive growth management planning in Maputo has led to unplanned buildings blocking natural drainage routes and substandard water management infrastructure. Unsanitary living conditions, the proliferation of disease, eroded infrastructure, and inhibited means of transportation are just some of the impacts that barrios must cope with.

The *Public Private People Partnership for Climate Compatible Development* (4PCCD) project used a participatory methodology to engage Maputo residents in climate change resilience planning by creating partnerships between civil society, municipal government and other stakeholders. Since the project officially ended in the summer of 2013, three of the seven actions proposed by residents and government in the Local Climate Change Action Plan are under implementation, including rehabilitation of the neighborhood drainage system, development of a recycling center[2], and creation of a community environmental education program.

THE 4PCCD PROJECT

The idea for the *Public Private People Partnership for Climate Compatible Development* (4PCCD) project arose when representatives from the University College London, University of York, Reading University, and Mozambique's Environment Fund (FUNAB) met at a Climate Development Knowledge Network (CDKN) Action Lab held at Oxford University. At this meeting, Carlos Seventine, Executive Secretary of FUNAB, expressed his interest in engaging community residents in Maputo to address climate change challenges affecting them. FUNAB envisioned a participatory process by which local government and civil society could

1 Midgely, S., Dejene, A., and Mattick, A. (2012). *Adaptation to climate change in semi-arid environments - experience and lessons from Mozambique.* FAO, Rome. Retrieved from: http://www.fao.org/docrep/015/i2581e/i2581e00.pdf

2 While the recycling center is not a climate adaptation measure in and of itself, it does attempt to address poor waste disposal, which currently exacerbates the climate-related flooding problem by clogging drainage systems.

work together to tackle some of these pressing issues, but as a national-level entity, lacked the capacity to execute such a locally-focused project. The university representatives from the UK had experience carrying out projects using a Participatory Action Plan Development (PAPD) methodology, so they approached CDKN together with FUNAB to present their project idea, and ultimately secured £114,000 ($187,150) in funding from CDKN to bring their idea to fruition.

Quarteirão 16A, Chamanculo C

The team decided to implement the project in Chamanculo C, a densely populated barrio with a population of 26,179, because of its vulnerability to flooding, and the fact that an urban upgrading plan for this barrio was at that time being carried out by the Municipality of Maputo in partnership with Cities Alliance, the Italian AVSI Foundation, and the Government of Brazil. Within Chamanculo C, the pilot project targeted Quarteirão 16A, the "block" consisting of 350 residents, with opportunity to scale up the effort to all of Chamanculo C, and eventually the city of Maputo. The project sought to: 1) Identify climate change vulnerabilities and impacts in Maputo through a combination of desk research and interviews with community members and 2) develop partnerships between local government, private businesses, and communities to address those issues.[3] Implementation of the 4PCCD project took place from January 2012 until July 2013.

THE PROCESS

The three stages of the 4PCCD project included: Stage 1) A review of state-of-the-art publications on climate change in Maputo to characterize key climate change impacts, identifying vulnerabilities to the city, and devising mechanisms to communicate this information to key stakeholders at the local level; Stage 2) Implementation of a participatory methodology in a specific neighborhood, to share climate change information and debate key proposals; and Stage 3) Presentation of the community's proposals to a wide-ranging group of municipal and national governing bodies to establish potential avenues for implementation of the Local Climate Change Action Plan and develop partnerships to support it.[4]

FUNAB recruited Domingos Macucule, a professor at the Universidade Eduardo Mondlane's Urban Planning Department in Maputo, as a consultant tasked to liaise between the various project stakeholders, including the local and national governments, the community, private businesses, NGOs, and the cohort of universities from the UK that spearheaded the project. "We began by mapping all the involved actors and dividing them into about seven groups," said Professor Macucule. "Then we conducted interviews with various actors to determine how they understand the issue of climate change in Maputo – whether they feel it is a problem and how they're affected by it – and also how they partner with other actors." In inquiring about existing

3 University College London Bartlett Development Planning Unit. *Development of a public private people partnership (4p) for climate compatible development in Maputo, Mozambique: project summary.* Retrieved from: http://www.bartlett.ucl.ac.uk/dpu/4pccd/read-more/Long_summary.pdf

4 University College London Bartlett Development Planning Unit. *Development of a public private people partnership (4p) for climate compatible development in Maputo, Mozambique: project summary.* Retrieved from: http://www.bartlett.ucl.ac.uk/dpu/4pccd/read-more/Long_summary.pdf.

partnerships between stakeholders, the 4PCCD team sought to understand relationships between actors and identify existing areas of collaboration to build upon.

Because the municipality was executing an upgrading project in Chamanculo C, key research on climate change impacts in the region and other information about the local context already existed, cutting down on the amount of time and resources needed to implement Stage 1. The Italian NGO involved in the municipal upgrading initiative, AVSI, served as an important resource to project leads, providing data and links to local champions within the community.

Participatory Action Plan Development (PAPD) is a consensus building tool that seeks to identify and then solve environmental or livelihoods problems with community support and input. PAPD draws from several participatory techniques and principles. Its key features are; 1) recognizing the wide range of stakeholders and their diverse interests in natural resource management; and, 2) engaging these stakeholders fully.

Source: Practical Action

Charlotte Allen joined the project as a consultant to work with the residents of Chamanculo C, local government staff, and other on-the-ground actors to carry out the project using a Participatory Action Plan Development (PAPD) methodology (see side box) and to document it. She collaborated with AVSI and the *Chefe de Quarteirão* (the elected neighborhood leader) to identify local champions to serve as facilitators. They selected and trained four local facilitators to engage residents in community workshops through a participatory process. Dozens of families from Chamanculo C attended community workshops to discuss the impacts of climate change, propose solutions, and devise a community action plan focused on the pilot block of *Quarteirão* 16A. The groups uncovered several proposed solutions related to improving and maintaining drainage channels, protecting the water supply, managing local waste systems, and building channels of communication between citizens and relevant institutions.[5]

Residents elected a five-member Climate Change Planning Committee (CPC) to represent the perspectives of the various community groups (youth, elderly, small business owners, etc.) to a larger audience. The CPC analyzed each proposed solution across social, technical, environmental, political, and sustainability factors before meeting with outside stakeholders.[6]

Next, a workshop brought together the CPC, actors identified through the stakeholder mapping process, and those identified by AVSI and other groups working on the ground to share and discuss the community action plan. Forty-six representatives from city government, FUNAB, private sector corporations, and NGOs attended the workshop to become familiar with the participatory methodology, discuss the feasibility of the various proposed solutions, and establish partnerships to execute agreed upon solutions.

Partnerships for Climate Change Adaptation Workshop afternoon session

One of the major project successes that stemmed from this multi-stakeholder workshop was the strong relationship forged between community members and the municipal government of Maputo. "In the beginning, the government saw this plan as a challenge, like the community was trying to challenge their power," said Professor Macucule. "But during the process they started to understand that this is

5 University College London Bartlett Development Planning Unit. *Development of a public private people partnership (4p) for climate compatible development in Maputo, Mozambique: project summary.* Retrieved from: http://www.bartlett.ucl.ac.uk/dpu/4pccd/read-more/Long_summary.pdf.
6 University College London Bartlett Development Planning Unit. *Development of a public private people partnership (4p) for climate compatible development in Maputo, Mozambique: project summary.* Retrieved from: http://www.bartlett.ucl.ac.uk/dpu/4pccd/read-more/Long_summary.pdf.

a local initiative to accomplish mutual goals and they got on board to help the community to do better." The project unfolded in close consultation with the municipality, which is working to incorporate the local climate change action plan from Chamanculo C into their own climate change action plan, currently under development. The municipal commission working on upgrading water supply, sewage, and drainage in informal settlements is particularly interested in the proposals, as many of the proposed actions are in line with its own strategy and therefore can easily be supported by its budget. As a result, the commission has since begun working with residents and other stakeholders in Chamanculo C to engage in solid materials management and drainage cleaning in the name of the municipality.

Partnerships for Climate Change Adaptation Workshop working groups

The strengthened relationship between the community and the municipality also helped fortify the local government's vision for infrastructure improvement and climate change resilience in the barrio. As previously mentioned, the municipality was involved in an upgrading plan in Chamanculo C, but without involving the community, it was difficult to get their buy-in for the proposed actions that would affect them. "They were not speaking in the same language – the municipality did not understand what the community was saying and also the community sometimes did not understanding the municipality's plan for the neighborhood," said Professor Macucule. "And so I think the partnership formed through the workshop helped the municipality understand that the community plan could be integrated into their own plan, and the community felt empowered and therefore began to support the municipality's plans."

> "Far too often, planners like me fail to understand that working on the small scale is more effective. We can develop a small neighborhood drainage plan that is run by the local community, and that will solve the problem far more effectively."
>
> *– Professor Domingos Augusto Macucule*
> *Universidade Eduardo Mondlane's Urban Planning Department*

At the national level, the 4PCCD project obtained a commitment from the Ministry of Environment (MICOA) and the Environmental Fund (FUNAB) to work towards a participatory approach that reflects the needs of the urban poor in the implementation of their Climate Change Development Policy, supported by the World Bank.[7] In addition, the National Institute for Disaster Risk Management (INGC) expressed interest in using the 4PCCD project as a model to inform a series of partnerships to combat the impacts of climate change at the community level, and has since established Community Emergency Response Committees in the municipality. Part of the INGC's role is to work with municipal governments in Mozambique to collect and provide data and research about climate change, coordinate early warning systems and emergency response efforts, and facilitate other climate adaptation activities.

PROJECT SUCCESSES AND OUTPUTS

The primary goal of the project was to establish partnerships between the various multi-disciplinary actors on the ground in Maputo so that they could collaboratively take action to build resilience to the impacts of climate change. These partnerships would lay the groundwork for civil society and local government to work together in the future to promote sustainability. The partnerships that have formed between actors and the activities that they have planned together attest to realization of this goal.

7 University College London Bartlett Development Planning Unit. *Development of a public private people partnership (4p) for climate compatible development in Maputo, Mozambique: project summary.* Retrieved from: http://www.bartlett.ucl.ac.uk/dpu/4pccd/read-more/Long_summary.pdf.

"What this project has demonstrated is that people know how to gain resilience – they have a knowledge of context, they can articulate proposals, they can really identify efficient points of intervention, and they can do part of those interventions themselves," said Vanesa Castán Broto, Director for the 4PCCD project and a lecturer at the University College London's Bartlett Development Planning Unit. "And, if given the opportunity, as we did by creating a network of regional actors, they can come and present their results and they can create regional partnerships with more powerful actors."

Polluted drainage channels in Quarteirão 15Q, Chamanculo C.

Another major accomplishment of the project is the sense of empowerment it afforded to the residents of Chamanculo C. "People got very excited during the community meetings – they were eager for their voices to be heard and thrilled to be part of the process," said Charlotte Allen, the consultant who worked with the community and local stakeholders to see the project through from start to finish. "It was empowering to realize they could contribute meaningfully to the process and that their ideas would be taken seriously."

As for project outputs, three of the seven climate solutions proposed in the community action plan are currently underway (see box, next page). While not all seven actions are explicitly adaptation actions, they all contribute to adaptation of the wastewater system.

One such action is rehabilitation of the drainage channels. Previously, there was only one drain serving the entire barrio that was dysfunctional since it was not cleaned and was often blocked by community members who didn't want the dirty water flowing past their houses. The community is in the planning process and will take responsibility to build and maintain a new drainage channel. The municipal commission in charge of upgrading informal settlements is helping to form partnerships to get this initiative off the ground.

Another project underway is the development of an environmental education program intended to train the community leaders of Maputo to become environmental educators. The goal is for these educators to teach residents about pertinent environmental issues, such as drainage maintenance and how to manage domestic waste and wastewater. Professor Macucule and his colleagues at the Universidade Eduardo Mondlane's Urban Planning Department designed the program and are in the process of adapting courses currently offered by the Ministry of Environment. This program will be piloted in Chamanculo C.

A third activity underway is the establishment of a recycling center to combat the inadequate disposal of recyclable waste and compost. This effort serves to limit the prevalence of household waste clogging drainage infrastructure which exacerbates the climate-related flooding problem. The CPC partnered with AMOR – the Mozambican Recycling Organization – and together they designed a pilot project consisting of a resident-run ecopoint within the barrio for waste separation and recycling. The ecopoint will purchase recyclables from residents and resell metals and plastics, with proceeds going toward an environmental fund that will

pay for activities such as drainage cleaning and maintenance.[8] While this action is more focused on climate change mitigation rather than adaptation, it does have adaptation co-benefits, as improper disposal of waste contributes to drainage problems and flooding in neighborhoods.

There is still more work to be done. Other actions proposed in the Local Climate Change Action Plan have yet to be implemented. Community leaders are currently working with partnerships forged through the project planning process to secure funding in order to execute these activities. In the future, the project team hopes to replicate the 4PCCD project in other communities in Maputo.

Community Proposed Solutions to Local Climate Change Impacts

Proposed Action	Status
Project for community environmental education (including climate change, correct use of water, and correct treatment of domestic waste) and community mobilization for cleaning the drain.	In progress
Project for separation and recycling of domestic waste	In progress
Rehabilitation of the existing drainage channel and construction of new, larger drainage channels.	In progress
Leveling of streets and alleyways so that the water can drain away.	Not yet begun
Regular cleaning of the drainage channels by the residents, and better organization of the residents to deal with this, including collaboration between quarteirões.	Not yet begun
Establishment of a dialogue with the water company regarding leaking pipes.	Not yet begun
Construction of toilet blocks and improved latrines.	Not yet begun

LESSONS LEARNED

1. **Participation at the community level is key**. The 4PCCD project demonstrates that a participatory planning process is an effective method for identifying climate vulnerabilities and establishing partnerships between multi-disciplinary stakeholders to collaborate on topics of mutual concern. The residents of Chamanculo C felt empowered because they were given the platform to express both their concerns and their proposed solutions, and the local government used this input to inform their own plans. Involving the community in the decisionmaking process aided the local government's development and resilience goals in the barrio because not only did it create local buy-in, but residents took more initiative in helping to facilitate and take ownership for actions. They are also more apt to provide information and updates from the micro-level that can aid planning, action, and monitoring stages. The project challenges the typical top-down, technocratic approach often used for local climate change planning.

2. **Think small scale**. It pays to do the research to determine climate impacts and vulnerabilities that affect citizens' lives at the local scale and to pursue small infrastructure solutions that can be managed locally. "As a planner, I generally think about the big plans – large scale infrastructure projects such as city-wide drainage systems," said Professor Macucule. "We don't have the techniques to assess the smaller needs that impact people day to day. Far too often, planners like me fail to understand that working on the small scale is more effective. We can develop a small neighborhood drainage plan that is run by the local community, and that will solve the problem far more effectively."

3. **Make the case to the community by emphasizing impacts close to home.** In educating community members and other important stakeholders about the impacts of climate change and the "dos and don'ts"

8 University College London Bartlett Development Planning Unit. *Development of a public private people partnership (4p) for climate compatible development in Maputo, Mozambique: project summary.* Retrieved from: http://www.bartlett.ucl.ac.uk/dpu/4pccd/read-more/Long_summary.pdf

of disposing of waste, building and maintaining infrastructure, etc., it is important to make the link to everyday challenges that residents face. "It was not easy to make local communities understand and think about climate change," said Professor Macucule. "But when we talked about things of critical importance affecting the neighborhood – like drainage and sewage – I think people started to understand how climate change influences them day to day in a tangible way." Citizens are far more concerned with things like making a living, educating their children, and caring for the health of their families, so getting them to think about something "lofty" and future-focused like climate change can be difficult. In these instances, it helps to focus on direct impacts of climate change and climate variability that are already impacting people, and once you have local buy-in, the door is opened to frame a larger narrative around long-term and indirect impacts of climate change.

FOR MORE INFORMATION

University College London Bartlett Development Planning Unit. *Development of a public private people partnership (4p) for climate compatible development in Maputo, Mozambique: project summary.* Retrieved from: http://www.bartlett.ucl.ac.uk/dpu/4pccd/read-more/Long_summary.pdf

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CASE STUDY

CONFRONTING CLIMATE CHANGE IMPACTS ON WATER IN MICHOACÁN, MEXICO

Michoacán, Mexico. Photo Credit: Wiki Media

BACKGROUND

The state of Michoacán, located in central Mexico, has a diverse climate due to its varied topography. Michoacán encompasses two watersheds, the Lerma-Santiago-Pacifico and the Balsas Basin, which provide critical water supplies to this predominantly dry state. Agriculture, a key source of income and employment in the state, accounts for most of the water use in both basins, while hydropower is the largest non-consumptive user.

Photo credit: Damanill et al., 2010

Drought is a significant concern in Michoacán, especially to agriculture, a key economic sector in the state.

Michoacán experiences both floods and droughts. However, the risk of flooding is relatively low compared to other parts of Mexico and droughts are of greater concern. Droughts affect a diverse set of water users, including agricultural, domestic, public, commercial, industrial, and hydropower sectors. Although the state has invested in water storage infrastructure, the storage buffer is insufficient to meet demands during periods of low rainfall, partly due to over-allocation of surface water and high rates of siltation in reservoirs. Michoacán expects an increase in the demand for water as the population and economy grow, while climate change is projected to increase the frequency and intensity of both droughts and heavy rainfall events.[1] The state thus faces the challenge of balancing rising water demands with more variable water supplies.

To address this challenge, the Government of Michoacán and the World Bank collaborated on a study to identify climate risks and adaptation priorities for the state's water resources and water supply infrastructure. This case study provides an example of a consultative approach that combines climate change science with local expertise and experience to allow stakeholders to reach a consensus on adaptation priorities. This approach has been pioneered with success in other water-constrained contexts, most notably Australia,[2] and has the potential to be replicated in other cities, regions, or countries with similar concerns.

1 Damanill, R.; George, D.; Jacobsen, M.P.S.; Rodriguez, D.J.; Glauber, A.J.; and Ramos, V.S. (2010). *Confronting a changing climate in Michoacán.* World Bank. Retrieved from: http://documents.worldbank.org/curated/en/2010/01/13431499/confronting-changing-climate-michoacán.

2 Government of Australia, Department of the Environment and Heritage, Australia Greenhouse Office. (2006). *Climate change impacts and risk management: A guide for business and government.*

THE PROCESS

In June 2009, Mexico launched the Special Climate Change Program which described the country's overarching strategy for combating climate change. The federal government called for states to take action and offered support in the formulation of state plans. This, together with strong political support from state officials, led to the decision to develop a State of Michoacán Climate Change Action Plan (referred to here as "the Plan"). Under the leadership of the Ministry of Urbanism and Environment, the Government of Michoacán gathered support from federal agencies, including the Secretary of Environment and Natural Resources and the National Institute of Ecology, as well as the World Bank and academia, to launch a framework to guide development of the Plan. In collaboration with the World Bank, the state government held a workshop in November 2009 to start the Plan's preparation. The workshop raised awareness about climate change and gave stakeholders a basic understanding of potential impacts and adaptation measures.

The next step was to determine the impacts of climate change in Michoacán; however, a lack of climate change information and data presented a barrier to this effort. On the one hand, the information needed to be at a local scale to be relevant to day-to-day decision making. On the other hand, providing climate change data at a small scale could increase the uncertainty of climate change projections and reduce their usefulness. In addition, the wide range of expected climate change impacts called for an approach that could generate consensus on priority adaptation responses.

To overcome these barriers, the Government of Michoacán adopted a model that had been successfully implemented in other water-constrained economies. The approach aims to identify and prioritize adaptation measures through the following steps: 1) select key climate variables and identify future trends; 2) analyze resulting impacts on the sector of interest; 3) evaluate the risk as Low, Medium, High, or Extreme based on consequence and likelihood; and 4) identify and prioritize adaptation measures based on the aforementioned levels of risk and expected benefits.

To address the lack of climate change information and data, the state government partnered with the National Autonomous University of Mexico and the World Bank to develop downscaled climate change projections for the state of Michoacán. The results suggested an increase in temperature, more erratic rainfall, and an increase in the frequency and intensity of droughts and flooding. However, the magnitudes of changes were not excessively large, and there was considerable uncertainty in rainfall projections.

In their collaboration with the World Bank, the Government of Michoacán chose to focus on water and agriculture, two key sectors of the state economy.[3] The climate scenarios with the driest, wettest, and medium outcomes were entered into a hydrological model to generate projections of water balances. The analysis showed that even without climate change, there would be considerable unmet water demand due to population and economic growth – under the best (wettest) scenario, the unmet water demand would be at its current high level, and this water deficit would be substantially higher under the worst (driest) scenario.

To prioritize risks and adaptation measures, the Government of Michoacán held another workshop with the World Bank in October 2010. Participants involved in prioritizing adaptation measures for the water sector were sector specialists with knowledge of the Michoacán hydrological master plan. The participants were presented with information on the range of possible climate futures and water balance outcomes. They identified the anticipated impacts of climate change on five key parameters in the water sector (water quantity, water quality, infrastructure, health, and ecosystems), and evaluated the risks based on their likelihood of occurrence, and the magnitude of the anticipated consequences.

3 This case study only focuses on the water sector as it is more relevant to an urban context.

Impact Risk and Vulnerability Matrix of Climate Change for Water, Biodiversity and Health

Features of Climate Change	Water Quantity	Water Quality	Water Infrastructure	Health	Ecosystem
Higher minimum temperatures	Increased evapo-transpiration and decreased water availability Increased use and demand for water	• Increased decomposition and eutrophication • Increases the BOD/ decreased OD Higher concentrations of toxics due to higher evaporation, all leading to a deterioration in water quality	N/A	Need for investment • Increase in the dispersion of air pollutants • Reduces problems of cold-related illnesses • Increase pest problems	Impact on biodiversity • Changes in migration routes • Negative impact on biodiversity due to reduction of spawning areas and changes in pollination
Higher maximum temperatures	Increased evapo-transpiration and decreased water availability Increases use and demand for water	• Increased decomposition and eutrophication • Increases the BOD/ decreased OD Higher concentrations of toxics due to higher evaporation, all leading to a deterioration in water quality	N/A	• Increase in vector and gastrointestinal diseases • Increased stress from high temperatures (heat shock)	Forest fires on the rise • Impact on diversity • Changes in migration routes
Increased intensity of precipitation	• Increased flooding • Increased risk of mudslides • Reduced natural recharge rates Increased erosion	• Increase of polluted runoff • Modification of the natural process of infiltration • Increased sedimentation	• Decreased storage capacity • More complicated treatment of water by surface water turbidity • Water treatment plants do not support large flows • Economic losses for damage to infrastructure and services	Multiple trauma and asphyxiation by landslides and floods • Increased intestinal infections, skin infections and transmission of vector (dengue, malaria, etc)	Impacts on biodiversity • More stress on plants and animals • Flooding and siltation can cause changes in ecosystem functioning

An excerpt of the Impact Risk & Vulnerability Matrix of Climate Change for the Water Sector in Michoacán. Darker color indicates higher risk. (Source: Damanill et al., 2010)

The stakeholders then identified possible adaptation measures and prioritized based on urgency of risk, immediacy of benefits, and the measures' robustness to a wide range of climate futures. The adaptation options were clustered into four broad categories, including improving efficiency of water use; investing in additional storage and reducing water leakage from urban networks; improving land use, reforestation, and agricultural practices; and investing in information systems to inform planning. To address the large uncertainty in rainfall projections, the stakeholders prioritized "no-regret" adaptation measures such as greater efficiency of water use that would be beneficial even without climate change.

The workshops and participatory approach have enabled the stakeholders in Michoacán to reach consensus on a broad set of adaptation priorities in the water and agricultural sectors. Since then, Michoacán has completed their State Climate Change Action Plan; however, several challenges remain related to implementation phases. First, there is a need for more and higher quality information on climate change to reduce uncertainty. Second, additional information on the costs and benefits of adaptation measures is needed to determine the priority and magnitude of adaptation investments. Third, while the climate change agenda has largely been led by the environment department, there is a need to better engage other departments, especially the major economic sectors that hold greater power and will ultimately decide whether to mainstream adaptation into their activities and operations.

LESSONS LEARNED

1. **Given the uncertainties surrounding climate change impacts, adaptation measures need to be robust to withstand a range of possible climate futures.** There is a need for an adaptive decision making process that is responsive to new information over time, and sensitive to the needs of local stakeholders. An incremental approach to adaptation is preferable due to uncertainties in climate change impacts, the need to continue to evaluate the effectiveness of different adaptation measures, and limited resources.

2. **Adaptation priorities should be sequenced in terms of urgency of risk, immediacy and certainty of benefits.** It is insufficient to come up with a list of adaptation options; these investments must be prioritized to facilitate their implementation. For some less-urgent impacts, the best strategy may be to wait until more information is available to enable better decisions, particularly when there is a large cost associated with action and the benefits are less clear. Nevertheless, no-regret measures can still be implemented to increase resilience to these impacts. For most challenge areas, strategies with the largest range of benefits should be prioritized.

3. **Climate change often reinforces the need for measures to improve the efficiency of natural resource use.** Greater efficiency of natural resource use is a no-regret and cost-effective way of adapting to a wide range of climate futures. In Michoacán, measures to improve water use efficiency, such as improved irrigation technology, adjustment of existing water rights to reduce over-allocation of water, and reduction of water leakage from urban networks, were high on the list of priorities as they address both current and future challenges in the water sector. Furthermore, these measures provide benefits under a range of climate change futures, as analysis has shown that there would be unmet water demand in Michoacán even without climate change.

4. **Decision makers need to be careful to avoid maladaptation.** Some policies or practices can inadvertently increase vulnerability to climate change. For example, the *tarifa nueva*, a subsidized energy tariff scheme in the agricultural sector in Michoacán, could increase power consumption and over-abstraction of groundwater, exacerbating water shortage.

FOR MORE INFORMATION

Damanill, R.; George, D.; Jacobsen, M.P.S.; Rodriguez, D.J.; Glauber, A.J.; and Ramos, V.S. (2010). *Confronting a changing climate in Michoacán.* World Bank. Retrieved from: http://documents.worldbank.org/curated/en/2010/01/13431499/confronting-changing-climate-michoacán.

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CASE STUDY

PUBLIC-PRIVATE PARTNERSHIPS FOR FINANCING URBAN INFRASTRUCTURE IN BRAZIL

Rio De Janeiro, Brazil. Photo Credit: Chantal Wagner

BACKGROUND

The city of Rio de Janeiro is one of the largest metropolitan areas in Latin America, home to almost 6 million people. It is an economic and sociocultural powerhouse in the region, recently designated (in part) as a World Heritage Site for its global cultural significance;[1] Rio is among the most visited cities in the southern hemisphere.[2]

Photo credit: David Berkowitz

Unregulated favelas have spread up the hillsides of Rio

Rio is a coastal city experiencing high rates of economic investment and growth, with climate-related vulnerabilities further compounded by the city's topography, spatial development patterns, and a wide range of socio-economic factors.[3] Climate-related hazards include sea level rise, coastal erosion, and increased variability in precipitation patterns, expected to produce worsening extremes, such as alternating periods of drought and an increased incidence of heavy rainfall events. The increase in deluge events is likely to cause surface flooding in low-lying areas and landslides in hilly areas[4] where the poorest of Rio's residents – an estimated 20% of the population – live in informal and unregulated *favelas* that have spread up the city's hillsides.[5] These impoverished neighborhoods lack the basic infrastructure services and systems, both physical and institutional, needed to handle increased climate risks.

This case study explores a unique public-private partnership (PPP) model that can help local governments finance and expedite public infrastructure projects to improve climate resilient infrastructure services, especially in difficult-to-manage informal settlements. PPPs are often touted as economical and effective ways to hold cities accountable for the financial risks and responsibilities associated with development projects. Among many benefits, PPPs can help attract additional financing, improve project selection, accelerate projects, and offer cost-effective design and construction.

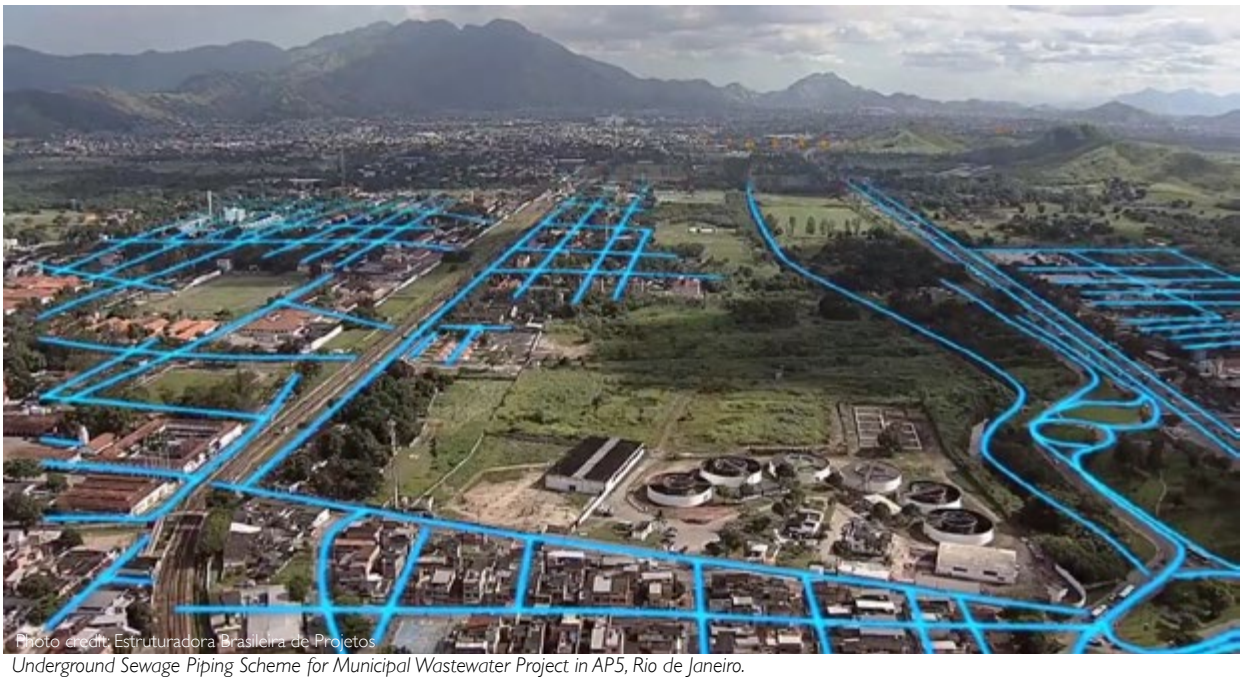
1 UNESCO. (2012, July 1). *Rio de Janeiro: Carioca landscapes between the mountain and the sea.*

2 King, T. (2009, September 11). *Rio de Janeiro's beach culture.* BBC World News Retrieved from: http://news.bbc.co.uk/player/nol/newsid_8250000/newsid_8250700/8250788.stm?bw=bb&mp=wm&news=1&nol_storyid=8250788&bbcws=1.

3 Ramses. Retrieved from: http://www.ramses-cities.eu/cities/rio-de-janeiro/.

4 De Sherbinin, A., Schiller, A., and Pulsipher, A. (2007). The vulnerability of global cities to climate hazards. *Environment and Urbanization*, 19(1), 39–64.

5 CNN. *Rio de Janeiro: Storm city.* Retrieved from: http://www.cnn.com/2012/06/14/world/americas/rio-climate-change-c40/index.html



Underground Sewage Piping Scheme for Municipal Wastewater Project in AP5, Rio de Janeiro.

THE PROCESS

Municipal officials and community members alike are coming to terms with the *favelas'* vulnerabilities, particularly in the face of a changing climate. One informal region, known as Area 5 (AP5), comprises 47% of the city's territory and is home to 2 million people – approximately 30% of the city's population, and some of its poorest citizens. AP5, made up of 21 neighborhoods, has sprawled rapidly in recent years into an unplanned, unmanaged network of informal settlements. Municipal officials have struggled to keep up with its rate of growth, and have been unable to supply adequate infrastructure or social services for the area residents. One of AP5's major infrastructure challenges is wastewater treatment; less than 6% of the wastewater from this location is currently being treated, leading to major sanitation concerns. Impending climate change impacts, such as coastal erosion and tidal flooding that result from sea-level rise and storm events, threaten to further weaken drainage infrastructure and wastewater treatment processes,[6] as a section of AP5's western zone lies below sea level. This has fortified the resolve of municipal officials to address the challenges head-on.

The city of Rio released an invitation for AP5 wastewater project bids on August 25, 2011. However – as is often the case in developing countries – the municipal government did not have the resources or capacity to execute all the necessary pieces of the bidding and procurement processes, including legal services, technical studies, cost assessments, modeling compliance efforts, environmental impact assessments, and other essential processes. Officials recognized that success would demand a high level of agility and speed, particularly because of the two- or three-year window available to elected officials working to accelerate a process and develop mandates before the next election cycle. In an effort to get the AP5 wastewater initiative off the ground swiftly, the municipal government of Rio engaged in a PPP with a new and innovative enterprise, the Estruturadora Brasileira de Projetos (EBP).

EBP is a special purpose company launched in 2009 as a joint venture between the Brazilian Development Bank (BNDES) and eight financial groups to support the public sector in meeting infrastructure and public policy goals by acting as a "sell-side advisor" for PPPs. In this role, EBP assists governments (municipal, state, or federal) in all stages of the bidding and procurement processes, executes studies and assessments to ensure modeling compliance with government regulations, and helps with project economic and financial structuring,

6 CNN. *Rio de Janeiro: Storm city.* Retrieved from: http://www.cnn.com/2012/06/14/world/americas/rio-climate-change-c40/index.html.

among other things. EBP assists local governments with a wide variety of projects, including water supply and sewage management, solid waste, airports and transport, parking and bus terminals, hospitals, and schools. In its four-year history, EBP has advised local governments throughout Brazil, helping structure more than US$1.4 billion in municipal infrastructure projects.


Photo credit: Rio de Janeiro landscape

A key purpose in launching EBP was to help municipalities address the challenge of finding private sector investors willing to invest in public infrastructure projects, which are often perceived by the private sector as politically and financially risky. "I like to say we're a private company that does work in the public interest," said Mr. Helcio Tokeshi, Managing Director of EBP. "Essentially, what we do is take political risks by investing our shareholders' capital in the studies to get a government project off the ground." Formerly Head of the Competition Agency within the Brazilian government's Ministry of Finance, Tokeshi has an in-depth understanding of the difficulties in funding public infrastructure in the country's urban settings.

SUCCESSES AND OUTCOMES

With EBP's support in executing all necessary technical studies, financial models, and contractual proceedings, the bid for a Rio wastewater project in AP5 was awarded to a consortium of Foz do Brasil and Aguas do Brasil in November 2011. The contract includes the significant task of building 2,000 km of underground piping and 19 wastewater treatment stations during a 30-year agreement. Through this system, sewage will be collected from the residences and commercial buildings in AP5 and transported to the treatment stations where the wastewater will be processed and sanitized. Until construction of the project began, less than 6% of sewage from AP5 was being treated. Today, the project has ambitious targets stipulated in the contract, starting with a commitment to achieve 55% treatment by year 5 (2017) and steadily increasing until it reaches the final target of 90% treatment.

The Rio wastewater project is already moving along at a rapid pace. Since the contract signing in the first quarter of 2012, the project inauguration has been held and one wastewater treatment plant has already opened. Capital investments for the AP5 sanitation undertaking are projected to be 1.67 billion Reais (approximately US$ 780 million).

LESSONS LEARNED

1. Trusted partners can add much-needed staffing capacity to local government planning staff and offer access to private investment. The speed and agility with which EBP operates are what make the projects possible. EBP's technical studies have involved upwards of 150 technicians and take approximately two years on average. This relatively fast turnaround would not be possible if the government carried out all necessary assessments and navigated the bidding process, since they do not have the resources. EBP's role is not one of a competitive service provider; they do not bid on the project themselves to promote their own services. As such, municipalities are having their needs addressed by trusted partners quickly and efficiently.

"There were lots of bottlenecks – and they were kind of obvious," said Mr. Tokeshi, of the project model

in use before EBP's launch (see box). "There were lots of money and investment opportunities, but the governments weren't able to prepare a decent pipeline of projects following demands to meet environmental goals, reasonably allocate grants between the public and private sectors, and produce a solid contract behind it all. And so what we do is provide a service that will essentially build these things – we build these studies – and provide good groundwork for the project."

Before utilizing the services of EBP, the municipality had three options in executing these types of large-scale infrastructure projects:

1) Design the project themselves. This would require hiring 10-12 staff to fill capacities lacked in required specialties (legal, engineering, financial, etc.); a time-consuming and difficult option, given limited resources for increasing staffing and capacity.

2) Execute the necessary assessments and feasibility studies themselves, and then contract externally for the actual project design. This process would take many years to complete, given the relative dearth of technical expertise and capacity available within the limited urban planning staff, even in a city with the size and wealth of Rio de Janiero.

3) Release a request for proposals for the whole process. This option would pose risks, since RFP applicants – typically large, full-service construction companies or service providers – often capitalize on their own interests and specialties in their proposals.

"The most crucial benefit that EBP provides our municipality is expertise and knowledge to get these projects off the ground swiftly and engage meaningfully with the private sector investors," said Mr. Gustavo Guerrante, Coordinator for Special Projects to the Secretariat for the Prefecture of Rio de Janeiro. "We know and trust that, as a private company whose success depends on that of the project, they have the best interests of the municipality in mind. Furthermore, their canny sense of investment and their experience working with private companies help attract investors to our projects and ensure that we the municipality are seeing eye-to-eye with them."

EBP assumes the financial risk by investing their shareholders' money in the project up front to get it off the ground. The access that EBP provides to private investment is a game-changer to city governments, as they often lack the financial and business capacities to attract investment from private companies. This mutually beneficial relationship works out in EBP's favor as well, as they are reimbursed by the company who wins the project bid.

> "I like to say we're a private company that does work in the public interest. Essentially, what we do is take political risks by investing our shareholders' capital in the studies to get a government project off the ground."
>
> *– Mr. Helcio Tokeshi, Managing Director of EBP*

2. Investments in infrastructure resilience can help build long-term adaptive capacity to climate change. The Rio government expects that this comprehensive wastewater treatment system will improve the adaptive capacity of AP5 residents in multiple ways. While they cannot eliminate the threat of storm-induced landslides in the hillside favelas, the municipality recognizes that investment in infrastructure projects like these reduces the extent and degree of existing socioeconomic vulnerabilities that keep poor residents living in high-risk areas. AP5 households will benefit from the increased infrastructure capacity from vastly improved wastewater treatment, drainage, and potable water supply systems.

This, in turn, puts them in a position to be better able to cope with – and recover from – increasing severe and more frequent heavy rainfall events, storm surge, and consequential flooding. Secondly, the indirect economic and social stability resulting from running water and proper sewage affords families the opportunity to channel their limited resources to increasing resilience to multiple threats, including climate-related disasters. For example, residents with access to potable, running water and sewage can repurpose time spent securing safe sources of water and disposing of waste to education and training. Decreased social and

economic vulnerability is a central objective in the sustainable and climate-resilient development objectives for city officials, particularly because this elevates the adaptive capacity of the city's poorest residents in the face of disaster.

This project is the first in which the municipality of Rio and EBP have worked together, but Mr. Guerrante notes that they are already planning to partner again on another public infrastructure project. This unique private-public partnership model demonstrates the role and value of an agile intermediary company like EBP in working with city governments to get public infrastructure projects financed and off the ground quickly and efficiently. It is a model that can be replicated elsewhere for climate resilient infrastructure projects that are often seen as too risky to investors.

FOR MORE INFORMATION

De Sherbinin, A., Schiller, A., and Pulsipher, A. (2007). The vulnerability of global cities to climate hazards. *Environment and Urbanization*, 19(1), 39–64.

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CASE STUDY

INTEGRATING CLIMATE RESILIENCE INTO URBAN PLANNING IN VIETNAM

Hue, Vietnam. Photo Credit: David McKelvey

BACKGROUND

The city of Hue, in central Vietnam, is a favorite vacation destination for both Vietnamese and foreign tourists. Hue is home to 340,000 residents and the Citadel, a walled fortress that contains the imperial grounds of the former Nguyen dynasty, is a popular United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site. Hue is a growing city and serves as a regional transportation hub; however, climate change poses threats to this city's continued success.

Hue is subject to typhoon-induced floods that are projected to become more extreme as the climate continues to change.[1] Climate change will also bring temperature increases and sea level rise that pose risks to tourism, public health, and infrastructure.[2]

One strategy to help build city-wide resilience to these impacts is to incorporate climate change and adaptation considerations into the city's urban plans. However, integrating climate change information into land-use decisions and urban planning is a challenge for Hue and many other cities, due in part to the complexity and sheer volume of climate information, as well as the difficulty of altering established planning processes.

A project team working under USAID's Climate Change Resilient Development (CCRD) Climate Resilient Infrastructure Services (CRIS) program has been collaborating with a diverse group of city stakeholders to customize and apply a tailored software tool that facilitates integration of climate change considerations into Hue's urban planning process. This Climate Impacts Decision Support Tool (CIMPACT-DST™) was originally built by Cascadia Consulting Group to help staff at the City of Seattle, Washington in the United States to identify and address projected climate impacts to city assets and infrastructure (see box, page 34).

The tool brings together information about locally relevant climate stresses – information that is typically found in multiple technical reports and is often difficult for non-scientists to interpret – into one place, using language that is accessible to urban planners and other city staff. By providing concise and easy-to-understand summaries of local climate change impacts and displaying these alongside adaptation strategies, a tool user can quickly identify which climate change impacts they need to consider; how those impacts may affect a specific sector and location; and what responses or adaptation strategies they should consider to improve resilience in their project design and land-use decisions. Adaptation strategies integrated into the tool are based on feedback gathered through local stakeholder engagement.

1 Institute of Meteorology Hydrology and Environment (IMHEN). (2012). *Climate change, sea level rise scenarios for Vietnam.*
2 Tran, P., & Shaw, R. (2007). Towards an integrated approach of disaster and environment management: A case study of Thua Thien Hue province, central Viet Nam. *Environmental Hazards*, 7(4), 271–282. Retrieved from: doi:10.1016/j.envhaz.2007.03.001.

The project team worked closely with local collaborators to customize the tool's organizational structure and embedded information to reflect Hue's local context. In the Hue CIMPACT-DST, adaptation guidelines are segregated into three categories: Physical System, People/Community, and Institutional. The Physical System category includes "hard" infrastructure recommendations, such as the incorporation of reflective materials into paved areas and walkways, while the People/Community and Institutional categories include policy changes and "soft" land-use and operational considerations, such as strategies to increase public access to drinking water during high heat events. This case study highlights important lessons applicable to all climate change adaptation projects, including how cities can overcome challenges in obtaining and maintaining reliable, actionable climate information and how local stakeholders play a key role in ensuring the success of a project such as the Hue CIMPACT-DST.

THE SEATTLE CLIMATE IMPACTS PLANNING TOOL

Cascadia Consulting Group first developed the Climate Impacts Decision Support Tool (CIMPACT-DST) for the City of Seattle, Washington, USA to assist city staff in incorporating climate change considerations into their decision making.

A new policy required that staff consider climate change in their infrastructure projects, but the city lacked a clear resource or tool to guide staff through the process. CIMPACT-DST allowed the city to consolidate and tailor climate information and adaptation guidance for their staff so that it was relevant to their individual job responsibilities, focused on issues important to the City of Seattle, and consistent with other pertinent local policies.

The tool's initial deployment occurred in 2011. One prominent example of the city's use of the tool to improve climate-resilient decision making involves a bridge retrofit conducted by the Seattle Department of Transportation. A project team used the tool to inform reconstruction of a local drawbridge, and as a result, engineers discovered that the planned bridge joints were not compatible with projected future temperature increases. With this information, engineers revised the expansion joint design – saving money on future maintenance and insuring better long-term bridge function.

THE PROCESS

Gathering, reviewing, and refining the information inherent in climate impacts planning requires considerable time and stakeholder engagement. For Hue, it was important that the users of the tool (primarily city staff) were confident that the information was "approved" by their leaders. To achieve this, local stakeholders worked together to reach important decisions around what information to include, from which sources, and how best to organize that information to integrate with existing urban planning processes and systems.

During the process, a key project partner was the Institute for Social and Environmental Transition (ISET), an NGO with a local presence and established stakeholder relationships. A local stakeholder group, previously assembled to advise an earlier vulnerability assessment, provided important contributors who reviewed much of the tool's core information. This group consisted of representatives from the following organizations:

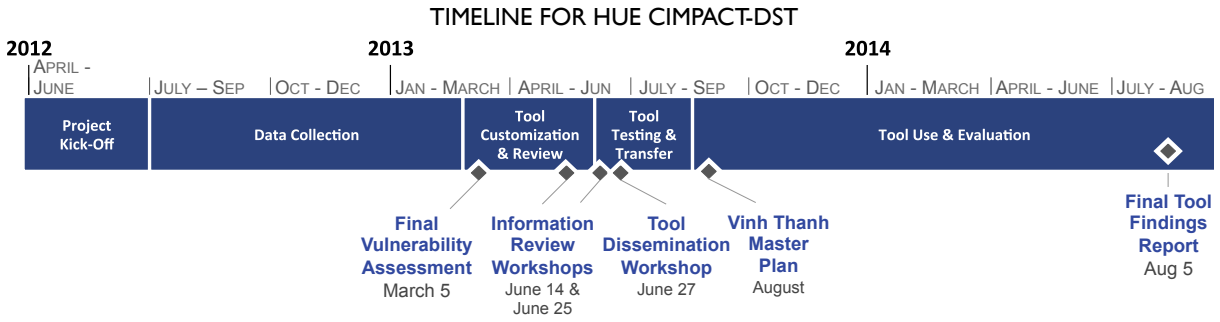
- Department of Natural Resources and Environment (DONRE)
- Board of Flood and Typhoon Prevention
- Association of Planning and Urban Development
- Department of Planning and Investment
- Department of Architecture, Hue College of Sciences
- Department of Agriculture and Rural Development (DARD)
- Hue Monuments Conservation Center
- Department of Construction (DOC)

The Hue Planning Institute (HPI or the Institute) served as the project's primary local "champion" as well as eventual administrator and core user of the tool. This Institute, a quasi-governmental entity that functions as an in-house consultant for the Provincial Department of Construction, was chosen by the project team for its close ties to the local planning context, policy makers, and government agencies, as well as the willingness and interest of its director to address climate change in their work.

The project team aimed to build confidence in the tool by bringing in local information and knowledge from these and other collaborators. Climate information and guidance was locally vetted and then revised based on

stakeholder feedback. Tool outputs were tailored in a way that works with the city's current urban planning classification systems and processes.

PROJECT TIMELINE



Challenge #1: Information Surplus, Scarcity, and Validation

Configuring the CIMPACT-DST tool for Hue required the compilation and consolidation of the most relevant local climate change information. These data included regional climate projections approved by the national government, local-scale spatial representations of current and future climate impacts (e.g., flood maps), climate-related policies, and sector-specific climate impact summaries and adaptation strategies. In Hue, the project team faced two seemingly contradictory challenges in gathering and summarizing these data: one stemming from a surplus of information, and the other from a scarcity of information.

The project team was presented with a multitude of local and regional climate-related reports and information sources to be reviewed and approved by local stakeholders. Following a major flood in 1999, more than 70 climate-related studies had been conducted within the project area, which varied in their level of depth and relevance to the project. Sifting through such a large volume of reports to find accurate, relevant, accepted inputs for the tool presented a significant challenge.

To address the surplus of climate impacts and guidance information, the project team devised a systematic and adaptive process for reviewing, vetting, and consolidating available information. Cascadia worked closely with a local partner NGO and a previously established working group to engage with the city on a multi-stakeholder vulnerability assessment study. This included convening a workshop to review and gather feedback on the proposed climate planning tool framework and climate information sources. The stakeholder group of local leaders and experts became well-informed about the key climate issues facing Hue, able to effectively review and revise the presented information to ensure the tool's reliability and relevance. The project team worked with the stakeholder group over the course of several months to review and revise the key tool inputs.

Cascadia worked closely with participants from a recent climate vulnerability assessment process conducted in 2012 and 2013 in Hue (sponsored by USAID's M-BRACE program) to leverage the momentum, relationships, and information built from that project.

At the same time, the project team faced a lack of high-resolution, city-scale, climate information. Lower-resolution regional climate information is available through the Vietnam Institute of Meteorology, Hydrology, and Environment (IMHEN), which provides climate projections for temperature, precipitation, and sea level rise. However, there are other elements of urban

planning, such as flood risk mapping, for which IMHEN's data is either unavailable or insufficient. Obtaining such information requires the use of more sophisticated, localized models and spatial information than those readily available from a national level government agency such as IMHEN – a situation not unique to Vietnam.

To address the lack of spatially relevant information, the project team convened the same stakeholder group for a spatial information workshop during which they were asked to review and "ground-truth" existing flood maps and identify areas where urban heat islands were known to exist. This local knowledge and insight was fundamental to creating the climate impact maps that are used in conjunction with the Hue CIMPACT-DST tool.

Local partner Dr. Phong Tran, from the Institute for Social and Environmental Transition (ISET), solicited stakeholder input on the flood maps that were integrated into the climate impacts planning tool.

To set the stage for continued provision of dependable, comprehensive climate information, the project team transferred the final configured tool, along with responsibility for maintenance and updates, to HPI. After undergoing extensive training on the tool's maintenance and update procedures, staff at HPI confidently assumed the role of primary tool administrators, while the Institute's director, who has strong ties to the local and provincial leadership, supervised tool management and dissemination. Allowing the tool to stay within local ownership assured tool users in Hue that the information and guidance in the tool will continue to be locally relevant and will reflect local policies, strategies, and context.

Challenge #2: Stakeholder Coordination, Engagement, and Buy-in

For optimal utility, information programmed into the tool must not only be accurate, it must also be accepted by tool stakeholders; relevant to day-to-day decision making; tailored to the political, social, and natural geography of the locale; and contributive toward building the city's resilience. Identifying and selecting information that met these criteria required both coordination and engagement of local leaders, experts, and stakeholders across diverse sectors, disciplines, and affiliations. Local government departments in Vietnam exist in silos (not unique to Vietnam, of course), and this configuration presents an ongoing challenge for adequately addressing such crosscutting issues as climate change.

To coordinate and engage the diverse tool stakeholder group, the project team leveraged existing resources and established trusting relationships with key leaders and experts within the Hue community. By using the momentum, relationships, and progress from an existing stakeholder engagement process, the team efficiently solicited vital design input, review, and outreach. Partnering with a key local climate expert, Dr. Phong Tran of ISET, helped the team identify, review, and refine the available input data. Identification of a local "tool champion," the Director of the HPI, was also critical for paving a path toward local tool ownership, maintenance, and continued use after project completion. The project's concluding workshop was widely attended and highly publicized and allowed the team to secure critical buy-in and trust among local government staff and officials from multiple departments and positions. These steps to identify key contacts, build relationships, and convene relevant stakeholders were essential to project success.

At the tool dissemination workshop, Mr. Le Dien Minh of Flood and Storm Prevention discussed the role of private contractors in the tool's implementation.

SUCCESSES AND OUTCOMES

Through assembling and reviewing relevant climate information, emphasizing local partnerships, and building stakeholder relationships, the Hue climate impacts tool was deployed for use in urban planning in August 2013. Since its initial deployment, the tool has been used to inform a new climate-resilient urban master plan for the nearby Vinh Thanh commune, with additional urban master plans slated to be finished in the coming months. HPI used the tool to make three key modifications to improve the climate resilience of the urban master plan for Vinh Thanh – a rural coastal community poised to grow substantially in the near future.

Mr. Nguyen Viet Tien, former Director of the Department of Construction (DOC) and Hue City People's Committee Chairman and current Chairman of Thua Thien Hue Planning and Development Association, spoke at the tool dissemination workshop about the importance of securing widespread support for the tool and using accepted and official information.

The first modification was the relocation of a residential zone farther inland, away from the coastline and the lagoon. This added buffer will reduce future residents' exposure to inundation and storm surge from destructive storms and typhoons, expected to become increasingly severe as the climate changes.

The Hue Planning Institute (HPI) played a crucial role in guiding tool development, securing stakeholder buy-in and using the tool to inform local planning projects. During the project team's recent visit to Hue, Dr. Nam, director of HPI, and Mr. Linh, urban planner at HPI, took Cascadia staff on a tour of nearby Vinh Thanh commune, where the tool was used to inform the development of the Institute's first climate-resilient urban master plan.

The second change involved a low-lying area between the lagoon and the coast, which is currently occupied by rice paddies. Because intrusion of saltwater into these lowlands has made it harder to grow rice, planners were weighing different options for new uses for that land, with eco-tourism infrastructure the leading candidate. Insights from the tool suggested that such low-lying areas are best kept as green space to allow for adequate drainage or storage of floodwater during storms. Given this guidance, HPI decided to preserve the natural drainage features of this area, promote farming of more salt-tolerant crops, and locate eco-tourism infrastructure elsewhere.

Lastly, HPI modified its plan for areas directly adjacent to the beach. The beautiful beaches of Vinh Thanh give it great potential as a tourist destination; traditionally, such areas would be slated for beachfront resorts and large restaurants. Heeding the guidance provided by the tool to maintain natural coastlines with buffers to mitigate storm surge, HPI planners revised their thinking. The master plan they developed preserves the beaches' protective dunes and apportions the beachfront area for less substantial infrastructure, such as beach huts and small bars. Resorts would be located farther inland.

Seeing the results in Vinh Thanh, HPI has starting applying it elsewhere, further customizing the tool to extend its applicability. After recently integrating GIS software into their planning processes, the Institute took the lead in replacing the tool's initial flood maps with newly updated versions. They also plan to work closely with tool developer, Cascadia Consulting Group, to evaluate and further optimize the tool, including the incorporation of report-ready outputs that better mesh with the Institute's existing urban planning templates. HPI will continue working with the Cascadia project team to solidify a process for regularly

The new climate-resilient urban master plan for Vinh Thanh commune, for which urban planners at HPI used the tool to make three key planning changes: 1) a residential zoning shift inland to minimize exposure to storm surge, 2) an emphasis on low-impact coastal tourism development, and 3) preservation of drainage-conducive agricultural zones.

updating and disseminating the tool as new information and policies arise. The process will include an ongoing stakeholder engagement process, led by HPI, that brings in expert input, review, and approval from representatives of local and provincial governmental agencies.

LESSONS LEARNED

The challenges and successes of this project revealed the following key lessons:

1. **Tap local knowledge.** When faced with both an over- and under-abundance of climate information, insight and review from local experts and leaders is crucial to prioritizing, ground-truthing, and amending the information for improved usefulness and dependability.

2. **Establish and foster key relationships.** Establishing close collaborative relationships with local and respected climate experts (if they exist) and one or more key stakeholder organizations is vital to generating "acceptable" and locally relevant climate information as well as overall project support.

3. **Secure buy-in.** Organization of a culminating project workshop can promote cross-departmental coordination and buy-in for the project, nurturing a sense of local ownership and inciting enthusiasm for the project.

4. **Leverage existing processes and resources.** Instead of building a stakeholder group and review process from scratch, wherever possible leverage the relationships, processes, and momentum of an existing stakeholder group or process, saving on precious time and resources for both the project team and its stakeholders.

Aquaculture, which borders the Tam Giang lagoon in Vinh Thanh, serves as an important industry for the commune.

FOR MORE INFORMATION

Institute of Meteorology Hydrology and Environment (IMHEN). (2012). *Climate change, sea level rise scenarios for Vietnam.*

Tran, P., & Shaw, R. (2007). Towards an integrated approach of disaster and environment management: A case study of Thua Thien Hue province, central Viet Nam. *Environmental Hazards*, 7(4), 271–282. Retrieved from: doi:10.1016/j.envhaz.2007.03.001.

Climate IMPACT Decision Support Tool- http://www.cascadiaconsulting.com/services/climate/climate_adaptation_planning

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CASE STUDY

ALBAY PROVINCE: A MODEL FOR DISASTER PREPAREDNESS AND RESILIENCE

City of Legazpi with Mayon Volcano in the background. Photo Credit: Wim Hertog

BACKGROUND

Located on the eastern coast of the Philippines, Albay Province is commonly regarded by Filipinos as the "Vatican of Disasters."[1] In 2006, a major landslide and two cataclysmic typhoons affected hundreds of thousands, killing 755. Albay is also prone to volcanic and seismic activity from Mount Mayon, which has erupted four times since 1999, and is a source of ash and debris runoff into villages during heavy rains, even when the volcano is not active. The impacts of climate change threaten to add to the list of vulnerabilities facing Albay in the future. In recent years, sea level rise and increased incidence of severe weather events, coupled with variability in temperature and precipitation patterns, have led to greater storm surge, severe flooding, and deadly landslides.[2]

Because climate impacts threaten to worsen the region's existing vulnerability, local and regional officials are proactively seeking ways to increase community resilience by incorporating climate change adaptation strategies into their pre-disaster planning processes. This allows them to effectively integrate lessons learned from recent and historical response and recovery experiences into tools, tactics, and strategies for climate preparedness and long-term adaptation. Although funding sources to address climate change impacts differ from those allocated for disaster risk reduction of non-climate stressors like earthquakes and volcanic eruptions, aligning these efforts to design a comprehensive risk management plan is highly beneficial.

This case study describes a model multi-hazard, no-regrets approach to pre-disaster planning developed by the municipality of Albay to mitigate the impacts of both geological and climate-related disasters and to build local adaptive capacity.

PROCESS

In an effort to ensure the safety of its citizens, the municipal government of Albay recognized that while natural disasters may not be avoidable, proper planning before a disaster strikes can dramatically reduce the impact on citizens, infrastructure, and the local economy. Local leaders in the region have been recognized internationally for their comprehensive and innovative approach to combining disaster risk reduction (DRR) and climate change adaptation (CCA), considered to be a successful model for resilience.

1 Salceda, J.S. (2012). Adapting to climate change: Strategies of Albay, Philippines. *Agriculture and Development Notes on Climate Change Adaptation*, 2(1). Retrieved from: http://climatechange.searca.org/index.php/climate-change-adaptation-knowledge-showcases-5/adaptation-notes/1243-adapting-toclimate-change-strategies-of-albay-philippines.

2 Yumul, G.P., Cruz N.A., Servando, N.T. and Dimalanta, C.B. (2011). Extreme weather events and related disasters in the Philippines, 2004–08: a sign of what climate change will mean? *Disasters*, 35(2), 362-382. Blackwell Publishing. Retrieved from: http://onlinelibrary.wiley.com/doi/10.1111/j.1467-7717.2010.01216.x/pdf.

Since assuming office in 2007, Governor Joey Salceda – known in the Philippines as the "Green Economist"– has championed a "Zero Casualty"[3] plan, which builds off the existing disaster preparedness strategy and combines preparedness education for citizens, disaster risk mapping, early warning systems (including Albay's own radar for monitoring typhoons and a system for predicting volcanic eruptions, coordinated with the Philippine Institute of Volcanology and Seismology), strategies for evacuation and resettlement, and humanitarian aid efforts.[4]


Photo credit: Shubert Ciencia
Mayon Volcano, Albay Province

These DRR and CCA efforts complement a host of local climate change measures – including measures to both reduce and prevent impacts – implemented through a wide variety of government, nonprofit, grassroots, and private sector partners (see below). The local government focuses on institutionalizing DRR and CCA and mainstreaming these concepts, approaches, and objectives into existing poverty reduction and quality of life efforts.

Multisectoral Institutions Tasked with Executing the Zero Casualty Plan[5]

Institution	Role
Albay Public Safety and Emergency Management Office (APSEMO)	An office that implements DRR programs and serves as the hub of coordination, communication, and emergency response in all types of emergencies and disasters.
Albay Millennium Development Goals Office (AMDGO)	A project office designed to respond to the rehabilitation and recovery phase of DRR.
Centre for Initiatives and Research on Climate Adaptation (CIRCA)	A center tasked with promoting climate risk adaptation and public education via the various academic institutions in the province.
Team Albay	A corps of volunteers trained in emergency response.
Provincial Disaster Risk Reduction and Management Council (PDRRMC)	A cohort of local radio stations which help disseminate public service announcements and early warnings via their broadcasts.
Climate Change Academy[6]	An education/training effort which seeks to streamline local DRR and CCA efforts across the country to fit with the national strategy by building the capacity of municipal governments and related stakeholders.

3 Salceda, J. (2013, October 3). *Zero casualty: DRRM in Albay* (powerpoint presentation). Global Public Innovations Conference. Retrieved from: http://www.galingpook.org/main/images/gpic_presentations/Day1_PM_Panel2_1Philippines(Albay)_Salceda.pdf.

4 Abano, I.V. (2014, February 3). *In the Philippines, a model for confronting climate change and nearly every disaster you can think of*. CitiScope. Retrieved from: http://www.citiscope.org/story/2014/philippines-model-confronting-climate-change-and-nearly-every-disaster-you-can-think.

5 Espinas, A. (2012/2013). Geography and public planning: Albay and disaster risk management. *Human Development Network*. Discussion Paper Series PHDR 4. Retrieved from: http://hdn.org.ph/wp-content/uploads/DP_04_Espinas.pdf.

6 The curriculum of Albay's Climate Change Academy includes awareness building on disaster risks and climate change issues; scenario building, climate and disaster risk assessment, and disaster risk management; technical assistance to mainstream disaster and climate risk management in local planning processes; and guided experiential learning in the implementation of "disaster or climate proofing" by local stakeholders. For more information visit: http://www.mdgphilippines.org/tools/?jp&tool=68

SUCCESSES AND OUTCOMES

In 18 of the last 19 years, with an average of eight to nine storms impacting the province per year, there were no casualties, perhaps a direct reflection of the success of Albay's comprehensive Zero Casualty plan.[7,8]

Photo credit: Phillippine News Agency

Albay Governor Joey Salceda is named the Senior Global Champion of Disaster Risk Reduction in 2010 at the opening of the Asian Ministerial Conference on DRR in South Korea

One of the plan's major successes is its comprehensive, institutionalized approach that coordinates actors across sectors and departmental boundaries: from governmental entities focused on development and land use planning, to elected officials working on policy formulation and budget appropriations, to nonprofit and civil society groups accelerating local strategies to reduce poverty and improve public health and educational attainment. Salceda emphasizes the importance of mainstreaming CCA and DRR approaches and actions into virtually every facet of local government.

Other countries in Southeast Asia look to Albay as a guide when designing their own DRR and CCA strategies, and officials from a host of countries have attended Albay's Climate Change Academy, including industry leaders from Cambodia, Indonesia, and Vietnam.[9]

In 2008, Albay Province was declared a "Global Local Government Unit (LGU) model for Climate Change Adaptation" by UN-ISDR and the World Bank, and in 2012 the Zero Casualty policy to natural disasters was recognized by the Guangzhou International Awards for Urban Innovation as a model approach.

"Local governments must be more accountable when disaster strikes," said Salceda, recently named Co-Chair of the Board of Directors for the United Nations Green Climate Fund. "Responsibility must come with resources for capacity building, equipment, and people. Making the extraordinary very ordinary is the thing to do. There should be a state of common sense when a disaster strikes."[10]

7 Uy, V. (2013, November 27). *7 lessons on how to build back better after 'Yolanda'*. InterAksyon. Retrieved from: http://www.interaksyon.com/article/75697/buildback-better-after-yolanda-7-lessons-from-albay-europe-latam-africa-and-a-pinoy-architect.

8 Brown, S. (2013, November 11). The Philippines is the most storm-exposed country on Earth. *TIME*. Retrieved from: http://world.time.com/2013/11/11/thephilippines-is-the-most-storm-exposed-country-on-earth/#ixzz2uHGkv3e8.

9 Abano, I.V. (2014, February 3). *In the Philippines, a model for confronting climate change and nearly every disaster you can think of*. CitiScope. Retrieved from: http://www.citiscope.org/story/2014/philippines-model-confronting-climate-change-and-nearly-every-disaster-you-can-think.

10 Abano, I.V. (2014, February 4). *Joey Salceda: Key to disaster preparation is "Making the extraordinary very ordinary"*. CitiScope. Retrieved from: http://www.citiscope.org/story/2014/joey-salceda-key-disaster-preparation-%E2%80%9Cmaking-extraordinary-very-ordinary%E2%80%9D.

LESSONS LEARNED

> "Disaster risk reduction and climate change adaptation converge naturally, spontaneously, and seamlessly on the ground. We have to do this for the people and for the planet. All it takes is political will."
>
> *– Joey Salceda, Co-Chair of the Board of Directors for the United Nations Green Climate Fund*

1. **Focus on prevention.** This model process exemplifies the notion that *an ounce of prevention is worth a pound of cure*. All in all, Albay Province spends nine percent of its budget on DRR and CCA activities.[11] Local government officials seeking to replicate the model process used by local leaders in Albay Province may balk at the high level of effort needed to convene, align, and mainstream disaster mitigation and climate preparedness elements into existing community processes. However, through these intensive pre-disaster planning measures, every dollar spent on risk reduction is estimated to save between $5 and $10 in economic losses post-disasters.[12]

2. **Understand the science.** *"Science saves lives,"* said Salceda. "Local officials must understand the science behind climate change so they will know how to respond to it. Disaster risk reduction and climate change adaptation converge naturally, spontaneously, and seamlessly on the ground. We have to do this for the people and for the planet. All it takes is political will."[13]

FOR MORE INFORMATION

Salceda, J.S. (2012). Adapting to climate change: Strategies of Albay, Philippines. *Agriculture and Development Notes on Climate Change Adaptation,* 2(1). Retrieved from: http://climatechange.searca.org/index.php/climate-change-adaptation-knowledge-showcases-5/adaptation-notes/1243-adapting-toclimate-change-strategies-of-albay-philippines.

Yumul, G.P., Cruz N.A., Servando, N.T. and Dimalanta, C.B. (2011). Extreme weather events and related disasters in the Philippines, 2004–08: a sign of what climate change will mean? *Disasters*, 35(2), 362-382. Blackwell Publishing. Retrieved from: http://onlinelibrary.wiley.com/doi/10.1111/j.1467-7717.2010.01216.x/pdf.

Espinas, A. (2012/2013). Geography and public planning: Albay and disaster risk management. *Human Development Network*. Discussion Paper Series PHDR 4. Retrieved from: http://hdn.org.ph/wp-content/uploads/DP_04_Espinas.pdf.

11 Abano, I.V. (2014, February 3). *In the Philippines, a model for confronting climate change and nearly every disaster you can think of.* CitiScope. Retrieved from: http://www.citiscope.org/story/2014/philippines-model-confronting-climate-change-and-nearly-every-disaster-you-can-think.

12 Schwartz, E. (2006, March 23). A needless toll of natural disasters. Op-Ed; *Boston Globe*. Retrieved from: http://www.boston.com/news/globe/editorial_opinion/oped/articles/2006/03/23/a_needless_toll_of_natural_disasters/

13 Abano, I.V. (2014, February 4). *Joey Salceda: Key to disaster preparation is "Making the extraordinary very ordinary"*. CitiScope. Retrieved from: http://www.citiscope.org/story/2014/joey-salceda-key-disaster-preparation-%E2%80%9Cmaking-extraordinary-very-ordinary%E2%80%9D.

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CASE STUDY

QUITO, ECUADOR: DEVELOPING AND IMPLEMENTING A CITY-LEVEL CLIMATE CHANGE STRATEGY

Quito, Ecuador. Photo Credit: Yassef Briceño García

BACKGROUND

The city of Quito is located at 2,800 meters above sea level in the Central Andes. Quito is at high risk of floods and landslides due to its landscape of steep slopes, ravines, and gorges. The city is also vulnerable to forest fires, which are mainly caused by Quito's intense and prolonged summers, the traditional practice of burning fields to prepare for the planting of crops, arsonists, accidental fires and irresponsible and inadequate fire management.[1] In 2012 alone, 2,600 forest fires were reported in the Metropolitan District of Quito, which includes the city of Quito and surrounding parishes.[2] In 2011, nearly 144 landslides during the rainy season caused severe damage to the city.[3] Additionally, the city has massive seismic movements and has experienced earthquakes and volcanic eruptions in the past.

In the last 100 years, Quito has experienced an average temperature increase of 1.2°C to 1.4°C. The change in the city's climate patterns affects ecosystems, infrastructure, water availability, human health, security and hydroelectric generation, both directly and indirectly.[4] Temperature increases and changing precipitation patterns due to climate change threaten to cause glacial retreat and the loss of páramo ecosystems, which in turn affect water supply in Quito. Forest fires may also increase as a result of more intense and longer dry spells. In addition, climate change is projected to increase the frequency and intensity of extreme rainfall events, exacerbating floods and landslides. These changes will have negative impacts on the infrastructure and residents of Quito, particularly those living in informal settlements on steep hillsides or in the urban periphery.

In response to these current and future challenges, Quito has developed a City Climate Change Strategy.[5] The city has also created a Climate Change Action Plan (2012-2016)[6] that identifies concrete adaptation actions to implement the strategy. Quito is one of the first cities in Latin America to have adopted voluntary mitigation and adaptation commitments as part of its Environmental Agenda (2011-2016).[7] This case study describes how the city of Quito has built upon earlier disaster prevention and preparedness experience and cooperated

1 FLACSO and UNEP. (2011). *Quito environment and climate change outlook.* Retrieved from: http://www.pnuma.org/deat1/pdf/2011%20-%20ECCO%20Quito%20Summary%20(web).pdf.
2 Rockefeller Foundation. (2013). *100 Resilient Cities: Quito, Ecuador.* Retrieved from: http://100resilientcities.rockefellerfoundation.org/cities/entry/quitos-resilience-challenge.
3 Rockefeller Foundation. (2013). *100 Resilient Cities: Quito, Ecuador.* Retrieved from: http://100resilientcities.rockefellerfoundation.org/cities/entry/quitos-resilience-challenge.
4 Zambrano-Barrágan, C., Zevallos, O., Villacís, M. and Zevallos, D.E. (2010). *Quito's climate change strategy: A response to climate change in the metropolitan district of Quito.* Paper prepared for the 1st World Congress on Cities and Adaptation to Climate Change, Bonn, Germany.
5 Municipality of the Metropolitan District of Quito, Secretariat of the Environment. (2009). *Quito climate change strategy.*
6 Municipality of the Metropolitan District of Quito, Secretariat of the Environment. (2012). *Quito climate change action plan (2012-2016).*
7 Municipality of the Metropolitan District of Quito, Secretariat of the Environment. (2011). *Quito environmental agenda (2011-2016).*

with key stakeholders, including various municipal agencies, the private sector, academia, and civil society, to successfully develop a climate change strategy and facilitate its implementation.

PROCESS

The City of Quito, Ecuador

Due to the prevalence of natural disasters, local government officials in Quito realized the importance of disaster risk management many years ago and have implemented a series of strategies to reduce disaster risks. These include hillside management (since 1997); improved glacier monitoring (since 1998); flood control (since 1999); watershed protection (since 2000); and urban agriculture (since 2002) to increase food security, especially in marginalized communities living on the hillsides and slopes.[8] These programs have gradually moved from emergency response to integrated disaster prevention and preparedness for two reasons. First, Quito's metropolitan area has increased 20-fold and its population has increased six-fold since 1950, causing the existing disaster response strategies to be insufficient to address the increasing governance and development needs of the city. Second, there was a strong need to complement national level actions with local government initiatives and leadership.[9]

The city of Quito has also made important changes in its governance structure, including the creation of new public bodies responsible for climate change adaptation as part of the 1993 reform of Quito municipal law. They also passed administrative decentralization and participatory management reforms (starting in 2000) that increase the involvement of civil society and academia in local policy-making.

These early programs and the enabling policy environment created momentum for the city of Quito to pursue the development of a Climate Change Strategy. The strategy first gained traction in late 2006 when Quito decided to host the 2007 Clima Latino event, the first regional climate change and development conference in the Andean states. Following the decision to host the event, Gonzalo Ortiz, a Metropolitan Councilor, gave a presentation to fellow Council members about the need for Quito to develop a climate mitigation and adaptation strategy in light of recent data on temperature and glacial changes. He received strong support from fellow Council members and the former Mayor, Paco Moncayo, and was empowered to create an Inter-Institutional Commission consisting of several municipal agencies to prepare the draft strategy. The municipality was motivated to complete a draft climate strategy in time for the Clima Latino conference to demonstrate Quito's leadership on the issue.[10] The Inter-Institutional Commission then presented the draft strategy to key municipal agencies and consulted with community-based organizations and non-governmental organizations, including representatives from the most vulnerable communities. The strategy was finalized in 2008, and was adopted as an official municipal policy in 2009, when the current administration of Mayor Augusto Barrera took office.

The Quito Climate Change Strategy addresses both adaptation and mitigation and is organized into four strategic areas: (1) information generation and management; (2) use of technologies and good environmental practices; (3) communication, education, and citizen participation; and (4) institutional strengthening and

8 Anguelovski, I. (2009). Building the resilience of vulnerable communities in Quito: Adapting local food systems to climate change. *Urban Agriculture Magazine,* 22. Retrieved from: http://www.ruaf.org/sites/default/files/UAM22%20Quito%2025-26.pdf.

9 Evidence and Lessons Learned for Latin America (ELLA). (2013). *City-level climate change adaptation strategies: The case of Quito, Ecuador.* Retrieved from: http://ella.practicalaction.org/node/1091.

10 Carmin, J., Anguelovski, I. and Roberts, D. (2012). Urban climate adaptation in the global south: Planning in an emerging policy domain. *Journal of Planning Education and Research* 32(1), 18-32.

capacity building. Given that the city's Secretariat of Environment is responsible for managing the climate adaptation strategy and coordinating with the various actors involved, while the municipal government is responsible for adaptation policy-making, in order to implement the Strategy, the municipal government adopted, in 2012, Quito's Climate Action Plan. Therefore, the Strategy aims to develop comprehensive policies that guarantee the implementation of adaptation and mitigation measures, while the Action Plan identifies concrete adaptation and mitigation actions. The Action Plan comprises a portfolio of 29 strategic projects in three areas: information generation and management, adaptation and mitigation in strategic sectors, and citizen participation and stewardship.

In developing the Climate Change Strategy, Quito opted not to conduct a separate vulnerability assessment at the start of the adaptation planning process, but to build on existing studies on climate-related risks. More recently, as part of Quito's Climate Action Plan and with the support of the Climate and Development Knowledge Network, the city developed a detailed vulnerability and adaptation assessment. In addition, to implement the Climate Change Strategy and Action Plan, the city of Quito is now creating two institutional mechanisms, including Quito's Panel on Climate Change (a scientific and expert committee to advise the municipality on climate change actions) and the Metropolitan Climate Change Committee (a committee consisting of key representatives from the main local institutions).

SUCCESSES AND OUTCOMES

The Quito Climate Change Action Plan (2012-2016) identifies and describes specific adaptation measures to support the Climate Change Strategy. The adaptation actions focus on five sectors, including drinking water provision, infrastructure and productive systems, risk management, health, and ecosystems and biodiversity. The actions target short- to medium-term goals and have concrete time horizons for completion. In a context of limited resources, the Action Plan prioritizes measures and actions that have multiple benefits, focusing on adaptation, mitigation and sustainable development. Selected climate adaptation actions in Quito and their implementation status are presented below:

Selected adaptation actions and their implementation status in Quito (adapted from ELLA, 2013)

Adaptation actions	Results
Integrated Climate Risk and Early Warning Plan	In progress
Actions related to Quito's Water and Sanitation Master Plan (2010-2040), e.g., investment in water conservation plans, water supply infrastructure, and storm drainage systems	Infrastructure activities range from 10% to 100% completed
Hillside Management Program (since 1997) to minimize landslides and mudslides	Social vulnerability study, disaster risk reduction plan, 25 small-scale works and 51 large-scale works completed
Youth Action on Climate Change (since 2000)	20 innovative projects by high schools, NGOs, and universities; environmental film festival
Actions built on Urban Agriculture program (since 2002), e.g., helping indigenous and migrant dwellers improve agricultural productivity and business kills; building capacity on climate-resilient agriculture for 1,000 farmers annually	48,000 beneficiaries and consumers, 56 productive enterprises
Forest governance and conservation of protected areas for adaptation and mitigation (REDD+)	In progress
Green roofs and incentives for sustainable urban development and construction	In progress

Quito's climate change adaptation actions have been largely financed by the city's budget, while the city's leadership has attracted the financial and technical support of regional, national, and multinational public sector bodies as well as nonprofit, foundation, and private sector actors interested in accelerating forward-thinking adaptation action in municipalities. Some public companies have funded adaptation programs through incremental levies and taxes. For example, the Quito Municipal Water Supply and Sanitation Company contributes to the Fund for the Protection of Water (FONAG, as abbreviated in Spanish) with 1.5% of its revenue. This fund has been in operation since 2000 and supports programs and projects related to reforestation, education, and environmental monitoring.[11] The city has also received financial support from international donors such as the World Bank, UN Habitat, The Nature Conservancy, and Climate and Development Knowledge Network for selected adaptation projects. Additionally, Quito was recently selected as one of the cities in the Rockefeller Foundation 100 Resilient Cities program.[12]

Quito is not only advancing its own adaptation efforts but is also helping to further adaptation in other cities in Ecuador. In 2011, the municipality led Quito's Climate Pact, a unique initiative that promoted political commitment from Ecuadorian local government authorities to contribute to adaptation and mitigation. More than 80 local authorities signed the Climate Pact. Since then, the municipality has provided technical assistance to other local governments so that they can replicate and adapt Quito's experience with its Climate Change Strategy and Action Plan.

Urban agriculture on hillsides in Quito

LESSONS LEARNED

1. **Aligning adaptation efforts with existing sustainability and environmental concerns allows cities to reduce climate change vulnerabilities in an integrated manner.** By embracing an integrated approach, Quito was able to address other relevant and existing problems (such as inadequate provision of basic services, increased new residents and migrants in high-risk areas, and increased deforestation due to population growth), while taking steps to prepare for future climate change. Some measures help address multiple risks and stresses simultaneously.

2. **Gradual implementation of climate adaptation allows for organizational learning and capacity building before the development of comprehensive strategic adaptation plans.** The key actors in Quito were able to learn to adapt through their experience with earlier risk management and environmental management programs, before developing more comprehensive adaptation plans. In addition, due to this gradual approach, the development of Quito's adaptation plan has faced little resistance.

3. **Inclusion of civil society in consultation and implementation strongly enhances local ownership of adaptation actions and ensures that actions benefit the most vulnerable populations.** An important enabling factor for this process in Quito is the city-level administrative reform that increased the participation of community groups and non-governmental organizations in municipal decision making. The city has focused on capacity building, especially for vulnerable communities, as a way to increase residents' resilience to climate change. For example, the city funded local NGOs to train indigenous farmers to improve water management in their urban farms and replant native tree species in hillside areas to reduce landslide risks.[13]

11 Zambrano-Barrágan, C., Zevallos, O., Villacís, M. and Zevallos, D.E. (2010). *Quito's climate change strategy: A response to climate change in the metropolitan district of Quito.* Paper prepared for the 1st World Congress on Cities and Adaptation to Climate Change, Bonn.
12 Rockefeller Foundation. (2013). *100 Resilient Cities: Quito, Ecuador.* Retrieved from: http://100resilientcities.rockefellerfoundation.org/cities/entry/quitos-resilience-challenge.
13 Carmin, J., Anguelovski, I. and Roberts, D. (2012). Urban climate adaptation in the global south: Planning in an emerging policy domain. *Journal of*

4. **The successful implementation of local adaptation measures requires intra- and inter-institutional coordination.** Quito's Inter-Institutional Commission and engagement of various municipal agencies during the consultation phase was critical to the successful development of the Climate Change Strategy. The creation of the Metropolitan Climate Change Committee will continue to facilitate this coordination and further adaptation efforts in Quito.

This case study was developed based on Evidence and Lessons Learned for Latin America (ELLA). (2013). City-level climate change adaptation strategies: The case of Quito, Ecuador. Retrieved from: http://ella.practicalaction.org/node/1091.

FOR MORE INFORMATION

Anguelovski, I. (2009). Building the resilience of vulnerable communities in Quito: Adapting local food systems to climate change. *Urban Agriculture Magazine*, 22. Retrieved from: http://www.ruaf.org/sites/default/files/UAM22%20Quito%2025-26.pdf.

Carmin, J., Anguelovski, I. and Roberts, D. (2012). Urban climate adaptation in the global south: Planning in an emerging policy domain. *Journal of Planning Education and Research* 32(1), 18-32.

FLACSO and UNEP. (2011). *Quito environment and climate change outlook*. Retrieved from: http://www.pnuma.org/deat1/pdf/2011%20-%20ECCO%20Quito%20Summary%20(web).pdf.

Municipality of the Metropolitan District of Quito, Secretariat of the Environment. (2009). *Quito climate change strategy.*

Municipality of the Metropolitan District of Quito, Secretariat of the Environment. (2011). *Quito environmental agenda (2011-2016).*

Municipality of the Metropolitan District of Quito, Secretariat of the Environment. (2012). *Quito climate change action plan (2012-2016).*

Rockefeller Foundation. (2013). 1*00 Resilient Cities: Quito, Ecuador.* Retrieved from: http://100resilientcities.rockefellerfoundation.org/cities/entry/quitos-resilience-challenge.

Zambrano-Barrágan, C., Zevallos, O., Villacís, M. and Zevallos, D.E. (2010). *Quito's climate change strategy: A response to climate change in the metropolitan district of Quito.* Paper prepared for the 1st World Congress on Cities and Adaptation to Climate Change, Bonn, Germany.

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PARTICIPATING TEAM PROFILES

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6. BUENAVENTURA, COLOMBIA
7. PIURA, PERÚ
8. TRUJILLO, PERÚ

TUXTLA GUTIÉRREZ, MEXICO

Population: 600,000

Tuxtla Gutiérrez is the capital and largest city in the state of Chiapas. Not a major tourist destination itself, this city is a transportation hub for tourists heading to other sites in the region. The population of Tuxtla Gutiérrez has doubled since 1980 and the city has not been able to increase affordable housing stock. This has resulted in an expanding, unplanned urban area which is in conflict with zoning and conservation plans.

There are 21 km of rivers running through the municipality, including the Grijalva or Grande de Chiapa, the Suchiapa, and the Sabinal – the last of which is severely polluted. Sewage from 15 upriver municipalities flows through Tuxtla Gutiérrez. The sewage system is more than 40 years old and drainage is quite poor.

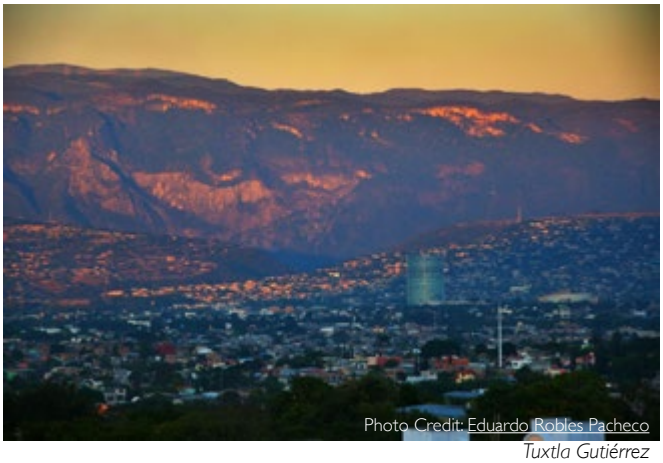
CURRENT INFRASTRUCTURE AND DEVELOPMENT PRIORITIES

- The 2010 "City of Water" project, a successful collaboration between the municipal and state governments, constructed a system that pumps fresh water from 20km away, now serves as the city's primary water supply
- A new waste water treatment plant
- Lighting efficiency projects

CLIMATE VULNERABILITIES AND CHALLENGES

With its relatively low altitude of 522 meters, the region has a hot and moderately humid climate with most rain falling in a defined rainy season. Although it is not on the coast, Tuxtla Gutiérrez is close enough to be impacted by hurricanes and tropical storms. In 1995, there was a significant flood that resulted in huge economic losses despite not claiming lives. In 2003, Tropical Storm Larry caused flooding in the city, forcing the evacuation of 7,000 people.

The rainy period in the region has become more erratic, with less average annual rainfall but more torrential rain events, exacerbating sewage issues.



Tuxtla Gutiérrez

KEY CLIMATE CHANGE IMPACTS

- Heat waves
- Precipitation changes causing strong rains in shorter periods of time
- Increased flooding during rainy seasons, which interrupts communications across the city and causes blackouts
- Increasing incidence of hemorrhagic dengue
- Fires during dry seasons
- Erosion, landslides

ACTIVITIES

- Development of a municipal Climate Change Action Program
- Development of partnerships with primary universities and other organizations to establish mitigation and adaption measures
- Importance of collaboration with other municipalities, as well as state and federal governments
- A municipal vulnerability analysis which is currently undergoing validation by the federal government

Photo Credit: Eduardo Robles Pacheco

Tuxtla Gutiérrez at night

SANTO DOMINGO, DOMINICAN REPUBLIC

Population: 965,040

Greater Santo Domingo is composed of 10 municipalities plus the National District – the National District houses the national government's executive office, congressional building, top judicial court, and public offices. Greater Santo Domingo is the largest economic center of the Dominican Republic and is home to the country's most important industries, including maritime transport, telecommunications, and tourism.

CURRENT INFRASTRUCTURE AND DEVELOPMENT PRIORITIES

- Water supply, sewers, and wastewater treatment
- Solid waste management
- Bridges (proper construction codes for new bridges)

CLIMATE VULNERABILITIES AND CHALLENGES

The coastal city of Santo Domingo is highly vulnerable to impacts from hurricanes and tropical storms, which commonly occur in the Caribbean. Flooding and erosion currently affect the region, particularly along the Ozama, Isabela, and Haina Rivers. These rivers are susceptible to flooding during periods of heavy precipitation. During these events, Santo Domingo can experience flooded neighborhoods, contaminated water supplies, collapsed bridges, and disrupted power generation, among other impacts.

Energy and transportation infrastructure along the Ozama River.

KEY CLIMATE CHANGE IMPACTS

- Increased hurricanes and tropical storms
- Increased coastal flooding

Climate change is likely to increase the intensity of hurricanes and tropical storm, which may exacerbate current problems of flooding and erosion in the region.

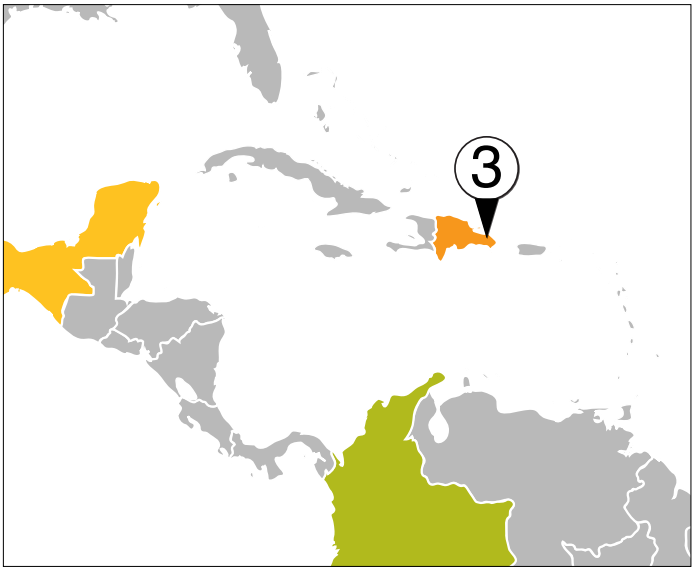
ACTIVITIES

- As one of USAID's Climate Resilient Infrastructure Services (CRIS) program pilot cities, Santo Domingo's National District is improving its climate change data collection and analysis by (1) making climate databases and information more accessible to planners and (2) analyzing historical weather trends in areas where proposed projects are located. The CRIS program is especially focused on the third ward, which is the most vulnerable of the National District's three wards due to a high level of poverty, informal settlements, and lack of services. In this ward, the city is developing an inventory of assets important to the provision of infrastructure services; deepening its understanding of historical and future climate impacts, vulnerabilities, and potential adaptation measures; and planning for community outreach activities.

A working group meeting as part of the CRIS program.

- CAASD (Santo Domingo's Water and Sewerage Corporation) has developed a Sanitation Master Plan to improve the current sewage system. The Master Plan runs through 2040 but Phase I is about to start, with the development of a wastewater treatment plant serving part of the National District and other Greater Santo Domingo municipalities. The CRIS project is helping CAASD to identify likely future climate change impacts that may threaten the new infrastructure, and explore ways to ensure its resiliency and protect the investment against such impacts.
- The National District of Santo Domingo has two weather stations and is planning to establish nine more to gather more accurate data. These stations will be housed at existing fire stations, which are staffed 24 hours a day, seven days a week, and can therefore help provide security and ensure the consistent collection of data. The National District is also planning for trend and other analyses of the data to provide a more accurate depiction of weather and climate impacts over time and facilitate integration into municipal planning.
- The National Office of Territorial Planning and Development (DGODT) is starting to develop a policy for territorial planning and development at the municipal level that must include climate change-related planning activities.
- USAID supported the drafting of the *Dominican Republic Climate Change Vulnerability Assessment* report, which focuses on coastal areas across the country, including Santo Domingo.
- IDDI (Instituto Dominicano de Desarrollo Integral) has developed an outreach plan that includes 24 community meetings to raise awareness about climate change and solicit feedback on adaptation options among the eight affected neighborhoods in the third ward.
- The National District has created a working group as part of the CRIS program, which will help sustain efforts across projects and build the capacity of the district to increase its resilience to climate change. The working group includes the National District's City Council (ADN), the Dominican Federation of Municipalities (FEDOMU), CAASD, ONAMET (National Meteorological Office), IDDI, and DGODT. They have started focusing their efforts on the CAASD Sanitation Master Plan Phase I implementation. By bringing together diverse stakeholders, the working group is able to take a cross-sectoral and integrated approach to addressing climate change risks.

VERÓN-BÁVARO, DOMINICAN REPUBLIC



Population: 130,000 residents (Verón: 60,000; Bávaro: 70,000)

Verón-Bávaro is part of the larger Punta Cana-Bávaro-Verón-Macao municipal district in La Altagracia, the easternmost province in the Dominican Republic. Facing both the Caribbean Sea and the Atlantic Ocean, the area is famous for its beaches and seaside resorts, and has been a popular tourist destination since the 1970s. In fact, this region generates 33% of the GDP for the entire nation. There are over 55,000 hotel rooms in the municipality with an estimated annual occupancy rate of 80%, receiving over 2 million visitors per year.

Verón-Bávaro was only formally established as a municipality in 2007, but has been rapidly growing ever since. As a new governing body, they are focused on environmental management efforts to ensure the long-term viability of the tourism industry upon which they depend heavily. Currently, the community lacks wastewater treatment infrastructure and has observed a marked decline in the groundwater table, which has fallen almost 10 meters in the last five years, threatening the availability and quality of freshwater for residents and visitors.

CURRENT INFRASTRUCTURE AND DEVELOPMENT PRIORITIES

- Securing sufficient potable water to support the population
- Control of salt water intrusion
- Coral reef restoration
- Recuperation of the beach dunes
- Relocating vulnerable infrastructure
- Landfill development
- Proper wastewater treatment infrastructure

Bávaro, Dominican Republic

CLIMATE VULNERABILITIES AND CHALLENGES

The mangroves and coral reefs along Verón-Bávaro's extensive coastline serve as natural buffers against storms and storm surge, but both buffers have been depleted in recent decades due to unregulated construction and tourism development. Larger storms and higher sea levels now bring saltwater several kilometers inland. The lagoons are over-salinated and trees are dying. Coastal infrastructure, both public and private, is slumping and falling into the sea. Subterranean aquifers, currently at risk of salination due to sea level rise, are the only source of freshwater in the area. Climate change is expected to bring more intense storms, rainfall events, and sea level rise, which may cause increased flooding in coastal areas susceptible to storm surge.

KEY CLIMATE CHANGE IMPACTS

- Sea level rise
- Coastal erosion
- Salt water intrusion
- Coral bleaching
- Algae blooms

ACTIVITIES

- Beach recovery
- Coral reef protection
- Mangrove reforestation
- Created an environmental impact statement based on environment assessments to regulate infrastructure development.
- Conducted public education about the threats and impacts of climate change to citizens.
- Relocated vulnerable infrastructure and protected natural resources such as coral reefs through collaboration with the private sector, particularly the hotel industry.
- Worked with wealthy residents and land owners to relocate private infrastructure threatened by climate change.

Bávaro Beach, Dominican Republic

RIOHACHA, COLOMBIA

Population: 150,000

Riohacha is located in northern Colombia, by the mouth of the Ranchería River and on the Caribbean Sea. Riohacha is the capital city of the Department of La Guajira. Livestock production and logging are some of the major industries in Riohacha – Riohacha lacks a large manufacturing sector.

The city's population has grown considerably over the last couple decades as internally displaced Colombians have migrated to the area, fleeing conflict zones in the interior of the country. As a result of these trends, the municipality has struggled with providing basic public services, including adequate housing, drinking water, wastewater treatment, and waste disposal. They are working closely with national government and development partners to increase the provision of infrastructure services to their residents.

CURRENT INFRASTRUCTURE AND DEVELOPMENT PRIORITIES

- Managing the loss of housing (including informal settlements) and economic assets in coastal zones due to beach erosion.
- Regional coordination to develop bankable resilient infrastructure projects.
- Acquiring technical knowledge.
- Obtaining financial support for projects.
- Raising constituent awareness and understanding of the importance of the environmental management of urban green spaces to enable the delivery of public services and decrease impacts due to flooding.

Riohacha shoreline

CLIMATE VULNERABILITIES AND CHALLENGES

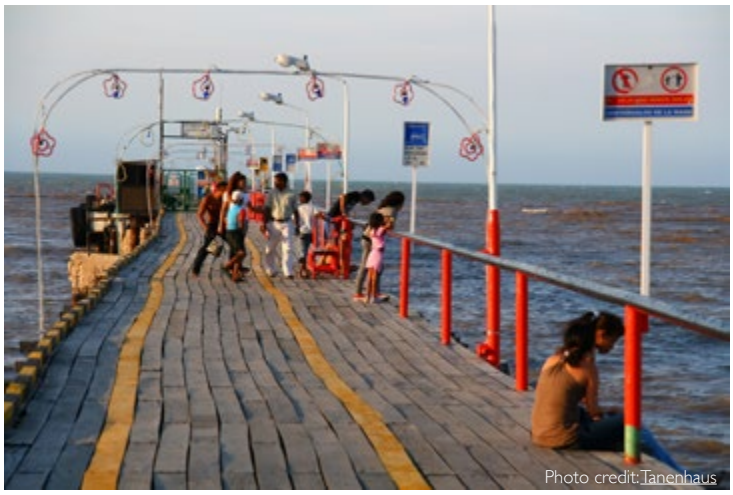
Riohacha has a semi-arid climate. Historically, heavy rains have occurred almost exclusively in May and between August and November, although the region is increasingly experiencing erratic rain and drought patterns in other times of the year. This change from traditional weather patterns has reduced the absorptive capacity of urban wetlands throughout the municipality and is exacerbating floods in the city center. In addition, sea level rise, coastal erosion, and heat waves are affecting the municipality's coastal neighborhoods. For example, in some inland bays, sections of neighborhoods are sinking, while water- and vector-borne diseases are on the rise.

KEY CLIMATE CHANGE IMPACTS

- Sea level rise
- Salt water intrusion
- Coastal erosion
- Severe flooding
- Severe drought
- Heat waves

ACTIVITIES

- Actively participating in the development of a regional climate change adaptation plan led by regional government partners.
- Executing a regional vulnerabilities study.
- Establishing a technical working group to confront coastal erosion.
- Embedding both climate adaptation and mitigation efforts into "Ciudad Amable," the municipality's sustainability plan.
- Evaluating the economic impacts of destruction and degradation to coastal infrastructure.
- Managing natural areas (e.g., restoring mangroves) to increase capacity for flood attenuation in urban wetlands.
- Relocating residents away from high-risk areas.
- Coordinating regional efforts and exchanging promising practices through a national network of climate change "nodes."



Riohacha pier

- Incorporating climate science and risk management principles into land use planning.
- Using "bio-climatic" housing construction to mitigate heat waves.
- Establishing early alert systems.

BUENAVENTURA, COLOMBIA

Population: 400,000

The city of Buenaventura is located on the western Pacific coast of Colombia at the intersection of the Dagua River and Buenaventura Bay. Buenaventura is a coastal seaport city within the department of Valle del Cauca. The city's footprint includes areas of concentrated development (mostly located on Cascajal Island) as well as scattered villages. Internal displacement within Colombia is changing the traditionally rural landscape of Buenaventura.

CURRENT INFRASTRUCTURE AND DEVELOPMENT PRIORITIES

- Acquiring technical knowledge to carry out infrastructure projects.
- Managing climate and non-climate stressors threatening ports and tidal and marine zones.
- Managing flood impacts to potable water, solid waste, housing, and roads.
- Meeting the demand of a growing population on housing and roadway networks.
- Obtaining financial support for projects.
- Securing missing data and information to support municipal decision making.

CLIMATE VULNERABILITIES AND CHALLENGES

Buenaventura has extreme precipitation rates – annual average precipitation reaches 12,000 mm per year in some places, making it one of the wettest places in the world. In recent years, both annual precipitation amounts and average temperatures have been increasing significantly. City officials have observed climate impacts in urban wetlands including decreased absorption capacity of mangroves ecosystems, and overflowing and increasingly channelized rivers.

Photo Credit: Daniel Amariles
Pianguita, Buenaventura

KEY CLIMATE CHANGE IMPACTS

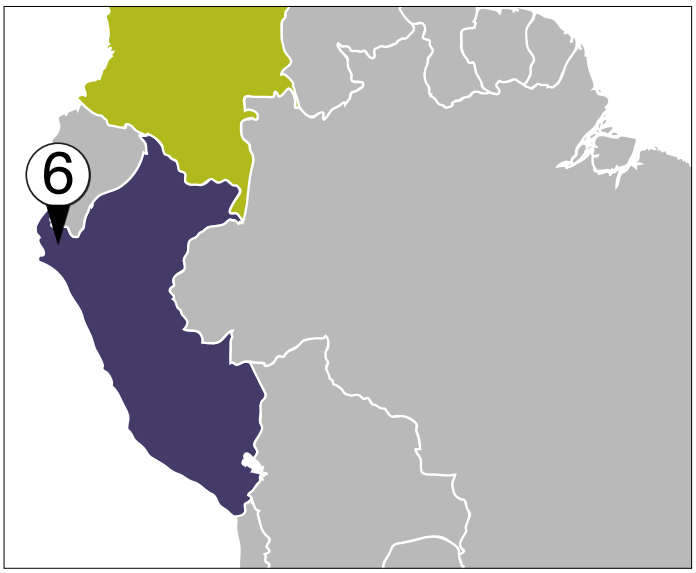
- Sea level rise
- Salt water intrusion
- Coastal erosion
- Severe flooding
- Storm surges

ACTIVITIES

- Fortification of port infrastructure to increase resilience to climate and disaster risk.
- Executing land use planning activities to reduce vulnerabilities, and incorporating climate science and risk management principles into those planning efforts.
- Creating disincentives within the land use planning process to limit investment and development in high risk areas.
- Managing protected areas to increase ecosystem health.
- Embedding climate change adaptation into existing sustainable development partnership work with regional departments.
- Participating in coordinated regional efforts and exchanging promising practices through a national network of climate change "nodes."
- Incorporated climate change considerations into district-level disaster risk council planning to engage public, private, and civil society sectors to effectively respond to and recover from disasters.
- Holding community workshops to raise awareness of local climate challenges and build capacity of local leaders.
- Using alternative materials and reforming building codes to increase resilience of the city's built environment.
- Establishing a coastal zone use duty tax used to finance marine/coastal zone protection and restoration efforts.

Buenaventura

PIURA, PERU



Population: 377,500

Piura is a rapidly expanding metropolitan area in northern Peru. Agricultural commerce is a key economic driver of growth in the city, with agricultural production relying on irrigation water from the Chira-Piura Water Management System.

CURRENT INFRASTRUCTURE AND DEVELOPMENT PRIORITIES

- Flood control and drainage
- Water supply, sewers, and wastewater treatment
- Roads

CLIMATE VULNERABILITIES AND CHALLENGES

While the city of Piura has an arid climate with typically low rainfall, it is highly vulnerable to flooding from extreme rainfall in the city and overflows along the Piura River during the rainy season and during El Niño Southern Oscillation (ENSO) events. Flooding has resulted in loss of life and damage to infrastructure, including the transportation system and water and sanitation system. The city has a combined stormwater/sewage system that is often clogged with sand, garbage, and other debris, which contributes to water contamination and public health problems during incidents of system overflow. Furthermore, informal settlements are expanding into increasingly vulnerable areas as the population grows.

Bridge sensitive to scour in Piura.

KEY CLIMATE CHANGE IMPACTS

- Increased flooding
- Increased temperatures

Climate change may increase the frequency and intensity of heavy rainfall events, exacerbating flooding risks to Piura's residents and infrastructure services. In addition, average and extreme temperatures are projected to increase. Extreme heat could cause illness, decrease water availability, result in road buckling, and limit city services such as sanitation collection.

ACTIVITIES

- As part of the USAID Climate Resilient Infrastructure Services (CRIS) program, the city of Piura is working to identify climate vulnerabilities in planned investment projects and existing city services like water supply, waste management, and transportation. This information will be used to develop a portfolio of options to manage current and future climate risks to these projects and services. The city of Piura is also considering establishing a technical network to support city decision making and build long-term capacity of the municipality to respond to climate change.
- The city is working to incorporate climate information into a revision of its Urban Development Plan to help direct development away from the most vulnerable sites. The plan's risk maps and zoning maps highlight vulnerable areas where development will not be permitted.
- National government funding through the National System of Public Investments (SNIP) is a primary source of finance for capital projects in Piura. SNIP already requires that municipalities assess their risks, and efforts are underway to ensure that future climate risks are included in this assessment. This requirement would create a significant push for incorporating climate resilience into municipal decision making and infrastructure projects. The municipality of Piura is working with the CRIS team to meet these new requirements as part of the development of investment project proposals.
- The city has also been working with a local NGO, PRISMA, since 2011 to raise awareness and conduct training among households on garbage reduction and solid waste disposal.

Juan Curo at Piura Planning Office showed an urban planning map to the CRIS team.

- The University of Piura is collecting and analyzing historical water flow information on the Piura River. The University is also developing detailed design documents for a municipal drainage project that would alleviate flooding issues in the city center.
- In the past two years, the city has been investing in sewer upgrades. EPS Grau, the local, quasi-private water utility, has contracted an external consultant to develop a feasibility-stage wastewater treatment project for Piura. The project includes climate change parameters and considers climate change within its risk analysis.
- Although the city has an Urban Development Plan that is currently being revised and has identified vulnerable areas where development is prohibited, the plan is not enforced. As a result, informal settlements – including both residences and businesses – are expanding into increasingly vulnerable areas. More effective and consistent enforcement of the updated Urban Development Plan will be important to ensure a real reduction in vulnerability.

TRUJILLO, PERU

Population: Approximately 900,000

The Province of Trujillo is located on the northwestern coastal plain of Peru and the metropolitan area includes nine districts. The city of Trujillo is an important commercial and transport center for the surrounding farming areas. The expansion of irrigated agriculture has caused tremendous growth in the city.

CURRENT INFRASTRUCTURE AND DEVELOPMENT PRIORITIES

- Water supply and sanitation
- Coastal protection
- Transportation network

CLIMATE VULNERABILITIES AND CHALLENGES

Trujillo has a temperate climate with an average annual temperature of 20ºC and is often known as the "City of the Eternal Spring." Portions of the metropolitan area, including the Districts of Victor Larco Herrara and Laredo, are coastal and vulnerable to coastal flooding and erosion. The metropolitan area of Trujillo is also at risk to flooding from extreme rainfall and overflow of the Moche River, which runs adjacent to the city. Furthermore, the city has inadequate housing infrastructure that is highly susceptible to damage from flooding after extreme rainfall.

Irrigated fields near Salaverry in the province of Trujillo, Peru.

KEY CLIMATE CHANGE IMPACTS

- Increased flooding
- Coastal erosion
- Glacial retreat

Climate change may increase the frequency and intensity of heavy rainfall events, exacerbating flooding risks to the city. In addition, glacial retreat may reduce water availability in the Santa River (from which Trujillo pumps water for agricultural irrigation and drinking water) over the medium- and long-term.

ACTIVITIES

- The Inter-American Development Bank (IDB) has supported Trujillo in developing a Sustainability Action Plan under the Emerging and Sustainable Cities Initiative that addresses both climate change mitigation and adaptation. The IDB conducted a detailed hazard and vulnerability assessment of the metropolitan area of Trujillo to climate and non-climate related disasters, including based on climate change projections. The main climate-related threats identified by the assessment are coastal flooding and coastal erosion. The report also assessed Trujillo's vulnerability to tsunamis.
- The municipality has signed an agreement with the National Ministry of the Environment (MINAM) to provide assistance in incorporating available climate vulnerability information into planning.
- UNDP is helping the province of Trujillo to develop disaster risk management plans.
- The IDB conducted a study, *Climate Change Impacts during Droughts on the City of Trujillo*, in 2012. The study found that population growth in Trujillo could make the city vulnerable to changes in water availability. This demand-side trend, combined with glacial melt due to climate change, could affect the supply of water for consumption as well as irrigation water for agriculture.

The CRIS team met with representatives from the municipality of Trujillo, Peru.

- UNEP and the Municipality of Trujillo conducted an Environment and Climate Change Outlook (ECCO) project for the City of Trujillo. The project trained a local team to undertake integrated assessments that included a component on vulnerability impact assessment and climate change adaptation strategies.
- As part of the USAID Climate Resilient Infrastructure Services (CRIS) program, the Municipality of Trujillo is building on the aforementioned work, in particular the IDB vulnerability assessment, to enhance the climate resilience of infrastructure services. CRIS activities are under discussion; the city is currently considering the need to identify a set of straightforward, inexpensive, and low-regret adaptation options to address a specific climate vulnerability.
- Trujillo has invested in new equipment for road surfacing, some of which utilizes stronger material that reduces road damage due to strong rains. This has reduced the need for repairs and the associated costs.

RESOURCE LISTS

SECTION CONTENTS

THE BASICS OF CLIMATE CHANGE ADAPTATION

1. USAID Climate Change and Development Strategy 2012-2016

The central goal articulated in this agency-level strategy document is to enable countries to accelerate their transition to climate – resilient, low emission, and sustainable economic development. The report outlines strategies to invest in clean energy and sustainable landscapes; invest in adaptation activities; and integrate climate change into Agency programming, learning, policy dialogues, and operations. Readers will find that these three strategic objectives provide a good summary of the rationale behind resilient infrastructure development.

U.S. Agency for International Development (USAID), January 2012, 27pp, ENGLISH
Download ▸ http://pdf.usaid.gov/pdf_docs/pdacs780.pdf

2. Climate-Resilient Development: A Guide to Understanding and Addressing Climate Change

This guide presents a framework for the systematic inclusion of climate considerations in development decision making. The framework's objective is to support the development process by assisting development practitioners in identifying, evaluating, selecting, implementing, and adjusting actions to reduce climate vulnerabilities and improve development outcomes.

U.S. Agency for International Development (USAID), 2014, 27pp, ENGLISH

3. Toward Resilience: A Guide to Disaster Risk Reduction and Climate Change Adaptation

The guide provides essential introductory information, principles of effective practice, guidelines for action in a range of sectors and settings, case studies and links to useful tools and resources, for the application of an integrated, rights-based approach to disaster reduction and climate change adaptation.

Catholic Relief Services, 2013, 194pp, SPANISH ENGLISH
Download ▸ http://www.ecbproject.org/resources/library/341-toward-resilience-a-guide-to-disaster-risk-reduction-and-climate-change-adaptation
En Español ▸ http://www.ecbproject.org/resources/library/342-hacia-la-resiliencia-una-gua-para-la-reduccin-del-riesgo-de-desastres-y-adaptacin-al-cambio-climtico

4. Building Resilience: Integrating Climate and Disaster Risk Into Development

This report, targeted at development practitioners and national policy makers, argues that climate and disaster resilient development is essential to eliminating extreme poverty and achieving shared prosperity by 2030. It recommends closer collaboration between the climate resilience and disaster risk management communities as disaster losses continue to rise, as well as the incorporation of climate and disaster resilience into broader development processes. Case studies are used throughout in order to illustrate promising approaches, lessons learned, and remaining challenges.

World Bank, 2013, 44pp, SPANISH ENGLISH
Download ▸ http://www.gfdrr.org/sites/gfdrr.org/files/WBG_2013_Building_Resilience_Full_Report-English.pdf
En Español (Resumen): http://www.gfdrr.org/sites/gfdrr.org/files/WBG_2013_Building_Resilience_Report-Executive_Summary-Spanish.pdf

5. Adapting to Coastal Climate Change: A Guidebook for Development Planners

The summary presented in the Guidebook is designed for policymakers and others who are interested in using the Guidebook as a reference document. The full Guidebook provides a detailed treatment of climate concerns in coastal areas and proposes an approach for assessing vulnerability to climate change and climate variability, developing and implementing adaptation options, and integrating options into programs, development plans, and projects at the national and local levels.

U.S. Agency for International Development (USAID), May 2009, 163pp, ENGLISH
Download ▸ http://pdf.usaid.gov/pdf_docs/pnado614.pdf

6. Approaches to Planning for Climate Change: Bridging Concepts and Practice for Low Carbon Climate Resilient Development

This paper identifies the core challenges arising from planning for climate change before considering the overarching challenge of 'uncertainty' in climate science. It also reviews activities in several key areas of relevant planning experience for climate change. The paper concludes by presenting lessons from existing practice, identifying gaps in knowledge and learning, and setting out ten critical dimensions of planning.

Institute of Development Studies (IDS), 2011, 19pp, ENGLISH
Download ▸ http://www.eldis.org/go/home&id=61537&type=Document#.UqIpfvRDsZA

7. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

This summary for policymakers presents key findings from the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX). The SREX is an assessment of the scientific literature on issues that concern the interaction of climatic, environmental, and human factors that can lead to impacts and disasters; options for managing the risks posed by impacts and disasters; and the important role that non-climatic factors play in determining impacts.

Intergovernmental Panel on Climate Change (IPCC), Hedger M. et al, 2012, 39pp, SPANISH ENGLISH
Download ▸ https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf

URBAN ADAPTATION

8. Sustainable Service Delivery in an Increasingly Urbanized World: USAID Policy

It is the vision of this Policy to support service delivery that attains large-scale benefit to urban residents in a sustainable manner over the long-term. In support of this vision, the Policy provides practical approaches to improving local capacity to manage urban service delivery systems.

U.S. Agency for International Development (USAID), October 2013, 38pp, ENGLISH
Download ▸ http://www.usaid.gov/sites/default/files/documents/1870/USAIDSustainableUrbanServicesPolicy.pdf

9. Urban Climate Adaptation and Leadership: From Conceptual Understanding to Practical Action

This report synthesizes key points raised in a series of discussions among "adaptation leaders" from fourteen cities around the world. The findings highlight how policy-makers and international organizations working with cities on issues of adaptation and resilience must support and facilitate processes of testing ideas, learning from experiences, and recalibrating as new information is obtained and lessons are learned.

Organization for Economic Cooperation and Development (OECD), Carmin, J., Dodman, D., and Chu, E.; December 2013, 48pp, ENGLISH
Download ▸ http://www.oecd-ilibrary.org/urban-rural-and-regional-development/urban-climate-adaptation-and-leadership_5k3ttg88w8hh-en

10. The Green Inner Circle: Towards Green Urban Infrastructure in Vitoria-Gasteiz

This guidebook provides a thorough overview of Green Infrastructure considerations for urban planning initiatives in the City of Vitoria-Gasteiz, Spain. The guidebook includes three chapters leading the reader through: 1) an overview of different components, types, and benefits of Green Infrastructure; 2) co-benefits in the application of Green Infrastructure approaches throughout the city; and 3) planning and design for a "green ring" which will connect the urban area with a network of green spaces along its periphery.

Centro de Estudios Ambientales, 2012, 53pp, SPANISH
Download ▸ http://www.vitoria-gasteiz.org/wb021/http/contenidosEstaticos/adjuntos/es/44/11/44411.pdf

11. How To Make Cities More Resilient: A Handbook For Local Government Leaders

This handbook provides mayors, governors, councilors, and other local government leaders with a generic framework for risk reduction and points to good practices and tools that are already being applied in different cities for that purpose. It discusses why building disaster resilience is beneficial, what kinds of strategies and actions are required, and how to go about the task.

United Nations Office for Disaster Risk Reduction (UNODRR), March 2012, 99pp, SPANISH ENGLISH
Download ▸ http://www.unisdr.org/we/inform/publications/26462
En Español ▸ http://www.unisdr.org/files/26462_manualparalideresdelosgobiernosloca.pdf

12. Building Urban Climate Resilience in Asia: 2012 Adaptation Partnership Workshop Report

This report provides an overview of a workshop held in Bangkok, Thailand, in the summer of 2012. It includes a summary of prioritized actions for development agencies, practitioners, and researchers that would serve to facilitate collaboration and knowledge sharing around the issue of increasing the resilience of cities.

Adaptation Partnership, 2012, 11pp, ENGLISH
Download ▸ http://www.adaptationpartnership.org/sites/default/files/AP_Bangkok_Report_Final.pdf

13. Toolkit for Resilient Cities

This toolkit explores how the resilience of critical urban infrastructure systems might be enhanced to prepare cities more effectively for major weather-related hazards and the co-benefits that resiliency actions have (e.g. environmental performance, energy efficiency, safety and security, etc.). The research focuses on physical infrastructure relating to energy, transportation, water, and buildings. Consideration is given to proven technology solutions applicable to emerging and established cities, and the enabling actions required from policy makers, utility providers, and other city stakeholders to facilitate delivery.

Siemens, Arup, and the Regional Plan Association, 2012, 8pp, ENGLISH
Download ▸ http://w3.siemens.com/topics/global/en/sustainable-cities/resilience/Documents/pdf/Toolkit_for_Resilient_Cities_Summary.pdf

14. Urban Governance for Adaptation: Assessing Climate Change Resilience in Ten Asian Cities

This paper focuses on the role that urban governments play in building climate resilient cities. It presents the findings of a rapid governance and capacity assessment of 10 South and Southeast Asian cities in an effort to explore their ability to plan and implement an integrated climate change resilience program.

Institute of Development Studies (IDS), Tanner, T. et al, 2008, 39pp, ENGLISH
Download ▸ http://www.eldis.org/vfile/upload/1/document/1102/Tanner_ClimateResilUrban.pdf

15. Catalyzing Urban Climate Resilience: Applying Resilience Concepts to Planning Practice in the ACCCRN Program (2009–2011)

This report begins by presenting the overall conceptual framework for resilience planning developed through the Asian Cities Climate Change Resilience Network (ACCCRN) program. It goes on to describe the communication of climate information; the applied approaches to shared learning; the implementation of vulnerability analyses, sector studies, and pilot projects; and the resilience planning processes and outcomes that were the key activities of the second phase of the program.

Institute for Social and Environmental Transition (ISET), Moench, M., Tyler, S., and Lage, J. (eds), 2011, 293pp, ENGLISH
Download ▸ http://www.acccrn.org/sites/default/files/documents/ISET_Report_CatalyzingUrbanClimateResilience.pdf

16. A Workbook on Planning for Urban Resilience in the Face of Disasters: Adapting Experiences from Vietnam's Cities to Other Cities

This comprehensive workbook provides tips on urban adaptation drawn from efforts to increase climate resilience in cities in Vietnam. Produced by the World Bank Group, it is intended to assist policymakers in developing countries plan for anticipated impacts of climate change. The workbook is designed to provide a user-friendly, step-by-step approach to national, provincial, and local planning.

World Bank, Shah, F. and Ranghieri, F. 2012, 169pp, ENGLISH
Download ▸ https://openknowledge.worldbank.org/bitstream/handle/10986/2235/665200PUB0EPI00rkbook09780821388785.pdf

17. Climate Change and Cities First Assessment Report of the Urban Climate Change Research Network

This book is the First Urban Climate Change Research Network (UCCRN) Assessment Report on Climate Change and Cities. The contents examine mitigation and adaptation strategies for developing and developed cities, enabling readers to utilize information on both and leverage co-benefits between the two; provides case studies from both developing and developed cities around the world in an effort to provide urban decision-makers with state-of-the-knowledge on climate change and examples of effective and efficient practices with potential for scaling-up; and unites the work of dozens of expert researchers worldwide.

Urban Climate Change Research Network (UCCRN), Rosenzweig, C. et al (eds), April 2011, 312pp, ENGLISH
Download ▸ http://www.cambridge.org/us/academic/subjects/earth-and-environmental-science/climatology-and-climate-change/climate-change-and-cities-first-assessment-report-urban-climate-change-research-network

18. Assessing City Resilience: Lessons from Using the UNISDR Local Government Self-Assessment Tool in Thailand and Vietnam

This report presents experience and findings from applying the United Nations International Strategy for Disaster Reduction (UNISDR) Local Government Self-Assessment Tool (LGSAT) in four cities in Vietnam and Thailand. According to the report, the LGSAT opened up dialogue and established baseline data for the Ten Essentials of UNISDR's Making Cities Resilient Campaign that can be used to track progress as the cities continue to build disaster and climate resilience. It also identifies gaps between policy and practice, and between planning and implementation of resilient practices.

Institute for Social and Environmental Transition (ISET), December 2013, 48pp, ENGLISH
Download ▸ http://www.i-s-e-t.org/images/pdfs/ISET_LGSAT_131219.pdf

INFRASTRUCTURE ADAPTATION

19. Guide to Infrastructure: An Environmental Management Tool

This guide provides orientation for using Environmental Impact Assessments, a major tool for the sustainable development of infrastructure projects. The document focuses on tourism, infrastructure, and the poultry, pork, farming and agroindustry sectors.

International Union for the Conservation of Nature (IUCN), 2009, 119pp, SPANISH
Download ▸ http://www.marn.gob.gt/documentos/guias/infraestructura.pdf

20. Addressing Climate Change Impacts on Infrastructure: Preparing for Change

This set of nine fact sheets and an overview provides information on the importance of climate-resilient infrastructure to development, potential climate change impacts that may affect that infrastructure, and adaptation options. Each of the nine fact sheets corresponds to an infrastructure category such as transportation, information and communications technology, buildings, potable water, and energy. The overview introduces common themes, climate change impacts, and adaptation strategies, and covers the basic terminology and concepts that are used in the fact sheets.

U.S. Agency for International Development (USAID), April 2013, 42pp, SPANISH ENGLISH
Download ▸ http://1.usa.gov/1bZwMoo

21. The Role of Infrastructure in Latin America's Comprehensive Development: Cities and Development

Economic growth in recent years and the slower growth trend of large metropolitan areas have resulted in a gradual improvement of urban infrastructure in Latin America. The large competitiveness, social and environmental issues of Latin American cities should not make us forget they are the region's most dynamic components and where solutions to most problems can be found, oftentimes thanks to infrastructure.

Andean Development Corporation (CAF), Ezquiaga Dominguez, J.M., 2012, 58pp, SPANISH
Download ▸ http://walk.caf.com/attach/19/publicaciones/ideal_2012/PDF/ciudades2012.pdf

22. Infrastructure for Regional Integration

This document, the second in a planned series, is the result of intense collaborative work between the Economic Commission for Latin America and the Secretary General of the South American Nations' Union (UNASUR). Its focus is to provide official national and subnational government authorities, academic and business circles, and the public at large, an analytical view of infrastructure and its services, two key issues in the South American nations' integration and development agenda.

La Comisión Económica para América Latina y el Caribe (CEPAL), 2012, 67pp, SPANISH
Download ▸ http://www.eclac.org/Transporte/publicaciones/xml/1/46191/UNASUR-Infraestructura.pdf

23. The Value of Green Infrastructure for Urban Climate Adaptation

In this paper, the Center for Clean Air Policy provides information on the costs and benefits of "green" infrastructure solutions for bolstering local adaptation to climate change. This report evaluates the performance and benefits of a selection of green infrastructure solutions, using their range of technological, managerial, institutional, and financial innovations as a proxy for their value for climate adaptation.

The Center for Clean Air Policy (CCAP), Foster, J., Lowe, A., & Winkelman, S., February 2011, 52pp, ENGLISH
Download ▸ http://ccap.org/assets/The-Value-of-Green-Infrastructure-for-Urban-Climate-Adaptation_CCAP-Feb-2011.pdf

24. Coastal Protection Infrastructure

This chapter in the publication referenced below describes the past and present condition of coastal protections, and their uses and importance. It presents generally the issues surrounding coastal protection in Mexico and offers some ideas for improved coordination and effectiveness of the efforts underway in this regard.

Instituto de Ingeniería, Universidad Nacional Autónoma de México; Salles Afonso de Almeida, P. y Silva Casarín, R.; 11pp, SPANISH
Download ▸ http://etzna.uacam.mx/epomex/pdf/mancos/cap13.pdf

25. Green Infrastructure Case Studies

This collection of case studies was evaluated by companies partnering with The Nature Conservancy to produce the White Paper, The Case for Green Infrastructure. The 14 case studies provide an overview of each project, as well as details of their timeframe, cost, technological maturity, project management considerations, benefits, risks and challenges, aspects of resiliency, and any key takeaway lessons.

Dow, Swiss Re, Shell, Unilever, The Nature Conservancy, June 2013, 45pp, ENGLISH
Download ▸ http://www.nature.org/about-us/working-with-companies/case-studies-for-green-infrastructure.pdf

26. The Case for Green Infrastructure

The focus of this study was to evaluate the ability of Green Infrastructure (GI) solutions to increase the resilience of industrial business operations to external stressors, to enhance the economic protection of business assets and infrastructure, and to reduce the resource intensity in the context of the globally applicable food-energy-water nexus.

Dow, Swiss Re, Shell, Unilever, The Nature Conservancy, June 2013, 9pp ENGLISH
Download ▸ http://www.nature.org/about-us/the-case-for-green-infrastructure.pdf

27. Infrastructure and Sustainable Development: A Vision Centered on Coastal Areas

In the framework of a University diploma course, Asus Adeah has designed a course curriculum in five modules that provides a basic yet comprehensive summary view of various coastal areas infrastructure issues.

Azuz Adeath, I. (ed); Centro de Enseñanza Técnica y Superior, CETYS-Universidad; 2007; 279pp, SPANISH
Download ▸ http://www.ileanaespejel.com/uploads/1/1/3/3/11330338/libro_final_cetys.pdf

28. Paving the Way for Climate-Resilient Infrastructure: Guidance for Practitioners and Planners

This publication summarizes the proceedings of an international conference about strategies for adapting public and private infrastructure to climate change held in San Salvador in 2010. It provides a guide to practitioners and planners on how to incorporate climate resilience into infrastructure planning.

United Nations Development Programme (UNDP), 2011, 126pp, ENGLISH
Download ▸ http://www.uncclearn.org/sites/www.uncclearn.org/files/inventory/undp_paving_the_way.pdf

THE ECONOMICS OF CLIMATE CHANGE ADAPTATION

29. Resilience Amidst Rising Tides – An Issue Paper On Trade, Climate Change and Competitiveness in the Tourism Sector in the Caribbean

The purpose of this paper is to foster an informed discussion among governments, private sector, and civil society to search for plausible ways to address adaptation and mitigation challenges in the tourism sector and build resilience in the Caribbean. The study explores the issues at the interface of trade, climate change, and sustainable development of concern and interest to Caribbean countries, with a focus on the competitiveness of the tourism sector.

International Centre for Trade and Sustainable Development, Niles, K., 2010, 52pp, ENGLISH
Download ▸ http://ictsd.org/downloads/2011/12/resilience-amidst-rising-tides.pdf

30. Shaping Climate Resilient Development: A Framework for Decision-Making

Focusing specifically on the economic aspects of adaptation, this report outlines a fact-based risk management approach that national and local leaders can use to understand the impact of climate on their economies and identify actions to minimize that impact at the lowest cost to society.

Economics of Climate Adaptation Working Group, 2009, 159pp, ENGLISH
Download ▸ http://ec.europa.eu/development/icenter/repository/ECA_Shaping_Climate_Resilent_Development.pdf

31. Inclusive Green Growth in Latin America and the Caribbean

This report outlines the sectoral objectives, challenges, and paths forward in making the LAC region's growth more environmentally sustainable. In doing so, it includes accomplishments made in demand sectors of urban development and infrastructure services as well as natural resources and rural development.

World Bank Sustainable Development Department of the Latin America and Caribbean Region (LCSSD), 2012, 56pp, ENGLISH
Download ▸ http://siteresources.worldbank.org/INTLAC/Resources/green_growth_full.pdf

32. The Caribbean and Climate Change: The Costs of Inaction

Commissioned by Environmental Defense Fund (EDF), this is the first detailed analysis of the potential economic effects of continued climate change for the entire Caribbean region. The report, similar in methodology to the recent study on the cost of climate change in Florida, compares two possibilities – an optimistic rapid stabilization case and a pessimistic business-as-usual case – and focuses on three categories of effects: hurricane damages, loss of tourism revenue, and infrastructure damage due to sea-level rise.

Tufts University, Bueno, R. et al., May 2008, 35pp, SPANISH ENGLISH
Download ▸ http://ase.tufts.edu/gdae/pubs/rp/caribbean-full-eng.pdf
En Español ▸ http://ase.tufts.edu/gdae/Pubs/rp/Caribbean-full-Span.pdf

33. The Economics of Climate Change in Central America: A 2012 Synthesis

The Central American Integration System Summit (SICA in Spanish) identified national and regional mandates to respond to climate change phenomena. The Economics of Climate Change in Central America Project was prepared within this initiative with a view at warning key regional decision makers on the urgency of rising to the challenge of climate change and opening a debate on policy and action options. With this goal in mind, the project reviewed the impacts of climate change in various emissions scenarios and prepared an estimate of their economic value. The study reviews the cost and benefit of potential responses, from business-as-usual through initiatives to reduce vulnerabilities, adaptation efforts and finally creating a sustainable low-carbon economy.

United Nations, October 2012, 112pp, SPANISH
Download ▸ http://www.eclac.cl/mexico/cambioclimatico/documentos/sintesis_2012baja.pdf

34. Understanding the Economics of Flood Risk Reduction

The purpose of this desk review is to explore literature on the costs and benefits of the flood risk reduction strategies being implemented by cities, local agencies, and national authorities. Using available information, the authors develop an overall framework for differentiating the factors that affect returns in various contexts and the critical assumptions underlying evaluation of these returns.

Institute for Social and Environmental Transition (ISET); Hawley, K., Moench, M. and Sabbag, L.; 2012, 42pp, ENGLISH
Download ▸ http://www.i-s-e-t.org/images/pdfs/isetinternational_understandingtheeconomicsoffloodriskreduction_khawleymmoenchlsabbag_2012.pdf.pdf

35. Green Infrastructure's Contribution to Economic Growth: A Review

The purpose of this report is to assess whether evidence exists to make the case for investment in Green Infrastructure (GI) to increase economic growth, as measured by Gross Domestic Product (GDP). GI is taken to mean a planned approach to the delivery of nature in the city in order to provide benefits to residents, including features such as street trees, gardens, green roofs, community forests, parks, rivers, canals and wetlands. Specifically, the report examines whether investment in GI increases GDP compared to what would have happened without the investment.

Centre for Regional Economics and Social Research (EFTEC); Gore, T. et al; July 2013; 91pp, ENGLISH
Download ▸ http://www.naturalengland.org.uk/ourwork/planningdevelopment/greeninfrastructure/gigrowthfeature.aspx

36. Private Sector Participation in Water Infrastructure: OECD Checklist for Public Action

The OECD has developed practical guidance to help governments and other stakeholders to assess and manage the implications of involving private actors in the financing, development, and management of water and sanitation infrastructure. This book provides a coherent catalogue of policy directions for consideration by governments, including appropriate allocation of roles, risks, and responsibilities, as well as framework conditions and contractual arrangements necessary to make the best of private sector participation and to harness more effectively the capacities of all stakeholders.

Organization for Economic Cooperation and Development (OECD), 2009, 135pp, ENGLISH
Download ▸ http://www.keepeek.com/Digital-Asset-Management/oecd/finance-and-investment/private-sector-participation-in-water-infrastructure_9789264059221-en#page4

REGIONAL CLIMATE ADAPTATION RESOURCES FOR LATIN AMERICA AND THE CARIBBEAN

37. C3A: Climate Change on the Coasts of Latin America and the Caribbean

Identified by the initials "C3A", this regional study includes an analysis of approximately 72,182 km of coastline. The study detected changes in coastal dynamics, the influence of climate variability, various information on coastal vulnerability (physical and socio-economic environment), physical settings and the same impacts, and risks predictable.

Government of Spain, 2014, SPANISH ENGLISH
Web link ▸ http://www.c3a.ihcantabria.com/

38. World Economic Forum on Latin America: Transforming the Region in a Global Context

This report summarizes the issues addressed at the Seventh World Economic Forum on Latin America. Leaders from 70 countries confirmed their innovative vision to change the region and accomplish its full potential in a sustainable and inclusive way. The report lists the challenges this vision poses, including the impact of developed economies on emerging economies, and on the region's dynamic development.

World Economic Forum (WEF), 2012, 24pp, SPANISH
Download ▸ http://www3.weforum.org/docs/LA12/WEF_LA12_Report_SP.pdf

39. Climate Change and the Caribbean: A Regional Framework for Achieving Development Resilient to Climate Change (2009-2015)

This regional framework provides a roadmap for action over the period 2009-2015, and builds on the groundwork laid by the Caribbean Community Climate Change Centre (CCCCC). The objectives of this document are to establish direction for the continued building of resilience to the impacts of global climate change by Caribbean Community (CARICOM) states. The document focuses on the identification and consolidation of a set of complementary activities that utilize the CCCCC and other regional institutions' current capacity and experience in addressing adaptation to climate change. This framework is comprised of four key strategies and associated goals designed to significantly increase the resilience of the CARICOM economies.

Caribbean Community Climate Change Centre, July 2009, 30pp, ENGLISH
Download ▸ http://dms.caribbeanclimate.bz/php/gateway/eldis.php?id=948

40. Central America's Environmental Guide for the Urban Infrastructure Development Sector

This document provides technical guidance on good environmental practices for urban infrastructure activities. It includes technical and environmental recommendations worth taking into account for plot identification, planning, pre- and post-feasibility studies, environmental design, building and operation of diverse projects, and urban works and activities. Useful in residential, commercial, tourist, (low impact) industrial and (low impact) road projects.

International Union for Conservation of Nature (IUCN), 2006, 99pp, SPANISH
Download ▸ http://bligoo.com/media/users/1/62550/files/GACentroamerica.pdf

41. Climate Change in the Caribbean and the Challenge of Adaptation

The report highlights climate change trends and climate variability, the impact they have on Caribbean Small Island Developing States (SIDS) in particular, and the efforts in responding to these issues. Its portrayal of regional actions is intended to offer a broad appreciation of the efforts at national and regional levels, highlighting successful experiences and good practices, as well as identifying gaps in knowledge and institutional weaknesses for addressing the threats, risks, challenges, and opportunities associated with climate change.

United Nations Environment Programme (UNEP), 2008, 103pp, ENGLISH
Download ▸ http://www.pnuma.org/deat1/pdf/Climate_Change_in_the_Caribbean_Final_LOW20oct.pdf

42. Enhancing the Climate Risk and Adaptation Fact Base for the Caribbean

This document provides an overview of the preliminary results of a study on the potential economic impact of climate change in eight Caribbean countries. It describes how these results can support the region's efforts to increase resilience against climate hazards, including preparing for the COP-16 Climate Change Conference in Cancun, Mexico and presents the next steps in finalizing the results and expanding the initiative to include all Caribbean countries.

Caribbean Catastrophe Risk Insurance Facility (CCRIF), August 2010, 28pp, ENGLISH
Download ▸ http://www.ccrif.org/sites/default/files/publications/ECABrochureFinalAugust182010.pdf

43. Risk Reduction Index: Analysis of the Capacities and Conditions for DRR – Central America

This report presents the findings from a study of the capacities and conditions for disaster risk reduction (DRR) in 7 Central American and Caribbean countries: Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, and the Dominican Republic. It has separate profiles for each country, which include risk drivers and recommendations for actions to improve DRR.

DARA International, 2010, 55pp, SPANISH ENGLISH
Download ▸ http://daraint.org/risk-reduction-index/central-america/

44. Achieving Low-Carbon Climate-Resilient Development: Cayman Islands' Climate Change Policy

The Cayman Islands' Climate Change Policy outlines consensus-based interventions to be implemented over the next 5 years that are required to address priority adverse impacts of climate change to be faced by these islands. Additionally, the climate change policy contains measures required to curb greenhouse gas emissions. This climate change policy recognizes that the combined actions of responding to the inevitable impacts of a changing climate and reducing further the contributions to climate change are cost-effective and urgently needed to ensure low-carbon climate resilient development in the Cayman Islands.

Caribbean Community Climate Change Centre, 2011, 26pp, ENGLISH
Download ▸ http://dms.caribbeanclimate.bz/php/gateway/eldis.php?id=4356

45. Resilient Urbanization – A First Response to Climate Change in the Mexican Gulf Coast

Every year, population growth and climate change expose an increasing number of people to coastal hazards along the Gulf Coast. Urbanization that is more resilient is not presently available anywhere in the Gulf. This document makes the case that building a compact, livable and walkable city while protecting the local wetlands is the best policy to face climate change.

Jacob, J. Found in: Impactos del Cambio Climático sobre la Zona Costera; A. Yáñez-Arancibia (Ed.); **Instituto de Ecología A. C.** (INECOL), Texas Sea Grant Program; **Instituto Nacional de Ecología** (INE-SEMARNAT); 2010; 24pp, SPANISH
Download ▸ http://www2.inecc.gob.mx/publicaciones/libros/638/urbanizacion.pdf

46. The Virgin Islands Climate Change Policy: Achieving Low-Carbon, Climate-Resilient Development

This climate change policy includes necessary, cost-effective actions to both adapt to the inevitable impacts of a changing climate and mitigate carbon emissions to minimize the extent of Climate Change across various sectors such as: Beach and Shoreline Stability; Tourism; Insurance and Banking; Agriculture; Human Health; and Critical Infrastructure among other issues.

Caribbean Community Climate Change Centre, 2011, 35pp, ENGLISH
Download ▸ http://dms.caribbeanclimate.bz/php/gateway/eldis.php?id=4423

ONLINE TOOLS, KNOWLEDGE CENTERS, AND INFORMATIONAL DATABASES

47. Evidence and Lessons from Latin America (ELLA)

ELLA is a knowledge sharing and learning platform that shares knowledge of recent Latin American experiences on selected economic, environmental and governance issues; supports learning between Latin American, African, and South Asian countries; and provides a networking platform for organizations and individuals to link to Latin America.

Web link ▸ http://ella.practicalaction.org/

Some relevant resources include: ENGLISH

- **City-level Climate Change Adaptation and Mitigation guide**
  Download ▸ http://ella.practicalaction.org/sites/default/files/131204_ENV_CitAdaMit_GUIDE.pdf
- **Urban Disaster Risk Management in Latin American Cities**
  Download ▸ http://ella.practicalaction.org/node/1140
- **Disaster Risk Management in Latin American Cities**
  Download ▸ http://ella.practicalaction.org/node/1140#sthash.R6jOw2Rp.dpuf
- **City of Quito Climate Change Strategy**
  Download ▸ http://ella.practicalaction.org/node/1091

48. Reviews of Current and Planned Adaptation Action in Latin America and the Caribbean

The Adaptation Partnership initiated a Review of Current and Planned Adaptation Action in the fall of 2010 in an effort to provide a baseline understanding of who is doing what on adaptation in three developing regions – Africa, Asia-Pacific, and Latin America and the Caribbean – and in priority adaptation sectors. Based on available resources, it seeks to provide a rapid assessment of: priority interests and adaptation needs; efforts by governments to support adaptation though policy and planning; the scope of international support for adaptation efforts in different countries and sectors; and potential gaps in adaptation efforts at the country and regional levels. In total, 12 regional and 114 individual country profiles were completed and may be accessed.

Adaptation Partnership, 2011, ENGLISH
Web link ▸ http://www.adaptationpartnership.org/blog/activities

49. weADAPT

weADAPT is an online "open space" that intends to bring together climate adaptation issues and greenhouse gas mitigation. The website helps practitioners, researchers, and policymakers access credible and high quality information and also to share experiences and lessons learned.

weADAPT, 2011, SPANISH ENGLISH
Web link ▸ weadapt.org

50. ClimateWizard

ClimateWizard enables technical and non-technical audiences to access leading climate change information and visualize the impacts throughout the world. The first generation of this web-based program allows the user to choose a state or country and both assess how climate has changed over time and to project what future changes are predicted to occur in a given area.

The Nature Conservancy, The University of Washington, The University of Southern Mississippi, 2009, ENGLISH
Web link ▸ http://www.climatewizard.org/

51. Climate Adaptation Knowledge Exchange (CAKE)

CAKE aims to build a shared knowledge base for managing natural and built systems in the face of rapid climate change. It is also intended to help build an innovative community of practice. It includes case studies, a virtual library, a directory, tools, and community forums for the discussion of current issues in climate adaptation.

EcoAdapt, 2013, ENGLISH
Web link ▸ http://www.cakex.org/

52. The Global Climate Risk Index 2014

This index analyzes to what extent countries have been affected by the impacts of weather-related loss events (storms, floods, heat waves etc.). The most recent data available – from 2012 and 1993–2012 – were taken into account. This year's 9th edition of the analysis reconfirms that less developed countries are generally more affected than industrialized countries. Regarding future climate change, the Climate Risk Index may serve as a red flag for already existing vulnerability that may further increase in regions, where extreme events will become more frequent or more severe due to climate change.

Germanwatch, Kreft, S. and Eckstein, D., November 2013, 27pp, ENGLISH
Web link ▸ http://germanwatch.org/de/download/8551.pdf

53. Climate Change Knowledge Portal

The Climate Change Knowledge Portal (CCKP) Beta is a central hub of information, data, and reports about climate change around the world. The site allows you to query, map, compare, chart, and summarize key climate and climate-related information.

World Bank, 2014, ENGLISH
Web link ▸ http://sdwebx.worldbank.org/climateportal/index.cfm

54. Adaptation Learning Mechanism (ALM)

Seeking to provide stakeholders with a common platform for sharing and learning, the ALM bridges knowledge gaps by bringing relevant knowledge and stakeholders together to exchange information, experiences, and expertise. The site includes country profiles summarizing key adaptation information, resources and projects, as well as a document database. Registration is free, and registered users can upload content to the site.

United Nations Development Programme (UNDP), 2009, ENGLISH
Web link ▸ http://www.adaptationlearning.net

55. Participatory Learning and Action: Community-Based Adaptation to Climate Change

Through reflections, case studies, and descriptions of available participatory tools, the authors give an overview of working in communities on adaptation efforts. The first section includes reflections on participatory processes and practice in community-based adaptation to climate change, including participatory vulnerability analysis and disaster risk reduction frameworks. The second section focuses on participatory tool-based case studies and describes a participatory process with an emphasis on the use of a particular tool. The third section, participatory tools, includes shorter, step-by-step descriptions of how to facilitate a particular tool in a community.

International Institute for Environment and Development (IIED), 2009, 224pp ENGLISH
Download ▸ http://www.iied.org/pubs/display.php?o=14573IIED

56. Participatory Capacity & Vulnerability Analysis

Oxfam's participatory capacity and vulnerability analysis (PCVA) tool is a risk analysis process designed to help staff and partner organizations engage with communities in contexts where natural disasters are significant drivers of poverty and suffering. PCVA draws on a wide range of participatory learning and action techniques and tools designed to channel participants' ideas and efforts into a structured process of analysis, learning, and action planning, with the overall aim of reducing a community's disaster risk.

Oxfam, Turnbull, M. and Turnvill, E., 2012, 43pp ENGLISH
Download ▸ http://policy-practice.oxfam.org.uk/publications/participatory-capacity-and-vulnerability-analysis-a-practitioners-guide-232411

57. GFDRR Country Adaptation Profiles

Country Adaptation Profiles offer historic climate information at national and sub-national levels, historic climate-related disaster information, a summary of observed climate trends, as well as summarized adaptation needs in key development sectors/themes.

The Global Framework for Disaster Risk Reduction (GFDRR), 2014, ENGLISH
Web link ▸ https://www.gfdrr.org/CountryPrograms

58. UNDP Climate Change Country Profiles

This web portal developed by the United National Development Programme provides historical and projected temperature and precipitation data for selected countries.

United Nations Development Programme (UNDP), 2014, ENGLISH
Web link ▸ http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/

59. Climate Investment Funds Climate Resiliency Pilot Program Reports

The Climate Investment Funds (CIF) programs give resources to mitigate and manage the challenges of climate change in 48 middle income and developing countries. Reports provide information on climate change vulnerability of pilot countries.

Climate Investment Funds (CIF), 2014, ENGLISH
Web link ▸ https://www.climateinvestmentfunds.org/cifnet

60. UKCIP Tools Portfolio

UKCIP has a range of tools to help plan an adaptation strategy. Specifically, these tools will help to: identify problems and objectives related to climate adaptation; establish decision making criteria; assess risks; identify options; appraise options; make and implement decisions, and monitor.

UK Climate Impacts Programme (UKCIP), 2014, ENGLISH
Web link ▸ http://www.ukcip.org.uk/wizard/tools-portfolio/

61. Caribbean Climate Online Risk and Adaptation TooL (CCORAL)

CCORAL is a Caribbean-focused tool to help organizations make climate resilient decisions. It helps users undertake quick screening, understand climate influence, apply climate risk management processes, find tools in CCORAL's toolbox, and learn more about climate change adaptation.

Caribbean Community Climate Change Centre (CCCCC) CCORAL Team, 2013, ENGLISH
Web link ▸ http://ccoral.caribbeanclimate.bz/

62. Regional Gateway for Technology Transfer and Climate Change Action in Latin America and the Caribbean (REGATTA)

REGATTA´s main objective is to strengthen capacity and promote knowledge sharing of climate change technologies and experiences for both adaptation and mitigation in LAC. REGATTA's online knowledge platform aims to strengthen the exchange of information and experiences among countries, institutions, and experts, and also to develop an inventory of initiatives and lessons learned on adaptation, mitigation, and technology development.

United Nations Environment Programme (UNEP), **Regional Gateway for Technology Transfer and Climate Change Action in Latin America and the Caribbean** (REGATTA), 2014 ENGLISH
Web link ▸ http://www.climatechange-regatta.org/index.php/en/all-about-regatta

63. SERVIR: The Regional Visualization and Monitoring System

This interactive data catalogue helps resource managers and other users make decisions by providing Earth observations and predictive models based on data from orbiting satellites. It helps nations in Mesoamerica, Africa, and the Himalayan regions address eight areas of societal benefit: disasters, ecosystems, biodiversity, weather, water, climate, health, and agriculture. SERVIR can be used to monitor air quality, extreme weather, biodiversity, and changes in land cover, as well as to respond to environmental threats such as wildfires, floods, landslides, and harmful algal blooms.

Web link ▸ https://www.servirglobal.net/ ENGLISH
Web link ▸ http://www.servir.net/ SPANISH

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