URBAN CLIMATE CHANGE RESILIENCE

A Synopsis

ADB

Publication Stock No. ARM146551

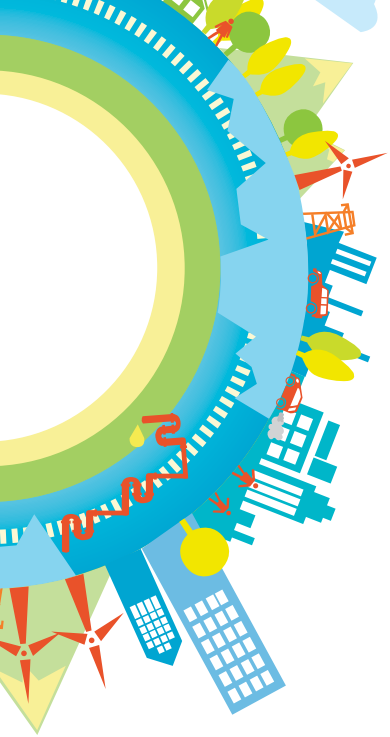
Note:
In this publication, "$" refers to US dollars.

6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
www.adb.org

For orders, please contact:
Public Information Center
Fax +63 2 636 2584
adbpub@adb.org

Contents

1	Introduction	4
2	Core Principles and Qualities	6
3	Planning for Resilience	9
4	Knowledge	14
5	Investments and Projects	17
6	Further Reading	26



1. Introduction

Cities across the globe, particularly those with urban poor communities, face long-term challenges in ensuring the well-being of their inhabitants. These challenges are partly a result of direct and indirect impacts of climate change, and are often compounded by preexisting vulnerability. **Urban resilience** is the capacity of cities to function, so that the people living and working in cities—particularly the poor and vulnerable—survive and thrive no matter what stresses or shocks they encounter.

Urban Climate Change Resilience

The concept of resilience has been useful in addressing climate risk and unexpected events, and in enhancing efforts to survive and thrive in the context of climate change.[1]

Urban climate change resilience (UCCR) embraces climate change adaptation, mitigation actions, and disaster risk reduction while recognizing the complexity of rapidly growing urban areas and the uncertainty associated with climate change. This approach places greater emphasis on considering cities as dynamic systems capable of evolving and adapting to survive and even thrive in the face of volatile shocks or stresses.

Urban resilience to climate change describes a city that is resilient on three levels:

- the systems of the city survives shocks and stresses;
- the people and organizations are able to accommodate these stresses into their day-to-day decisions; and
- that the city's institutional structures continue to support the capacity of people and organizations to fulfil their aims.

There is no single action that will make a city resilient to climate change. Resilience is instead achieved through a number of actions, building upon each other over time. These actions would be enhanced and progressed as peoples and institutions learn from past experiences and apply it to future decisions.

Maintaining essential urban functions

Actions to build resilience should respond to three key questions:

1. How does the city work (the urban systems)?
2. What are the direct and indirect impacts of climate change (climate change)?
3. Who is least able to respond to shocks and stresses (vulnerable groups)?

Figure 1 highlights that the action focusing on disaster risk reduction and/or urban poverty reduction is necessary but insufficient to maintain urban functions in the face of direct and indirect climate change impacts.

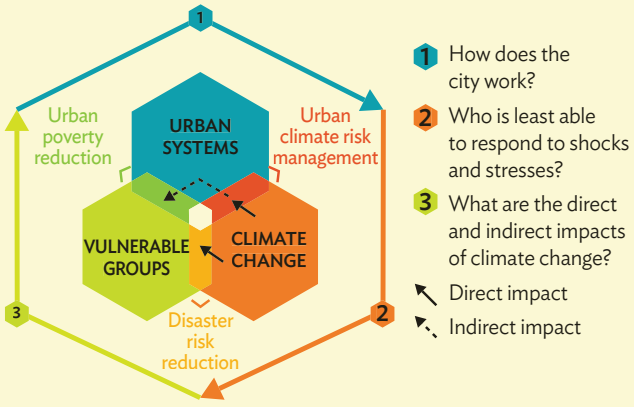


Figure 1: Conceptualizing Urban Resilience to Climate Change

Source: Da Silva, et al. 2012.

[1] Asian Cities Climate Change Resilience Network. 2013. *ACCCRN City Projects.*

As detailed in Section 2 (page 3) of this Synopsis, building UCCR is founded on the following principles and qualities that must be integrated into any effort to advance action:

- **Principles:** combining hard and soft measures, engaging diverse perspectives through multistakeholder processes, engaging different geographic and governance scales, addressing today's problems while embedding a long-term vision, tapping into local expertise, building leadership and local action, and focusing on vulnerable communities
- **Qualities:** reflective, robust, redundant, flexible, resourceful, inclusive, and integrated

Why second-tier cities?

Residents of second-tier cities have very different levels of access to services. This differentiation is a product of rapid increase in urban population and demand for services, a lack of funding, inadequate planning, and preexisting patterns of social marginalization.[2] Large sections of the urban population lack economic power and political voice, and an increasing number of people are living in slums.

At the same time, these cities will still be making significant decisions on planning, land-use, and major investment projects. It is during these decisions that the interactions between climate change and urban development can be effectively addressed. This type of decision making will assist in managing the challenges of current development whilst also considering the future scenarios of climate change.

Who (and what) is most at risk?

Urban areas that are most susceptible to external shocks and stresses (including climate change) are those that have fragile systems as well as large populations of the socially or economically marginalized. These impacts are most felt by vulnerable people as a result of their high exposure to hazards, or a lower ability to adapt and respond (due to physical limitations or financial capacity).

The direct impacts of climate change are twofold: shocks and sudden impacts such as storms, typhoons, and heat waves; and stressors or impacts that build gradually over time such as sea level rise, average temperature increase, and long-term changes in rainfall patterns. Between 2000 and 2012, the damage from natural disasters was $1.7 trillion globally.

Purpose of this Synopsis

What is it for? To provide a concise introduction to urban climate change resilience, including the core concepts and principles, relevant processes, experiences from implementation, and outcomes sought from a UCCR-based approach.

Who is it for? For ADB project officers, consultants, and partners who are interested in UCCR. It explains how UCCR is understood in the context of Urban Climate Change Resilience Trust Fund, managed by ADB.

Why is it necessary? To communicate the principles, processes, and practices associated with UCCR in a succinct and accessible way. UCCR is a relatively new approach to addressing the uncertainty that climate change and rapid urbanization bring to cities.

Definitions

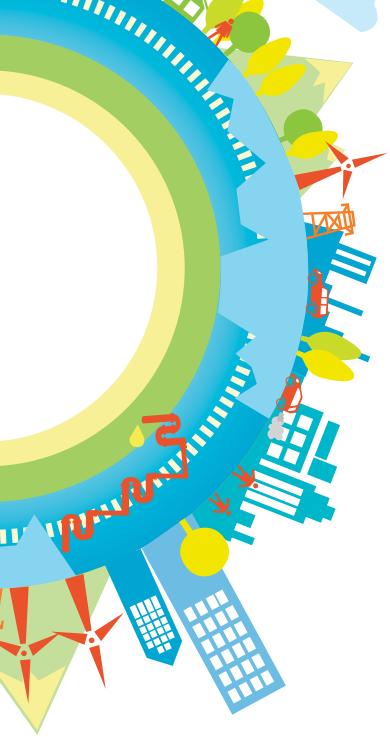
Climate Change Mitigation: actions to reduce emission of greenhouse gasses. Intergovernmental Panel on Climate Change (IPCC)

Climate Change Adaptation: adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. (IPCC)

Urban Climate Change Resilience: capacity of cities to function, so that the people living and working in cities—particularly the poor and vulnerable—survive and thrive in the face of shocks and stresses related to climate change.

Indirect impacts on urban areas resulting from these shocks and stresses include: severe flooding (stopping port or train operations, thus affecting travel to work and preventing goods to reach market); blackouts (as energy generation is affected by storms); increased risk of water- or vector-borne diseases (due to rainfall and changes in temperature); and heat stress (exacerbated by temperature increase). An increase in disease incidence and heat stress can put pressure on the health system and infrastructure during climatic events.

[2] A. Brown, A. Dayal, and C. Rumbaitis Del Rio. 2012. *From practice to theory: emerging lessons from Asia for building urban climate change resilience.* Environment and Urbanization.



2. Core Principles and Qualities

Urban climate change resilience can be found in cities that have avoided system-wide collapse to those that have transformed how they function in the face of disruption. Achieving resilient outcomes demands that a series of core principles are integrated into any effort to advance action, i.e., a process that is iterative, inclusive, and integrated. There are some generalizable qualities observable in resilient cities relating to the systems and the capacities of stakeholders—from different parts of city government to the business sector and civil society—who can shape those systems to create climate change resilience.

Guiding Principles of Urban Resilience

Combining hard and soft measures. Capacities, networks, and behavior (of individuals, communities, and institutions) are as critical as physical systems during disruption. Soft measures include new regulations, technology and information systems, and social networks.

Engaging diverse perspectives through multistakeholder processes. Given a city's varied socio-economic groups and economic interests, engaging across different sectors (government, business, civil society, and academia) and different departments within city government can result to the most transformative changes.

Enlist different geographic and governance scales: Beyond city boundaries. Considering the interconnectedness of markets and economies, it is important to understand how systems (economic, physical, ecological, political mechanisms) within and beyond the city affect how it functions. There is also a need to understand how to best enlist stakeholders at different scales.

Addressing today's problems while embedding a long-term vision: The future is now. The city's decision makers often find it difficult to look beyond current challenges, particularly when change is unpredictable. Planning processes should begin by addressing the current needs (e.g., water supply or urban drainage). Building on existing issues and analyzing how climate change might change or increase existing hazard risk is one way to bring future scenarios into current decision making.

CASE STUDY
Davao City, Philippines

In 2013, UN-Habitat and World Food Programme used multistakeholder and multisector processes to engage Davao City in a 7-month program to deepen understanding of spatial and sectoral vulnerability to climate change. This program led to the identification of preliminary resilience building options which were prioritized through a city-wide consultation.

Engage the city

- Briefing of local Chief Executive/Leaders
- Formation of Technical Working Groups (TWGs)
- Signing of Memorandum of Agreement (MOA)

Conduct the Vulnerability and Adaptation Assessment

- Climate Change Orientation (Cluster Workshop)
- Exposure analysis
- Sensitivity analysis
- Adaptive capacity analysis
- Coaching and mentoring sessions

City and community validation and local adaptation planning

- Community focus group discussions
- City consultation (Results of the VAA and hotspot assessments)
- Formulation of Climte Change Action Plan

Figure 2.1: Vulnerability Assessment Process for Davao City

Source: UN Habitat.

UCCR: an integrated approach to climate proofing projects

"Climate proofing" efforts on individual projects sometimes aim to make single piece of infrastructure more durable in the face of changing climate risk. When considered at the city scale, a collection of single actions has the potential to either improve or erode the resilience of the city by affecting the flexibility of urban systems to handle surprise and multiple interacting impacts.

In Quy Nhon, Viet Nam, roads and houses were raised above the potential water level in response to increasing seasonal flooding. While each piece of infrastructure endured higher water levels better, the system as a whole suffered—higher roads blocked natural drainage channels during a 2009 storm, causing flooding in new areas and more intensively in areas that had learned to manage seasonal flooding.[3]

Figure 2.2: Resilience qualities

Source: Arup. 2014.

Tapping into local expertise. Engaging local technical experts (e.g., researchers and academics) enables dialogues to be held on a sustained basis. For example, external experts may be paired with local technical institutions to bridge the quality-engagement trade off and build long-term adaptive planning capacity.

Building leadership and local action. Efforts to build resilience are most likely to be accelerated and sustained through strong leadership, driving commitment, and accountability with active community engagement to build awareness.

Focusing on vulnerable communities: Whose resilience? The litmus test for a meaningful urban resilience approach is its relevance to the interests of poor or vulnerable households. While resilience measures must be provided at multiple levels, it is important to constantly ask 'resilience for whom?' to establish their practical value and to ensure that equity concerns are kept at the heart of the agenda.

Resilience qualities

Resilient cities demonstrate observable qualities through their stakeholders and urban systems. These qualities are described below and in Figure 2.2, and illustrated in practice in Section 4.[4]

Reflective. People and institutions systematically learn from experience, with an adaptive planning mindset that accepts unpredictable outcomes. They have mechanisms to continuously modify standards based on emerging evidence, rather than seeking permanent solutions based on an assessment of today's shocks and stresses.

Robust. Robust city systems are designed and managed to withstand the impacts of extreme conditions and to avoid a catastrophic collapse of the city from the failure of a single element. A robust system anticipates system failures and makes provisions to maximize predictability and safety.

Redundant. Redundancy is to deliberately plan capacity to accommodate for increasing demand or extreme pressures – if one component of the system fails, other pathways or substitutable components can meet essential functional needs. One example is having multiple pathways to access water, such as city supply, water tankers, wells and tanks etc. Overreliance on a system 'fail-safe' can expose an underlying lack of resilience.

Flexible. Flexibility is a city with systems that can change, evolve and adopt alternative strategies (in either the short or longer term) in response to changing conditions. These systems tend to favor the decentralization of conventional infrastructure

[3] A. Brown and S. Kernaghan. 2011. *Beyond Climate-Proofing: Taking an Integrated Approach to Building Climate Resilience in Asian Cities.* UGEC Viewpoints, No. 6.
[4] Arup. 2014. *City Resilience Framework.* The Rockefeller Foundation.

with new technologies. For example, super storm Sandy in New York has brought into focus the value of decentralized energy systems in urban centers.

Resourceful. People and institutions should invest in capacity to anticipate future urban conditions, set priorities, and mobilize and coordinate the resources (human, financial, and physical). Resourcefulness prepares a city to respond quickly to extreme events, modifying organizations or procedures as needed.

Inclusive. An inclusive approach is one that includes the consultation and engagement of communities, particularly those who are vulnerable. A city cannot build resilience in isolation of others. Resilience needs collective ownership and joint vision from various groups within the city.

Integrated. City systems, decision making, and investments should be mutually supportive of a common outcome. Resilient system integration has evidence of systems that exist across different scales of operation. Integration requires ongoing feedback system for collection of information and response.

KEY QUESTIONS

- **Resilience for whom?**
- **How can the guiding principles support resilience planning and project design which target urban poor?**
- **Do new projects demonstrate a range of resilience qualities (reflective, robust, redundant, flexible, resourceful, inclusive, and integrated)?**
- **Are these qualities of resilience needed in the systems that support the functioning of the city?**

3. Planning for Resilience

Action to build UCCR should be informed by an **iterative, inclusive, and integrated** planning process which responds to three interlocking frameworks of analysis:

- **Urban Analysis**, particularly understanding how the city works and examining its current status and future trends (such as population growth and economic development);
- **Climate Change Risk Analysis,** particularly projections of direct and indirect climate impacts; and
- **Vulnerability Analysis,** particularly of the urban population that faces high exposure risk to climate change impacts and has limited coping capacity with which to weather these impacts.

The process of bringing these elements together in identifying actions to build urban climate change resilience is known as climate change resilience planning, and is outlined in more detail in this section.

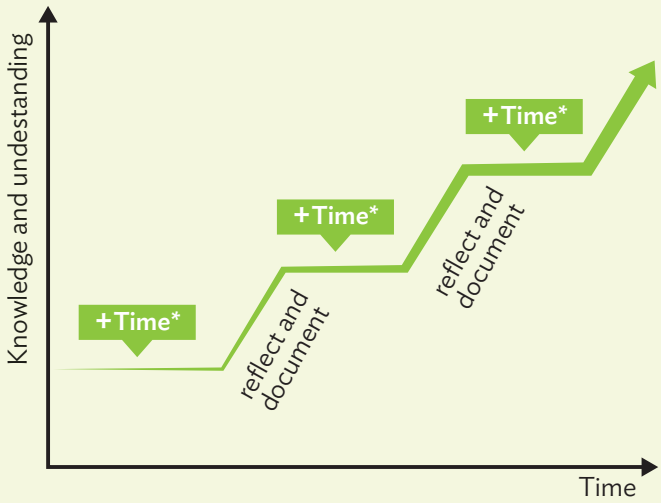
Iterative, Inclusive, and Integrated

Resilience planning is the process of bringing together technical, scientific, and local knowledge into city decision-making processes. It does not refer specifically to spatial or infrastructure planning, which are likely to be action areas identified in the planning process.

Resilience planning builds on **iterative, inclusive, and integrated processes** to reduce the uncertainty and complexity of rapid urban growth and climate change (as described below and in Figure 3.1).

Engagement with multiple stakeholders needs to be more than a once-off activity. Engagement that uses an adaptive cycle of **action and reflection** progressively builds capacity and understanding over time. This **iterative process** can increase the capacity of decision makers (business, community, household, or government) to incorporate new information and uncertainty (related to climate, urban growth, and vulnerability) into future plans and actions.

Multistakeholder, multisector engagement. Governments often work in silos, carrying out limited stakeholder engagement (with local and national government authorities, community representatives, business leaders, financing partners, and



* Actions examples:
- Scenario planning with community
- Vulnerability assessment
- Climate risk analysis

Figure 3.1: An iterative, inclusive, and integrated planning processes

Source: ISET. 2013.

academics) on urban challenges and potential solutions. Bringing together a wide range of stakeholders to discuss scientific information (climate change projections), governance, or technical studies provides an opportunity for findings to be verified from multiple perspectives. Implications of and responses to these issues can then be discussed.

Visioning and scenario planning. Scenario development can be a powerful tool for planning for urban and climatic uncertainty. It is designed to stretch their thinking about emerging changes and the opportunities and threats that the future holds.

Scenario planning can be used to focus on the impacts of climate change on urban growth trajectories, or to understand how climate change might affect specific sectors due to insufficient water supply coverage, recurrent flooding, or extreme average temperature.

Plan and prioritize actions. Resilience planning involves the development of a strategy that documents the cumulative understanding of current and future vulnerability, and identifies strategies and actions to build resilience over time. Prioritizing actions enables cities to identify what can be done now, and to identify which actions can reduce the existing city resilience deficit.

Urban Systems Analysis

Systems thinking provides a platform for a more holistic approach in which urban areas are considered as complex 'living' systems undergoing numerous dynamic exchanges at any given time.

Failures in networked infrastructure, such as the Surat Plague in 1994 which resulted in 52 deaths, have revealed how complex and interdependent the systems of a city are. These events show how delicate essential infrastructure may be and highlights the importance of regular repair and maintenance to ensure that these services can respond to shocks and stresses.[5]

Spatial analysis is often used to assess the direct impacts of climate on an urban population and sectors. However conventional spatial analysis neglects to consider the reliance of communities in one location with infrastructure (energy, water, transport) located elsewhere. Saline intrusion into a city's water supply has wide impacts on communities across a city, despite that water supply potentially being located far from the consumers. Recognising these indirect impacts through a systems based approach can therefore improve spatial analysis in the context of climate change.

CASE STUDY
Surat, India

In response to 2006 flooding, and as part of a climate resilience planning process, city stakeholders in Surat developed a City Resilience Strategy in 2010. Surat undertook a systems analysis to gain a deeper understanding of gaps or deficits in the infrastructure, institutions, and knowledge sharing processes in the city, and whether they were enabling or preventing resilience.

Through this process, an end-to-end early warning system was conceived which looked beyond administrative boundaries and engaged with multiple levels of government. The core infrastructure, dams and SMS based warning were already in place, leaving Surat to focus on improving access to knowledge, and building the capacity of existing institutions. For instance, the project improved the quality of data through comprehensive hydrological catchment modeling, and how that information was shared between decision makers, interpreted, and made accessible to vulnerable people.[6]

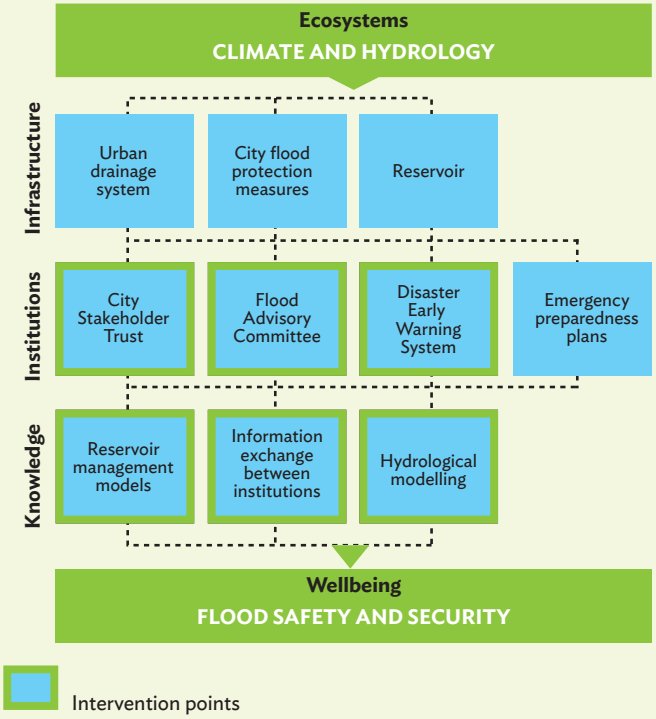


Figure 3.2: Urban Systems Analysis of Surat Flood Management

Source: Da Silva, et al. 2012.

[5] G. Bhat, U. Raghupathi, and U. Rajasekar. 2013. Urbanisation – Poverty – Climate Change: A Synthesis Report. India. Volume I and II.
[6] J. da Silva, S. Kernaghan, and A. Luque. 2012. A systems approach to meeting the challenges of urban climate change, International Journal of Urban Sustainable Development. pp.1-21.

An urban center's resilience to climate change is influenced by its resilience to the stresses and shocks in the past. The first aspect of any urban analysis is an assessment of its resilience to those familiar shocks and stresses that climate change is likely to exacerbate. For instance, as part of its climate resilience planning process, Indore, India focused initial studies on understanding vulnerability to climate change in the priority issue areas of urban health and environment, transport, water security, and energy security. The city then used multistakeholder processes to identify and highlight cross-sectoral linkages and capture the systemic interdependencies that needed action.

The impacts of climate change on cities cannot always be managed by the municipality alone. Cities have to look for external assistance to reduce risk. In Surat, India, the flood management system (Ukai Dam) is outside the municipal boundary and controlled by the Gujarat State Irrigation Department. This means that the city is unable to influence when and how much water is released, or to have sufficient time and information to prepare themselves for resulting floods.

Climate Risk Analysis

Climate risk analysis begins with an assessment of likelihood of hazards due to potential changes in the climate (i.e. changes to temperature, rainfall, or the frequency of storms). Climate change is impacting the type, frequency and extent of hazards that are faced by cities, making future climate risks even more uncertain.

Uncertainty in climate information will make it increasingly difficult to support design specifications for infrastructure including dams, dikes, and flood control channels. This uncertainty requires planners and engineers to find alternative design approaches that are less dependent on climate specifics (i.e., focusing on system rather than infrastructure resilience).[7]

Engaging city stakeholders in the development of climate risk assessments can build confidence in the findings and create understanding of climate change projections. Benefits of this approach include:

- City-level verification that inputs (data) being used are representative and reliable, and that outputs (future hazard profiles) are realistic based on local knowledge and experience.
- Making documentation accessible to a "nontechnical audience" can improve understanding of the process and create the opportunity for further discussion of findings and implications.

CASE STUDY
Semarang, Indonesia

Semarang, Indonesia is facing another significant urban climate change resilience challenge as it is forced to extract groundwater to meet its residents' basic needs.

In 2010, Semarang developed a City Resilience Strategy[8] in response to the need to adapt to climate change. As part of this strategy, the city analyzed its vulnerabilities to climate changes with regard to temperature, rainfall, and wind speeds.

Coupled with an understanding of the city's population and practices, the analysis identified some vulnerabilities, such as:

- Land subsidence as a side effect of groundwater extraction, which is taking place at a rate of up to 10 cm a year according to some estimates. This environmental problem has increased the city's vulnerability to flooding.
- Sea level rise of 21 cm by 2050 as a result of climate change, which compounds the predicted subsidence. This will impact coastal infrastructure, making the port and train station particularly vulnerable.

The indirect effects of coastal flooding include interruption of travel to work, shortages of goods, and failure of goods to reach market (see image below).

Tidal flooding impacting travel and ability to work in Semarang, Indonesia.

Source: Arup.

[7] ISET. 2013. *Climate Resilience Framework: Training Materials.* ISET International.
[8] Da Silva, et al. 2012.

CASE STUDY

Vulnerability Assessments in Surat, India

The city of Surat, India used a geographic information system (GIS)-based vulnerability assessment focusing on spatial and socio-economic vulnerability. Climate change scenarios for Surat indicate an increase in rainfall, with monsoons dominated by heavy spells of rain interspersed with longer dry spells.

The key findings of the vulnerability assessment were:

- One third of households have poor income stability, indicating high sensitivity to changes in the economy and to disasters and external shocks.
- 71,000 households are prone to tidal flood risks (12% of households).
- 450,000 households are at risk of sudden water release from Ukai dam (74% of households).

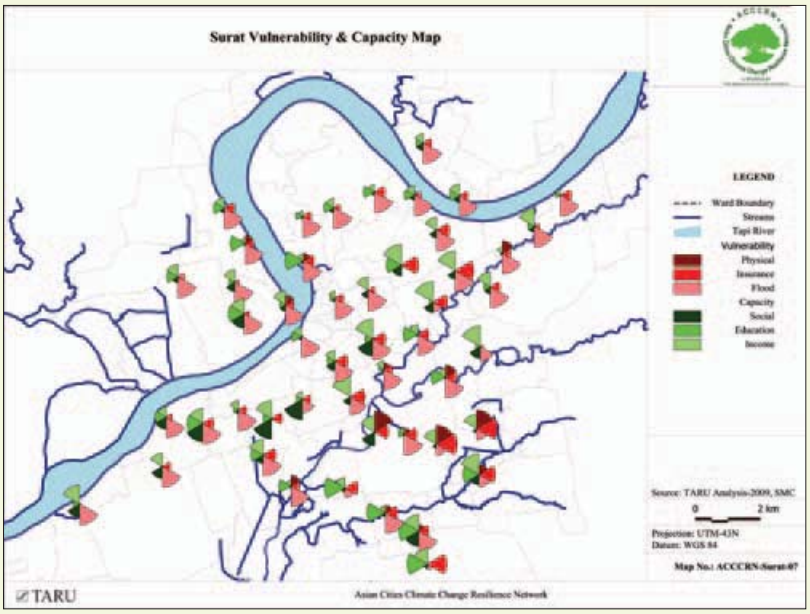


Figure 3.3: Surat, Capacity and Vulnerability Index

Source: TARU.

Lessons from integrating climate risk projections into resilience planning include:[9]

- Timescales need to be relevant to policy and planning processes
- Trends from global circulation models can provide enough information to begin to act.
- Cities often have no capacity to integrate models on their own and need external support.
- Hazard projection should not be combined, as each hazard needs to be considered separately.
- Climate modeling exercises should be accompanied by impact assessments on urban sectors, rather than just using spatial assessment of hazard impacts.

Analyzing Vulnerability

Climate vulnerability is the degree to which someone or something can be affected by climate-related hazards (e.g., short-term hazards such as storms to long-term changes such as sea level rise). This term includes both people and the context in which they live.

Vulnerability analyses identify the current location and dynamics of vulnerable urban population, as well as the vulnerabilities across different sectors and urban systems.[10] By conducting vulnerability assessments, the cities gain:

- an understanding of who and what are the vulnerable groups, areas, sectors, and urban systems;
- protection from the range of factors that make them vulnerable, including direct factors (such as exposure to hazards) and indirect factors (such as access to energy, food, and water systems); and
- a knowledge of existing capacities to adapt.

Vulnerable communities are particularly limited by the ability to manage or adapt to climate impacts. This may be due to a range of issues such as having low education or health care, insufficient access to basic infrastructure (potable water, sanitation, drainage) or financial capacity constraints (unemployment, poverty or extensive debt).

Nonresponsive political systems and bureaucratic structures mean that communities may have a limited voice or power to create change, and that they may lack safety nets (e.g.,

[9] D. Sharma, and R. Singh. 2013. *Urban Climate Resilience: A review of the methodologies adopted under the ACCCRN initiative in Indian cities.* ACCCRN Working Paper Series 5. The Rockefeller Foundation.

[10] ISET. 2013.

insurance and savings) and information, which in turn limits their ability to adopt alternative strategies.

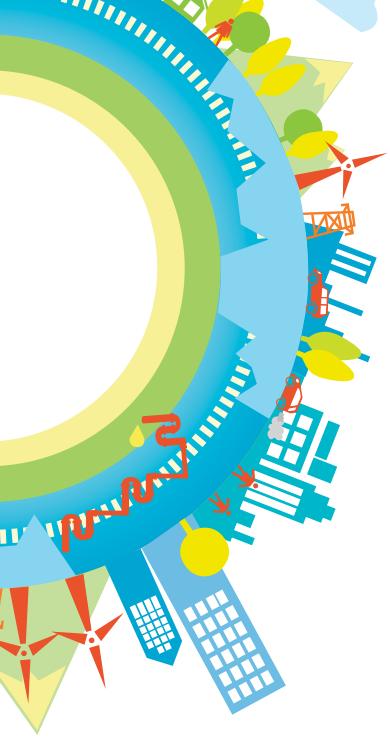
For instance, fishermen are a particularly vulnerable group.[11] Households dependent on fishing tend to be among the poorest and to live in weakly constructed houses, which are highly prone to typhoons. This vulnerability will be exacerbated over time as typhoons are expected to increase in intensity and frequency.

Vulnerability assessments undertaken as part of the Asian Cities Climate Change Resilience Network (ACCCRN) program placed greater emphasis on understanding the current vulnerabilities and how they might be exacerbated by climate change, in addition to projecting how ongoing climate change and climate variability might create new vulnerabilities. This assessment helps to anchor an understanding of climate change in today's context, rather than in a future timeframe.

KEY QUESTIONS

- **Who is most vulnerable to the shocks and stresses today?**
- **What are the locations and sectors at risk of these shocks and stresses?**
- **How would climate change impacts affect city functions?**
- **How will climate change and other trends (urbanization/ demography) create, enhance, or reduce vulnerability?**
- **Where are the opportunities (within infrastructure, institutions, and knowledge sharing processes) to create more resilient systems for today and the future?**

[11] Challenge to Change and Hue University. 2009. *Hazard, Capacity & Vulnerability Assessment in Da Nang.* ACCCRN, The Rockefeller Foundation.



4. Knowledge

Planning processes and actions are two related entry points that cities have initiated to become more resilient to climate change, thereby reducing risk to rapidly growing urban population. Creating sustained change requires the integration of UCCR into mainstream policy, development plans, and everyday decision making. Learning from city experiences and sharing that knowledge to improve practice is a third and equally important entry point. By bridging the information gaps in city decision making, we can improve the capacity of government, business, and the community to act. By identifying quantitative and qualitative benefits of UCCR, we can build the case for further investment in planning, projects, and knowledge activities that build climate change resilience.

Generating and Sharing Knowledge

Generating and sharing knowledge is critical to initiating UCCR action in cities. As outlined in Section 3, multistakeholder iterative processes provide access to new information and create the opportunity to reflect, learn, and act. Resilience planning engages decision makers and vulnerable population in managing climate change, and in implementing specific activities that can build understanding on how to respond. Bridging information gaps in the long term and improving capacity of government, business, and the community requires learning from project implementation, knowledge exchange, and formal and informal networks which bring wider experience and enable dissemination of information beyond the city.

Actions

Learning opportunities from investing in actions are both technical (how to design an early warning system that responds to the specific needs and existing infrastructure of the city) and capacity-related (resilience building actions often require cross-sectoral implementation teams who have not worked together before). Actions (identified as projects in Figure 4.1) provide an opportunity for stakeholders to learn how to collaborate, share the learning, and see how actions contribute to resilience. Sharing successes and challenges in real time and upon completion enables others to benefit particularly where cities are implementing UCCR actions in parallel.

City working groups

City working groups involving city and state government, community, academia, and business are one emerging mechanism for ensuring continued UCCR learning and exchange, and for reinforcing an integrated approach. Whether mandated by the Mayor or set up on a more informal basis, these groups can bring diverse perspectives into resilience planning, and evolve and change in response to the needs of the city.

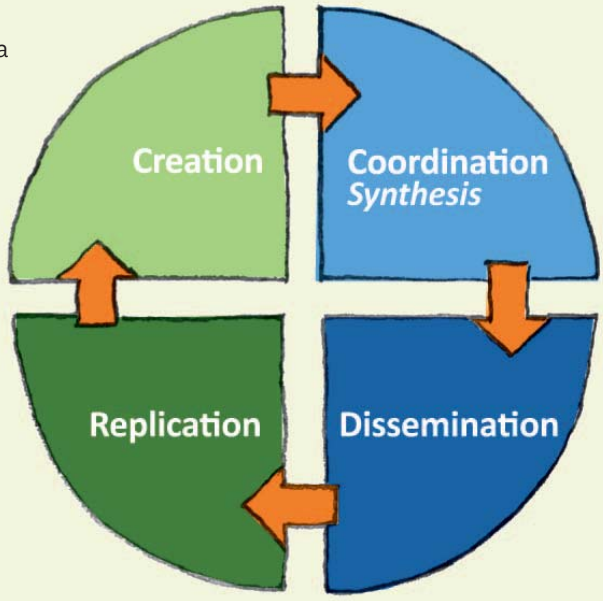
In Surat, India, an informal climate watch group created in 2009 has evolved into the Surat Climate Change Trust, and this organization has now taken the lead on UCCR planning and action across the city. City working groups have the potential to ensure that learning from project implementation is shared with other implementers, and fed into strategic planning processes.

Networks

Formal and informal networks bring wider experience and enable dissemination of experiences and lessons to national and regional forums. For example, in Viet Nam, a specific national UCCR network is emerging as part of the Viet Nam Urban Forum. Peer relationships forged through regional networking events can also trigger country-to-country exchange visits in areas of common interest (e.g., urban health or flood early warning systems).

Execute actions:
The initiation of knowledge, starting the journey from an idea through testing to evaluation to a point where it can be shared.

Review products:
Originators share their knowledge with a trusted community who review, develop and synthesise to create content for dissemination.



Network:
The content is so well known as to be common knowledge that informs emerging best practice and creation of new knowlege.

Distribution channels:
The content is made easily and readily available to targeted audiences and publically to anyone that wants to make use of it.

Figure 4.1: The knowledge life cycle

Source: Arup. 2013.

Research questions for Urban Climate Change Resilience

Resilience-based approaches are relatively new, with limited practice to underpin the costs and benefits of UCCR. Identifying quantitative and qualitative benefits are important to the continued emergence of UCCR as a valid approach to increasing the ability of cities to maintain core functions in the face of shocks and stresses.

What are the relative costs and benefits of UCCR?

There is a need for evidence of the net economic returns to resilience investment. Net returns vary according to a host of local demographic, socioeconomic, geographic, and to the frequency and intensity of the natural hazard.

A cost-benefit analysis of mangrove restoration in the Thi Nai Lagoon in Binh Dinh province of Viet Nam identified that the benefits of mangrove restoration are approximately double that of aquaculture development (from a 5% to a 15% discount rate).[12] Mangroves also provide socioeconomic development opportunities, particularly for fishing communities. These opportunities include fishing, ecoaquaculture, ecotourism, fuelwood collection, biodiversity conservation, carbon sequestration, and shoreline stabilization.

Further research, backed by the development of simplified methodological tools, would generate some broad yardsticks, providing a more solid basis for rational decision making about investment in resilience during preliminary project design and development.

Who are the decision makers in the city?

Governments are often seen as the key decision makers in cities, and therefore the focus of engagement for resilience building activities. However, there are a range of other actors, from businesses to universities to communities, who can make their own decisions and improve resilience in the household, community, system, and city.

For instance, after a series of shocks from disease outbreaks to recurrent flooding, the leadership of Chamber of Commerce in Surat, India has been instrumental in addressing the city's key challenges and in promoting integrated development planning. In the Philippines, the efficacy of a community-based early warning system in Metro Manila has been strengthened through access to data and knowledge as a result of the partnership between a local nongovernmental organization and the University of the Philippines.[13]

[12] Tuan and Tinh. 2013.
[13] Arup. 2014.

Figure 4.2: Framework for Sustaining UCCR Action Plan

Source: Kernaghan and da Silva. 2014.

How can UCCR action be sustained in cities?

Building UCCR is unlikely to be a one-off investment or a short-term engagement. Finding ways to catalyze longer-term changes is a challenge for UCCR. A framework for sustaining action is shown in Figure 4.2.

Indore and Surat in India, along with Bandar Lampung in Indonesia, have been the first cities to create a municipal budget line for climate change resilience action. Indore is also providing individual property owners with a 5% rebate on property taxes to adopt building-related energy-saving technologies to reduce the overall and peak energy load that Indore Municipal Corporation needs to plan for and reduce the likelihood of energy supply failures across the city.

Sustaining action on UCCR requires an understanding of the political economy of the city, and how municipal and other incentives for behavior change can have a long-term impact. Identifying pilot actions and investments that create transformative change in cities will be critical to enabling cities to function in the face of climate induced disruption in the long term.

KEY QUESTIONS

- What do you learn from planning or implementation?
- How are you sharing that knowledge?
- How can that knowledge change behavior or practice?
- Which actions are potentially transformative for cities?
- How can stakeholders beyond government contribute to building UCCR?
- How do you engage with these stakeholders?
- How can you learn from other cities, networks, or organizations that are already trying to answer these questions or solve the problem?

5. Investments and Projects

India

Building resilience to climate change requires multiple actions at multiple scales. For example, at an individual or household level, people need to live in a safe location. But at the same time, a government should invest in major infrastructure that builds resilience for individuals, the community, and the entire city.

Climate Change Risk in Urban India

As India faces rapid urbanization, the vulnerability of large populations, particularly the urban poor, has increased the extent to which cities focus on building resilience to climate change.

Resilience planning in Gorakhpur, Indore, and Surat, has led to the development of resilience strategies to identify challenges and prioritize responses. For example, Gorakhpur's resilience strategy has identified:

- priority issues of proper sewage and access to drinking water and sanitation;
- particular vulnerable sectors such as housing, industry, health, and basic services; and
- different intervention types, such as education and capacity building, ward-level master planning processes, and physical or technical solutions.

The following projects demonstrate how India is implementing actions to build resilience to climate change. The projects describe actions that target different scales (household, community, city) and various sectors (drainage, health, emergency management).

Intervention actions also vary, from physical infrastructure such as water pumps or toilets, to soft actions such as municipal planning.[14]

Gorakhpur: Implementing and Promoting Ward-Level Micro Resilience Planning

Scale: **Household, Neighborhood, Ward**
Action Area: **Planning, Drainage**

Gorakhpur, with a population of 670,000, faces frequent flooding, seasonal waterlogging, and subsequent health and mobility challenges. It is the poor communities that are most affected. This project established micro (household) planning mechanisms to build resilience to flooding.

Ward-level Solid Waste Management in Gorakhpur.

Source: Gorakhpur Environmental Action Group.

[14] ACCCRN. 2013.

Targeting differing scales

The activities from this project focused on two scales of the population:

- **The household**—by providing education and building capacity to develop integrated farming, construct flood-resilient houses, and carry out sufficient waste management.
- **The neighborhood**—by mobilizing community groups to engage common issues of improving health, sanitation, drainage, drinking water, and agricultural planning.

To support these actions, a ward-level committee was established to ensure that there is an ongoing provision and maintenance of municipal services. As a result of strengthening ward-level planning, the following qualities of resilience were built:

- **diversity** of community assets, through a range of water assets, including storm water drainage, hand pumps, and improved toilets;
- increased **resourcefulness** of the community to anticipate problems and respond accordingly; and
- a reflective community and government to cope with the aftermath of flooding, particularly with better sewer and drainage systems, and community-level monitoring of solid waste.

Almost 6000 people have benefited from new drains in Mehewa Ward. Following record rainfall in 2012, when 423mm fell in the month of September 2012 where Mehewa ward did not experience waterlogging.

Indore: Strengthening Vector-borne Disease Surveillance and Response Systems

Scale: City, Sector
Action Area: Health

Indore faces health risks from stagnating water in natural drainage channels. Stagnant water causes vector- and water-borne diseases and is worsened by more intense and frequent storms.

Coordination across sector-stakeholders builds city resilience to disease

In response to these health risks, a citywide disease surveillance and response system is being developed. The system collects data daily from city health departments, medical practitioners, and hospitals and labs across Indore. This builds the capacity of the city's health system to respond to or prevent the outbreak of diseases.

The information collected by the disease surveillance and response system enables a more timely preventative action. As a result, health risks will impact fewer people, reducing cost burden on the health system. The resilience qualities of **resourcefulness** and **integration** are demonstrated by this project in the following:

- Health facilities are more responsive in recognizing the threat of disease outbreaks.
- The capacity of health services is further built up to develop disease surveillance.
- Learning and education is improved in health departments and agencies.

It is estimated that nearly 800,000 people will benefit from this project, particularly those in poorer areas.

Surat: End-to-End Early Warning System for Local Floods[15]

Scale: City
Action Area: Drainage, Institutional Mechanisms, Emergency Management

Surat faces significant floods, with recent floods in 2006 inundating much of the city area. The city administration recognized the need for an early warning system to better prepare for flooding.

Flooding in Surat in 2006.

Source: TARU.

[15] Asian Cities Climate Change Resilience Network. 2011. *Surat City Resilience Strategy,* The Rockefeller Foundation, Surat Municipal Corporation, The Southern Gujarat Chamber of Commerce and Industry, TARU Leading Edge.

The project established the Surat Climate Change Trust to design this system, which includes:

- Climate change modeling, which simulates flooding and rainfall impacts induced by climate change.
- An early warning and disaster risk management system, based on near real-time modeling results. This provides at least four days of preparation before flooding occurs, to minimize damage and reduce the vulnerability of the poor.
- Feasibility studies to develop a database of vulnerable people and to create bylaws in favor of the poor during emergency situations.

A city-scale model which benefits the majority

The project strengthens the quality of **integration** by the coordination of 13 departments that cross state boundaries.[16] The advantages of the project are extensive, with 75% of the population benefitting from reduced risks of damage and increased response time.

The cost of setting up the Early Warning System in over two years was about $500,000. The benefits of better preparation and early response outweigh the costs of unmitigated impacts of flooding.

KEY QUESTIONS

- What actions are your city taking to build urban resilience?
- Do these actions improve the qualities of resilience?
- Are these actions integrated?
- How is the city building capacity and knowledge from the community to the government?
- Is this information being fed to the system?
- Are the city's intervention actions a combination of soft and hard (physical or nonphysical) actions?

Viet Nam

Building urban resilience to climate change requires support from a number of stakeholders. A city may invest in physical infrastructure that supports the wider community, while, at the same time, a household can take individual action to build resilience. On a wider scale, a city-to-city coordination supports overall resilience of a city.

Climate Change Risk in Urban Viet Nam

As Viet Nam continues to grow steadily, particularly in cities, the country expects to host an urban population of 45% by 2025. Vulnerability to climate risks, such as strong winds and storm surge (typhoon) or flooding (increased rainfall), faced by an increasingly urban population (delete 'and the poor') has shifted the focus of cities towards building resilience to climate change.

The ACCCRN approach has been adopted by the cities of Can Tho, Da Nang, and Quy Nhon. Each city has developed

Can Tho Climate Change Coordination Office.

Source: ISET Viet Nam.

[16] ACCCRN. 2013.

resilience strategies to help support and prioritize issues. The cities have identified:

- priority issues of public health, water resources, and food security;
- particular vulnerable sectors such as agricultural production, physical infrastructure, and health; and
- different intervention types, such as awareness enhancement, planning, infrastructure construction, and healthcare services.

These priority areas illustrate how Viet Nam is implementing actions to build city resilience to climate change. The identified interventions include actions at different scales (household, institutional, city) and various sectors (planning, emergency management).[17] Intervention actions also vary, from physical emergency shelters to soft actions including mechanisms to support government coordination.[18]

Can Tho, Da Nang, Quy Nhon: Climate Change Resilience Coordination Offices

Scale: City Institutional
Action Area: Planning, Coordination

All three ACCCRN cities in Viet Nam identified a lack of coordination across government departments, and the need for a focal point for climate change action, as a key element of building city resilience. As a result, this project established a Climate Change Coordination Office (CCCO) in each city. The CCCOs are now responsible for the climate change adaptation and mitigation projects. These responsibilities include:

- developing projects and climate change action plans for each city;
- coordinating climate change resilience analysis between city and provincial departments, ensuring access to the best data for planning and decision making; and
- building awareness and capacity of government staff to respond to climate change impacts.

Resilience being supported by city-to-city coordination

This project created an effective mechanism to plan, implement, and inform decision making for climate change resilience. The CCCO program provides a system-wide approach that crosses city boundaries. The resilience qualities demonstrated are:

- **resourcefulness** in increasing understanding of particular climate change impacts;
- a **reflective** resource to analyze and coordinate urban climate resilience interventions for a wider area and large population; and
- an **integrated** mechanism for city-level agents to learn and build capacity when planning for climate change, particularly by sharing experiences and ideas.

This **inclusive** and **integrated** approach further supports other actions to build city resilience.

Da Nang: Storm and Flood-Resistant Credit and Housing Scheme

Scale: Household
Action Area: Storm Resistance

The poor people in Da Nang live in often inadequately built houses, which are at high risk for damage from storms. As a result, many of the poor people face financial stress and struggle to recover. In response to this vulnerability, Da Nang implemented a project that provides loans and grants to poor households in disaster-prone areas.

Investing in physical infrastructure builds resilience for individuals and households

Loans provided by the project supply technical assistance in constructing houses for the city's extreme poor, and in constructing houses that will withstand disaster. Around 370 households in the next six years will have reinforced or reconstructed houses to withstand typhoons.

Flood Resistant Credit and Housing Scheme.

Source: ISET Viet Nam.

[17] ISET International, Thailand Environmental Institute, Mercy Corps Indonesia, Gorakhpur Environmental Action Group. 2013. *Actions on Urban Climate Resilience.* ISET.
[18] ACCCRN. 2013.

In 2013, after Typhoon Nari hit Da Nang, an assessment of resistance to storm-related damage showed that none of the 244 household beneficiaries of a storm resistance housing project were damaged.

The benefit of the program also extends beyond building resilient houses. The program created:

- a unique opportunity for organizations to use integrated resources to identify opportunities and to educate partner organizations such as the Women's Union; and
- a network of vulnerable communities that increased its capacity and is better equipped to deal with or recover from disaster.

This case-study shows how a project focused on the household, had far-reaching benefits by building capacity of partner organizations and establishing a community network to prepare for disaster.

Quy Nhon: Developing Real-Time Flood Monitoring and Community Flood Communications and Response System

Scale: Household, Community, City
Action Area: Flooding, Sea Level

The Ha Thanh and Kon rivers are prone to flash flooding and this is exacerbated by further urbanization in the city of Quy Nhon. The poor are particularly vulnerable to flooding and climate change will lead to more frequent and intense storms. In response, the city developed a warning system, and at the same time, built community level preparedness against flooding.

The project sought to build the capacity of people in the city to respond to and recover from severe floods. A system was developed to automatically collect real-time flood-evel data and transmit this to a central facility through the internet or SMS messaging.

A project that builds the resilience capacity of an individual, household, and community

The action is supported by building the knowledge of the community in developing their own flood preparedness plans and in interpreting and responding to flood warnings. Community members are trained to be aware of evacuation routes, and of water, sanitation, and health care.

Furthermore, physical infrastructure has been provided in the form of community flood shelters and improved access to clean water for households using water filters, aluminium water tanks, or communal water reservoirs.

Around 40,000 people will benefit from the improved flood warning system. The cost of this system was $718,000 and took three years to implement.

KEY QUESTIONS

- What actions your city is taking to build urban resilience?
- Do these actions improve the qualities of resilience?
- Are these actions integrated?
- How is the city building capacity and knowledge from the community to the government?
- Is this information being fed to the system?
- Are the city's intervention actions a combination of soft and hard (physical or nonphysical) actions?

Indonesia

Building resilience to climate change for urban populations requires different types of actions and initiatives. For example, cities may invest in physical infrastructure (like drainage system) and also in community education and knowledge of effective emergency response to flooding.

Climate Change Risk in Urban Indonesia

Indonesia's urban growth is one of the fastest in the world, with already 114 million in urban areas (50% of the total population). This rapid urbanization places further stress on servicing the existing urban population, particularly for resilience to climate change.

The ACCCRN approach has been adopted by the cities of Bandar Lampung and Semarang, with each city developing resilience strategies to help support and prioritize issues. Bandar Lampung has identified:

- particular climate hazards in flooding, sea level rise, drought, landslides, and windstorms;
- particular risk groups such as the poor, the people in coastal areas, and the fishing industries;
- particular sectors affected, such as the drainage systems, public health, and emergency services; and
- different priority action types, such as community empowerment, forest rehabilitation, and building of resilient infrastructure.

The following projects demonstrate how Indonesia is implementing actions to build city resilience to climate change.[19] The projects describe actions of different scales (household, community, institutional) and of various sectors.

Community rainwater harvesting system in Semarang.

Source: Arup.

Semarang: Prefeasibility Study for Expanding Rainwater Harvesting Systems

Scale: **Community**
Action Area: **Water Supply**

Given the population growth and the current water supply, there will be insufficient potable water in Semarang by 2025. Climate change will exacerbate water shortages. In response to this, the project seeks to understand the feasibility of local rainwater harvesting systems.

The project undertook the following:

- Data collection and analysis of rainwater harvesting that is hydraulically and geographically specific to Semarang. (Other data such as supply and demand, socio-economic profile, and technology costs were also collected.)
- Feasibility studies and mapping of rainwater harvesting.

The project recommends communal rainwater harvesting system rather than the individual system, as installing the latter is a financial burden for the poor.

[19] ACCCRN. 2013.

Any rainwater harvesting infrastructure must be supported by the private sector and the community. Community participation promotes a sense of ownership and accountability.

Pre-planning to maximize the benefit to the city, community, and households

The project showed how careful planning prior to investment can maximize the benefit to the city, community, and ultimately to the most vulnerable household. As a result, the physical infrastructure gives access to a more reliable source of water, building resilience for poor households during drought.

The study identified seven locations feasible for rainwater harvesting systems (on top of 10 installed in 2011), and all have been fully funded. The project will benefit those 44% of the population without access to water.

Semarang: Flood Forecasting and Warning System

Scale: Community, City
Action Area: Flood Resistance, Emergency Management

Semarang is faced with increased incidences of inundation, with the expected number of households in flood-prone areas to increase to 50% by 2050.

Semarang implemented a project to build the preparedness of the local government and the most vulnerable communities for flood disasters. The project developed an early warning system to equip communities and local authorities with tools and knowledge.

The project is coupled with a disaster risk management training which educates the communities in flood-prone areas to be more prepared. The project targets the following scales or groups:

- vulnerable community groups (such as the poor communities residing in coastal areas or riverbanks), by training and informing them of emergency responses to minimize risk, injury, and casualty; and
- local government agencies, by informing the authorities where infrastructure capacity should be strengthened to minimize the impact of flood on major water infrastructure

Bandar Lampung: Building Teachers' and Students' Climate Change Resilience Capacity

Scale: Community
Action Area: Emergency Management

This project aims to educate teachers and students on how to be more adaptive to climate change impacts.

It will integrate climate change adaptation into the national curriculum. The curriculum includes modules on climate-risk preparedness, disaster reduction techniques, and climate change impacts in Indonesia.

This will help build individual and community capacity to make appropriate decisions and mitigate the worst impacts.

Teachers and students of four pilot schools are direct beneficiaries. With the new curriculum, about 450 more schools will benefit.

Flood forecasting planning workshop in Semarang.

Source: Arup.

Bandar Lampung: Ground Water Conservation (Biopores)

Scale: Community, City
Action Area: Flood Resistance

The project aims to reduce flood risk by installing biopore infiltration holes. These holes will increase groundwater quantity and improve quality, and accelerate soil infiltration capacity. They will also alleviate solid waste, as biopore systems rely on organic waste to increase soil porosity.

The project aims to install 100,000 biopores. The pilot project will determine the most appropriate location and method to install biopores.

The project is an example of a physical action to build city and community resilience to flooding. Around 300,000 people are expected to benefit directly from the reduction of surface runoff.

KEY QUESTIONS

- What actions your city is taking to build urban resilience?
- Do these actions improve the qualities of resilience?
- Are these actions integrated?
- How is the city building capacity and knowledge from the community to the government?
- Is this information being fed to the system?
- Are the city's intervention actions a combination of soft and hard (physical or nonphysical) actions?

Pakistan and the Philippines

Building resilience to climate change can begin by undertaking climate change vulnerability assessments of cities. The two examples below demonstrate how two different cities have undertaken vulnerability assessments as part of a careful planning process to identify high-risk areas and prioritize actions and initiatives.

Islamabad, Pakistan: Vulnerability Assessment

Islamabad, the capital of Pakistan, currently has a population of 805,000, with 66% of the population living in urban areas. The government recognized the city's vulnerability to climate change, and as part of the UN-Habitat 'Planning for Climate Change' approach, undertook a vulnerability assessment for the city. The assessment determined that the city is particularly exposed to climate change impacts including increased temperatures in central Islamabad, increased rainfall in pre-monsoonal seasons, and increased flooding.

Migrant workers and those living in temporary accommodations are particularly affected by economic losses and health impacts from extreme weather events. Also affected are the young, sick, and elderly, being exposed to drier seasons and respiratory diseases.

The project identified 14 broad interventions that can be undertaken by the city to enhance its resilience to climate change. The next steps are to prioritize and implement achievable and affordable actions.

Figure 5: The UN Habitat Planning Cycle

Source: UN Habitat.

Davao City, Philippines: Vulnerability and Adaptation Assessment Process

UN-Habitat, through the Cities and Climate Change Initiative, is supporting Davao City in its efforts to build the capacities of local governments to address climate change impacts. The city has a population of 1.45 million, and is the largest of the participating cities in the Philippines.

As part of the program, Davao City developed its vulnerability and adaptation assessment. It utilized socio-economic and ecological baseline data, as well as local information on historical trends and records of all climate change hazards. According to the assessment, the city will be affected by six major hazards: flooding, drought, rain-induced landslides, strong winds, sea level rise, and monsoon waves.

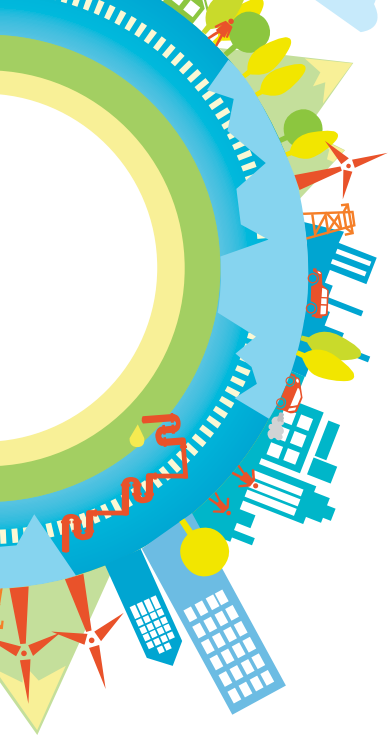
After identifying these impacts, the city then analyzed the vulnerability of the city in relation to wealth, technology, governance, and social and physical capital. The assessment determined that the city infrastructure has to improve to mitigate the impacts of multiple climate change hazards.

Davao City Vulnerability and Adaptation Assessment Process.

Source: UN Habitat.

It also identified infrastructure investment and economic development policies to support the project.

The Assessment process generated 109 options (programs, projects, and legislative changes) that will be prioritized to focus efforts in building resilience to climate change.



6. Further Reading

The following are references of journal articles and research tools and resources used to compile this Synopsis on Urban Climate Change Resilience in Asian cities.

References

Asian Cities Climate Change Resilience Network. 2011. Surat City Resilience Strategy, The Rockefeller Foundation, Surat Municipal Corporation, The Southern Gujarat Chamber of Commerce and Industry, TARU Leading Edge.

Asian Cities Climate Change Resilience Network. 2013. ACCCRN City Projects, The Rockefeller Foundation Asia Office.

Arup. 2013. Nurturing Knowledge Creating Community. Arup.

Arup. 2014. City Resilience Framework. The Rockefeller Foundation, City Resilience Index.

G. Bhat, U. Raghupathi, and U. Rajasekar. 2013. Urbanisation – Poverty – Climate Change: A Synthesis Report. India. Volume I and II.

A. Brown, A. Dayal, and C. Rumbaitis Del Rio. 2012. From practice to theory: emerging lessons from Asia for building urban climate change resilience. Environment and Urbanization. pp. 24–531.

A. Brown and S. Kernaghan. 2011. Beyond Climate-Proofing: Taking an Integrated Approach to Building Climate Resilience in Asian Cities. UGEC Viewpoints, No. 6.

Challenge to Change and Hue University. 2009. Hazard, Capacity & Vulnerability Assessment in Da Nang. ACCCRN, The Rockefeller Foundation.

J. da Silva, S. Kernaghan, and A. Luque. 2012. A systems approach to meeting the challenges of urban climate change, International Journal of Urban Sustainable Development. pp.1-21.

J. da Silva, Moench. M. 2010. The Urban Resilience Framework (URF), ISET. Arup.

ISET International, Thailand Environmental Institute, Mercy Corps Indonesia, Gorakhpur Environmental Action Group. 2013. Actions on Urban Climate Resilience. ISET.

ISET. 2013. Climate Resilience Framework: Training Materials. ISET International.

S. Kernaghan and J. da Silva. 2014. Initiating and sustaining action: Experiences building resilience to climate change in Asian cities. Urban Climate 7. pp. 47-63.

D. Sharma and R. Singh. 2013. Urban Climate Resilience: A review of the methodologies adopted under the ACCCRN initiative in Indian cities. ACCCRN Working Paper Series 5.The Rockefeller Foundation.

J. Taylor. 2010. Community Based Vulnerability Assessment: Semarang and Bandar Lampung, Indonesia. ACCCRN. Mercy Corps

T. Tuan and B. Tinh. 2013. Cost-benefit analysis of mangrove restoration in Thi Nai Lagoon, Quyn Nhon City, Viet Nam. Working Paper Series 4. Asian Cities Climate. Resilience

Further Reading: Tools and Resources

Arup. 2014. Understanding networks for cities and climate change. The Rockefeller Foundation, ACCCRN Network.

Asian Development Bank. 2013. Investing in Resilience: Ensuring a Disaster-Resistant Future. Manila.

A. Bahadur and T. Tanner. 2014. Transformational resilience thinking: putting people, power and politics at the heart of urban climate resilience. Environment and Urbanization. vol. 26 no. 1. pp. 200-214.

W. McBain, D. Wilkes, and M. Retter. 2010. Flood Resilience and Resistance for Critical Infrastructure. CIRIA C688. London.

New York State Governor's Office. 2013. NYS 2100 Commission Report: Building Resilience in New York.

H. Reid, J. Phillips, and M. Heath. 2009. Natural resilience: healthy ecosystems as climate shock insurance. The International Institute for Environment and Development (IIED). IIED Briefing.

Siemens, Arup, RPA. 2013. Toolkit for Resilient Cities: Infrastructure, Technology and Urban Planning. Siemens, Arup, RPA.

UN Habitat. 2013. Planning for Climate Change – Toolkit. A strategic, values-based approach for urban planners Cities and Climate Change Initiative. UN Habitat.

The World Bank. 2012. Building Urban Resilience: Principles, Tools and Practice. The World Bank, Australian AID.

The World Bank. 2013. Building Resilience: Integrating Climate and Disaster Risk into Development. The World Bank, The Global Facility for Disaster Risk Reduction and Recovery (GFDRR).

Urban Climate Change Resilience

A Synopsis

There is no single action that will make a city resilient to the shocks and stresses brought on by climate change. *Urban Climate Change Resilience: A Synopsis* provides a concise introduction to the core principles and qualities of urban climate change resilience (UCCR), including lessons from applying this approach across South and Southeast Asian cities. This Synopsis is intended for Asian Development Bank (ADB) project officers, consultants, and partner cities who are interested in building UCCR, and for those working with ADB's Urban Climate Change Resilience Trust Fund.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to approximately two-thirds of the world's poor: 1.6 billion people who live on less than $2 a day, with 733 million struggling on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

ADB

ASIAN DEVELOPMENT BANK
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org