CATALYZING URBAN CLIMATE RESILIENCE

Applying Resilience Concepts to Planning Practice
in the ACCCRN Program (2009–2011)

Edited by: Marcus Moench, Stephen Tyler, and Jessica Lage

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LIST OF ACRONYMS

ACCC	Adapting to Climate Change in China
ACCCRN	Asian Cities Climate Change Resilience Network
BAPPEDA	Regional Body for Planning and Development, Indonesia
BAPPENAS	National Development Planning Agency, Indonesia
BMKG	The Indonesian Meteorological, Climatology, and Geophysical Agency
C4	Center of Cities and Climate Change, Semarang, Indonesia
CAC	City Advisory Committee
CAS	Complex Adaptive Systems
CBA	Cost-Benefit Analysis
CCCMA	Canadian Centre for Climate Modeling and Analysis
CCE	Climate Change Explorer Tool
CCROM	Centre for Climate Risk and Opportunity Management, Indonesia
COP	Conference of Parties
CORDEX	Co-ordinated Regional Climate Downscaling Experiment
CRED	Center for Research on Environmental Decisions at Columbia University of New York City
CRS	City Resilience Strategy
CRU	Climatic Research Unit of the University of East Anglia
CSAG	Climate Systems Analysis Group at the University of Cape Town
CSC	City Steering Committee
CtC	Challenge to Change
CTU	Can Tho University
CWC	Central Water Commission, India
CWM	Urban User Groups for Conjunctive Water Management, Indore, India
DARD	Department of Agriculture and Rural Development, Vietnam
DEMs	Digital Elevation Models
DfID	Department for International Development, U.K.
DoC	Department of Construction, Vietnam, provinces
DoFA	Department of Foreign Affairs, Vietnam, provinces
DONRE	Department of Natural Resources and Environment Development, Vietnam, provinces
DPI	Department of Planning and Investment, Vietnam, provinces
DRR	Disaster Risk Reduction
EPA	Environmental Protection Agency, United States
GCMs	General Circulation Models
GDA	Gorakhpur Development Authority
GDP	Gross Domestic Product
GEAG	Gorakhpur Environmental Action Group, India
GHCN	Global Historical Climatology Network
GHG	Greenhouse Gas
GIS	Geographic Information System
GMC	Gorakhpur Municipal Corporation, India
HCVA	Hazard, Capacity, and Vulnerability Assessment
ICCSR	Indonesian Climate Change Sectoral Roadmap
ICLEI	International Council for Local Environmental Initiatives
IDA	Indore Development Authority, India
IDRC	International Development Research Centre, Canada
IITM-Pune	Indian Institute of Tropical Meteorology at Pune
IMD	Indian Meteorological Department
IMHEN	Institute of Meteorology, Hydrology, Environment, Vietnam
IPCC	Intergovernmental Panel on Climate Change
IPCC AR5	IPCC Fifth Assessment Report

ISET	Institute for Social and Environmental Transition
IWE	Institute for Water Resources and Environment, Vietnam
MONRE	Ministry of Natural Resources and Environment, Vietnam
NCMRWF	National Centre for Medium Range Weather Forecast
NGO	Non-Governmental Organization
NIES	National Institute for Environmental Studies, Japan
NISTPASS	National Institute for Science and Technology Policy and Strategy Studies, Ministry of Science and Technology, Vietnam
NOAA	National Oceanic and Atmospheric Administration
NPCC	New York City Panel on Climate Change
NTP	National Target Program to Respond to Climate Change, Vietnam
PPC	Provincial People's Committee, Vietnam
RCMs	Regional Climate Models
RCPs	Representative Concentration Pathways
RF	Rockefeller Foundation
RPJMD	Indonesian regional mid-term development plan
RPJP	Indonesian regional long-term development plan
RtR	Risk to Resilience
RTRW	Indonesian regional spatial plan
SEA START	South East Asia START Regional Center
SEI	Stockholm Environment Institute
SEDPs	Socioeconomic Development Plans, Vietnam
SGCCI	Southern Gujarat Chamber of Commerce and Industry, India
SIWRR	Southern Institute of Water Resources Research, Vietnam
SLD	Shared Learning Dialogue
SLR	Sea Level Rise
SMC	Surat Municipal Corporation, India
SRES	Special Report on Emissions Scenarios
START	Global Change System for Analysis Research and Training
SWM	Solid Waste Management
TCPO	Town and Country Planning Office, India
TEPCO	Tokyo Electric Power Company, Japan
TEI	Thailand Environment Institute
TMD	Thai Meteorological Department, under the Ministry of Information and Communication Technology
UCAR	University Corporation for Atmospheric Research
UCRPF	Urban Climate Resilience Planning Framework
UKCIP	United Kingdom Climate Impacts Program
ULBs	Urban Local Bodies, India
UPT	Technical Implementation Unit, India
URDI	Urban and Regional Development Institute, Indonesia
UrSMS	Urban Service Monitoring System, Surat, India
USAID	United States Agency for International Development
WAS*IS	Weather and Society* Integrated Studies

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At the national level, the work was coordinated and led by TARU Leading Edge in Indore and Surat, by the Gorakhpur Environmental Action Group in Gorakhpur, by Mercy Corps in Indonesia, by the Thailand Environment Institute in Thailand, and by the National Institute for Science and Technology Policy and Strategy Studies together with Challenge to Change in Vietnam. These partners and their roles are introduced in more detail on page 18 of this report. In each case, several different individuals contributed to the fieldwork, analysis, and report writing for the key documents that were used as sources for this summary. The contributions of these organizations and individuals are gratefully acknowledged.

The Urban Climate Resilience Planning Framework presented in Chapter 2 is based in part on contributions by the International Development team at Arup, who are advisors to the ACCCRN program. Their collaboration is acknowledged more specifically in that chapter.

The authors and editors would also like to acknowledge the editorial support provided by Dana Cappelloni and Lea Sabbag at ISET, who worked closely with editor Jessica Lage and designer Michelle Fox, providing valuable last-minute research and helping assemble and review components of the draft.

Finally, while acknowledging these vital contributions to the publication, the authors take responsibility for its contents and conclusions, including any errors or omissions therein.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This publication discusses the activities and findings from the second phase of the Asian Cities Climate Change Resilience Network (ACCCRN), a program supported by the Rockefeller Foundation. Changes in climatic conditions represent one of the greatest challenges facing humanity over coming decades. Climate change poses special concerns for the rapidly growing cities of Asia, where large populations, rapid urbanization, extensive poverty and social marginalization, and an already high level of exposure to climatic extremes create risks for large numbers of people. The impacts of climate change are likely to be particularly severe for poor and marginalized populations.

The ACCCRN program represents a unique initiative to understand and support urban areas in building climate resilience. The program's work in cities in India (Surat, Indore, and Gorakhpur), Indonesia (Bandar Lampung and Semarang), Vietnam (Da Nang, Can Tho, and Quy Nhon), and Thailand (Hat Yai and Chiang Rai) provides practical insights into the processes and outcomes that contribute to urban climate resilience. The ACCCRN program was a new and innovative approach for program partners. City representatives worked with diverse local stakeholders in novel ways to ensure that outcomes were directly relevant.

This report begins by presenting the overall conceptual framework that ISET and partners have developed through the program. It then describes the communication of climate information; the applied approaches to shared learning; the implementation of supporting vulnerability analyses, sector studies, and pilot projects; and the resilience planning processes and outcomes that were the key activities of the second phase.

The key insights generated by the program are briefly highlighted below and then discussed in detail in the subsequent chapters.

LINKING CONCEPTS AND PRACTICE

The Urban Climate Resilience Planning Framework (UCRPF), developed as part of the ACCCRN program, represents a practical way of systematically translating the growing body of natural and social scientific knowledge regarding resilience into applied planning practice. By focusing on urban systems (the foundations on which urban areas survive), urban agents (the diverse organizations that make up the urban social environment), urban institutions (the rights, laws, regulations, and other social structures that mediate relationships among agents and between agents and systems), and exposure to climate change, the UCRPF helps to identify specifically who might do what to build climate resilience. It also helps to identify specific points of entry for addressing the differential impact of climate change on the urban poor and other socially marginalized communities. As a result, while the framework is firmly grounded in emerging scientific knowledge, it is also a practical base for planning and action, and for building the knowledge and capacity necessary to respond effectively as climatic conditions evolve.

The UCRPF has three broad components. First, it is founded on recognition that building resilience requires shared learning. Climate change is a global process, but local conditions strongly shape its impacts, so practitioners must integrate local and global knowledge in order to identify effective responses. Furthermore, because many of the impacts depend on interactions between sectors, across scales, and among communities of actors, communication and the development of common understanding among diverse groups is essential. As a result, shared learning is a fundamental part of the resilience planning process: shared learning dialogues help cross barriers and initiate collaboration across sectors and scales, introduce scientific knowledge into local contexts, and drive action over an extended period of time — all critical aspects of resilience planning.

Second, understanding resilience requires analytical approaches that are capable of addressing the diverse components that make up urban areas. The UCRPF distinguishes between urban systems, urban agents, institutions, and climate change and identifies analytical approaches for understanding the interactions among these fundamental components of urban areas. The analysis then integrates these factors in order to understand vulnerability and identify potential points of entry for building resilience.

Third, the UCRPF focuses on process. It incorporates a specific yet flexible set of process considerations and supporting activities that can assist urban areas in planning, capacity building, implementing, and supporting the continuous process of learning that is central to the growth and maintenance of urban resilience.

LESSONS FROM ACCCRN PHASE 2

The activities in Phase 2 of the ACCCRN program focused on engagement with local partners to introduce climate change issues and to develop locally specific climate resilience strategies in the ten partner cities. Lessons from these activities include:

Linking concepts with practice

Unless there is a solid conceptually grounded analytical foundation, practice cannot move forward except on an ad hoc basis. One of the greatest challenges for organizations working on urban resilience is that individual interventions often appear exactly this way — ad hoc. In order to contribute in a significant way, local actions must be linked together as part of a conceptually well-founded strategy.

Balanced approaches

Responding to climate change requires strategies that address both the physical dynamics of systems and the social and institutional context of the city level. As a result, analytical and other strategies need to combine technical as well as social science-based approaches. Specialized technical studies as well as more "people-centered" forms of engagement are essential. Strategies that overemphasize one dimension to the exclusion of the other are likely to be ineffective.

Climate data

Quality climate information is difficult to access, particularly at a scale useful to adaptation planners. Local-scale historical climate information and future projections are not always easy to find and often do not exist at all for ACCCRN cities; even appropriate historical data can never tell us exactly what to expect in the future. Resilience planning, however, cannot wait for the ideal information.

Communicating climate information

High-quality translations of climate information — both of scientific terms and concepts into lay language and, subsequently, from English into local languages — are crucial. Sufficient time and resources must be allocated to allow for interacting and discussing the nuances of various specialized climate change and resilience building terms — many of which are still being clarified in English. In order to develop effective response strategies, local stakeholders must understand the uncertainties inherent in climate projections and what they might realistically indicate for the future, rather than interpreting them as fixed scenarios. Doing so requires skilled facilitators and translators who can bridge between the language of science and the local languages. It also requires the ability to work with diverse communities, from scientists to women living in vulnerable floodplains.

Responsiveness

While climate change is likely to affect many of the systems on which urban areas depend, few people are aware of climate change issues where they live. Engaging policymakers and local populations requires finding the issues that they view as tangible and immediate. Practical responses — such as sector studies, pilot projects and other ACCCRN planning responses — to immediate concerns such as storm risks, flooding, water supply, and disease are important entry points that respond to immediate needs and lay the foundation for understanding wider sources of risk.

Action

People will not be able to build understanding, ownership, and engagement unless they take tangible steps to respond to the problems urban areas face. As a result, while the development of overall understanding and proper planning will require a sustained effort, initial activities — whether at a pilot scale or larger — that address immediate problems as well as larger climate concerns are essential. In addition to building ownership and engagement, such activities provide the practical experience necessary to inform strategies. Furthermore, pilot projects lend credibility to climate resilience programs and instill faith in stakeholders that the programs will produce tangible outcomes.

Champions

Effective engagement within cities depends on active commitment to resilience planning on the part of a small number of individuals who are well connected with diverse local groups. Because for many urban areas, climate change is a "new" and poorly understood issue, and because effective responses must involve interaction among diverse groups of actors, identifying a few charismatic and articulate individuals who can serve as champions can greatly facilitate the growth of awareness and action.

Tailoring strategies to local contexts

While basic principles and broad process elements do apply across regions, results from ACCCRN demonstrate that variations in local contexts can be a significant challenge for resilience planning, so strategies must be tailored to localities. Because cultures, bureaucratic structures, physical characteristics of regions and urban areas, and a myriad of other factors affect how climate change impacts urban areas and what practically can be done, strategies must be locally grounded. "Cut-and- paste" solutions are inappropriate, and actors must have an open mind and be willing to consider diverse approaches.

Novel planning processes

Planning for urban climate resilience involves integrating many new concepts and tools into already complex local planning processes, and under conditions in which local government resources are already strained. Time constraints are a fact of life, but short time horizons are the enemy of quality engagement and learning. Even using iterative processes, it may be difficult to anticipate how much time is needed for introduction of basic concepts, collection of relevant climate and planning information, sharing and digestion of new information, and building consensus on action. Resilience is unlikely to be achieved without carefully acquired, shared understanding about the interdependencies of systems and people. Attempts to shortcut this process even with skilled external support run the risk of yielding ineffective or even maladaptive results. Working with local partners also involves being flexible: scheduling conflicts, shifting priorities, staff changes, political and bureaucratic procedures are inherent to this work.

Partnership

Building resilience at the urban scale requires recognizing the importance of partnership. No single organization alone will create resilience; it requires a small, core team of local stakeholders from diverse organizations who are able to coordinate the work, act as the repository of new knowledge, and promote climate issues within their own organizations. Furthermore, since implementing effective activities will require the ownership and direct engagement of a diverse array of stakeholders, the most important personal and professional characteristic in this work is not technical expertise, but rather the ability to coordinate across organizations in an open manner and work with diverse groups of people, recognizing the validity of their insights, their knowledge, and their perspectives on effective strategies.

Process

Just as the climate and our projections about it are changing, adaptation and resilience building must be understood as a continually evolving process. The process will be most successful if the strategy is continually revised, such that planners continue to gain new knowledge about city vulnerabilities and potential interventions from both local and global sources; engage and build awareness among the public, sector leaders, and decision makers; and evaluate and reevaluate priority areas for action. The resilience strategy is a useful tool only to the extent that it is revisited over time and generates further action. It is the process of developing the resilience strategy — bridging sectoral gaps, raising awareness, creating new knowledge, introducing coordination mechanisms, and especially building the capacity of key stakeholders — that is far more important than the document itself.

Much of ACCCRN's importance lies in its contribution to an emerging body of practice. While there is increasing interest in urban climate resilience globally, very little has actually been done. Because ACCCRN actively engages diverse groups of urban stakeholders in planning processes and implementation activities across a diverse array of contexts, it represents a unique initial contribution to practice. The analysis presented by ISET in this report represents only one facet of that experience. More can be gained from the reports and other materials produced by partners or through direct contact with these partners to understand their perspectives and the knowledge they have developed.

CHAPTER 1

INTRODUCTION

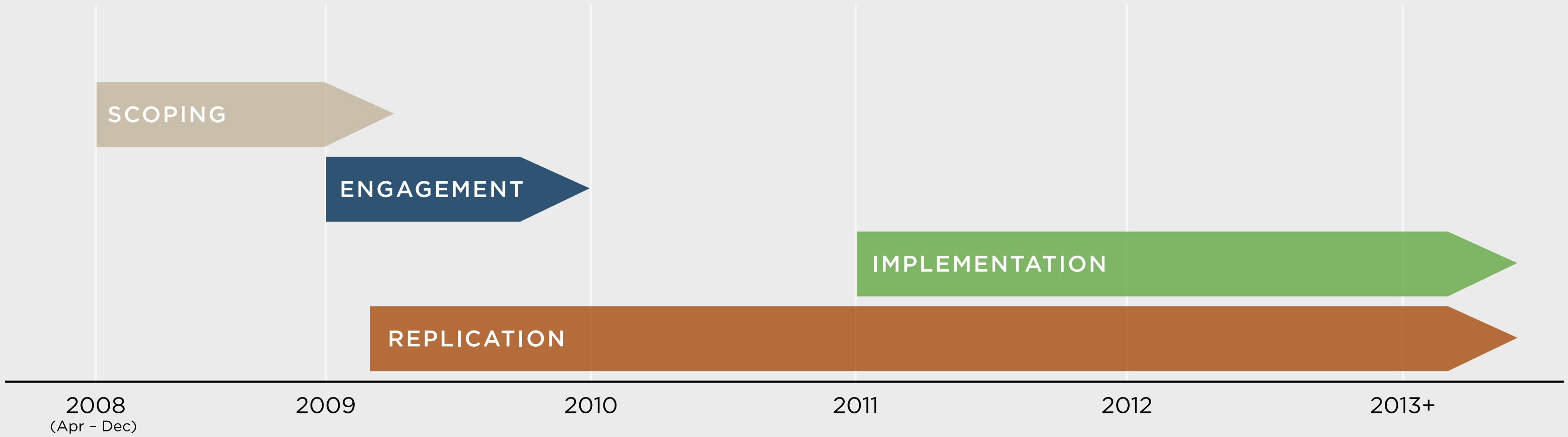
Marcus Moench and Stephen Tyler

In a dynamic and rapidly changing world, we can be so preoccupied with immediate problems that we lose sight of the long-term trends. This publication introduces new concepts and practices to address the intersection of two critical and widely recognized trends that will have a major influence on the daily lives of most of the planet's population in this century: climate change and urbanization. The evolution of human societies in the remainder of this century is fraught with uncertainty — technology changes, economic transformations, political shifts, civil insurrection, or military interventions may dramatically affect the course of events in any given location. But at a global level, there are few trends in which we have as much confidence as climate change and urbanization. It is somewhat surprising then that practitioners have devoted so little effort to understanding the interaction of these two issues. This publication reports results from the second phase of the Asian Cities Climate Change Resilience Network (ACCCRN), an innovative initiative supported by the Rockefeller Foundation to assess and respond to the interaction between urbanization and climate change in a selection of medium-sized cities in India, Indonesia, Thailand, and Vietnam.

The evidence for climate change is now overwhelming. Repeated international scientific assessments have demonstrated that human activities at a global scale, including fossil fuel use, deforestation, and agricultural practices, are changing the composition of the planet's atmosphere and modifying climate on an unprecedented scale (IPCC 2007b). Despite acknowledgement of the situation, there has been only very limited response by national governments under the rubric of the United Nations Framework Convention on Climate Change (UNFCC). Meaningful action on emissions reduction has generally eluded international agreement, and global emissions continue to rise rapidly (International Energy Agency 2011). This means that we can expect unavoidable changes in climate through the remainder of this century. It also points to the need for strategic plans and long-lived infrastructure investments in order to reduce anticipated impacts and take advantage of emerging opportunities.

Half of the world's total urban population is now in Asia, 75% of urban residents live in developing countries, and the most rapidly urbanizing countries in the world are also its poorest.

FIGURE 1.1 | Program Timing



Meanwhile, for the first time in human history, most of us live in cities. Slightly over half of the world's population is now urban, and that proportion is expected to steadily grow, reaching 60 percent in less than 20 years. Half of the world's total urban population is now in Asia, 75 percent of urban residents live in developing countries, and the most rapidly urbanizing countries in the world are also its poorest (UN-HABITAT 2011). While urban life may offer city residents employment, education, and services, many urban residents in developing countries still live in poverty. Many rapidly growing cities cannot meet existing demands for basic urban services and infrastructure. For example, across all cities in Indonesia, only 37 percent of households have connections to treated water supply, and in India, only 54 percent of urban households have access to sanitation infrastructure. The proportions are much lower in Africa (2008 data: UN-HABITAT 2011). In the coming decades, climate change may further strain the lives of poor urban residents and the already frayed infrastructure and administrative systems of these cities (Satterthwaite, Huq et al. 2007; Wilbanks, Lankao et al. 2007; Balk, Montgomery et al. 2009; UN-HABITAT 2011).

But urbanization also offers opportunity. Rural-urban migration, whether seasonal, temporary, or permanent, reflects the perception of greater opportunity and choice in the more productive and diverse environment of a city. For poor rural residents, especially those in vulnerable coastal areas or in marginally productive rain-fed agricultural zones, climate change will pose a challenge to their survival. Higher variability in rainfall, longer droughts, more severe floods, more intense storms and high tidal surges will all make rural livelihoods even riskier. Rather than face impoverishment in the countryside, many are likely to respond to greater climate risks by moving to the city.

In the face of climate change then, are cities in the developing world likely to become refuges of opportunity, security, and productivity, where migrants can avoid the worst impacts of climate change and seek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diverse alternative livelihoods with access to improved infrastructure and services? Or are cities likely to become centers of concentrated vulnerability to increasingly unpredictable climate hazards, with densely populated slums exposing tens of thousands of poor people to storms, flooding, sea level rise, or loss of basic services due to climate impacts? The outcome depends largely on whether local organizations at the city level can anticipate the risks and act accordingly to reduce them. This publication is an initial attempt to explore what is needed — in concept and practice — to ensure that climate resilience grows along with medium-sized cities in Asia.

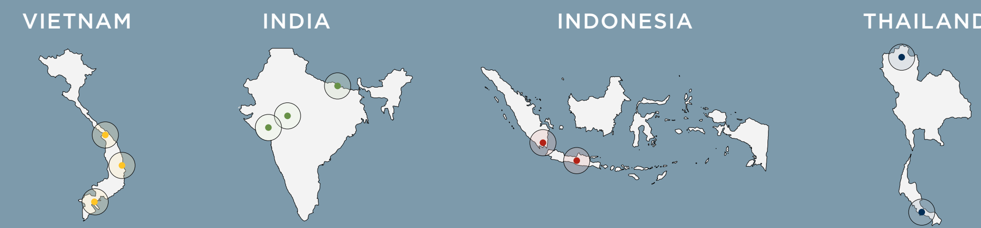
Recognizing this challenge, the Rockefeller Foundation committed in 2008 to supporting a group of medium-sized Asian cities in building their capacity to plan and implement adaptation measures for climate change. In its first phase, the ACCCRN initiative reviewed potential candidate cities, selecting four countries and ten cities to include in the program. This publication reports on the results of Phase 2 of ACCCRN, the engagement and planning phase, which ISET coordinated. Phase 2 lasted from early 2009 to early 2011, although different cities moved through the phase at different rates and over different time periods. ACCCRN is unusual because it focuses on *practice* rather than primarily on concepts. With ISET's coordination, Phase 2 utilized shared learning approaches to bring together emerging global knowledge on climate change with local knowledge and local groups of stakeholders, with the goal of producing city level resilience strategies.

ACCCRN is now in its third phase, in which local governments, non-government actors, or other local level partners identify and

ACCCRN Conception

The ACCCRN initiative was conceived by the Rockefeller Foundation with the intention of generating replicable models and interventions for climate adaptation in medium-sized Asian cities. The initiative takes an action research approach that has catalyzed city level actors to assess key climate stresses and potential vulnerabilities and to propose measures to respond to them, rather than commissioning external experts or national agencies to prepare such plans independently. More information on ACCCRN can be found at: **www.acccrn.org.**

implement activities for building resilience based on the results of the strategic planning conducted during the second phase. The cities participating in the second and third phases of ACCCRN are Gorakhpur, Surat, and Indore (India), Da Nang, Can Tho, and Quy Nhon (Vietnam), Bandar Lampung and Semarang (Indonesia), and Chiang Rai and Hat Yai (Thailand). These cities are described in the table below and their locations indicated on the accompanying map. They represent the large number of mid-sized cities across Asia that are growing rapidly, for which government planning capabilities are often strained, and in which large portions of the population are poor or socially marginalized. While the largest cities have greater prominence on national and international investment agendas, most of the urban population in Asia actually resides in these mid-size cities, and it is they that will face some of the most severe challenges in planning and responding to climate change.



COUNTRY BY COUNTRY

The following pages introduce the “Country by Country” sections, which appear in chapters 3 through 7. The sections describe each country’s on-the-ground experiences with the concepts and background that the chapters present.

Here, the Country by Country section provides background information about the ten ACCCRN cities.

FIGURE 1.2 | Country by Country: ACCCRN Ten Cities Map

TABLE 1.1 | Country by Country: ACCCRN Ten Cities Data

India City Data

CITY	POPULATION	DENSITY (people per km²)	GEOGRAPHY	TEMPERATURE RANGES	AVERAGE ANNUAL PRECIPITATION	MAIN ECONOMIC ACTIVITY
GORAKPHUR	622,701 (2001)	4559	136.85 km^2 On the river Rohin, eastern part of Middle-Ganga plain; 75–85m above sea level	**Average:** 25.68°C **Summer average:** 31.95°C	1,192 mm **Rainy season:** June–Sept	Largest commercial center of the Trans Suryu plain: tertiary and home based self-employment important, also government employment; agriculture
INDORE	1.52 million (2001)	12,598	134 km^2 Southern edge of the Malwa plateau; on Khan River; links Central India with the coast; 550 meters above sea level	**Summer average:** 42–44°C **Winter average:** 4-15°C	914 mm **Rainy season:** June–Sept	Commercial and industrial center
SURAT	2.81 million (2001)	8,812	326.515 km^2 Coastal city, on the Gulf of Cambay and the river Tapi	**Summer highs:** 37.8°C–44.4°C **Winter low:** 15.5°C	950-1,200 mm **Rainy season:** June-Sept 932 mm	Industry (diamond cutting, textiles)

Indonesia City Data

CITY	POPULATION	DENSITY (people per km²)	GEOGRAPHY	TEMPERATURE RANGES	AVERAGE ANNUAL PRECIPITATION	MAIN ECONOMIC ACTIVITY
BANDAR LAMPUNG	879,651 (2010)	4,460	197.22 km^2 (Southern end of Sumatra island)	**Annual average:** 30–32°C	2,000 mm Rainy year around **Primary rainy season:** Nov-May	Trade; important port city
SEMARANG	1.5 million	6,662	225.17 km^2 (Northern coast of Java)	**Average Max:** 31.1°C **Average Min:** 25°C	1,500mm **Rainy season:** Nov-May	Main shipping port for central Java, industry

Thailand City Data

CITY	POPULATION	DENSITY (people per km²)	GEOGRAPHY	TEMPERATURE RANGES	AVERAGE ANNUAL PRECIPITATION	MAIN ECONOMIC ACTIVITY
CHIANG RAI	226,555 (2009)	186	1,284.4 km^2 Kok river basin; 410–580 meters above sea level	**Summer Average:** 24.4°C **Winter Average:** 21.4°C	1,664 mm **Rainy season:** Jul-Sep	Agriculture, wholesale and retail trading, services, and real estate; in the "Golden Triangle" of Myanmar, Laos, China, and Thailand
HAT YAI	370,919 (2009)	435	852.796 km^2 Surrounded by mountain ranges; near Songkhla Lake	**Summer average:** 28.6°C **Average max:** 34.2°C **Rainy season average:** 27.5°C **Average min:** 23.0°C	1,916 mm **Rainy season:** Nov	Commercial and business center; education and tourism also important

Vietnam City Data

CITY	POPULATION	DENSITY (people per km²)	GEOGRAPHY	TEMPERATURE RANGES	AVERAGE ANNUAL PRECIPITATION	MAIN ECONOMIC ACTIVITY
CAN THO	1,200,200	857	1,400 km^2 On the Cuu Long Delta in the down-stream area of Mekong Delta Majority of city is 0.8–1 meters above sea level; higher elevations 1–1.5meters above sea level	**Annual average:** 27°C Highest daily max in April and lowest daily min in Jan	1,600–2,000 mm **Rainy season:** May–Nov	Services 44.9% Industry 38.4% Agriculture 16.7% (2008)
DA NANG	822,339 (2009)	599	1,256 km^2 92 km coastline; on two main river systems, the Cu De and the Han	**Average max:** 36°C (May–July) **Average min:** 23°C (Jan)	**2,044 mm (from World Meteorological Org)** **Rainy season:** Aug–Jan	Important port and industrial center; exporter of agricultural products; center of tourism
QUY NHON	280,300 (2009)	949	285.5 km^2 42 km coastline	**Average:** 27.1°C Little variation between rainy and dry seasons	1,950 mm **Rainy season:** Sept–Dec **Dry season:** Jan–Aug	Industry, trade, seaport services, aquaculture, and tourism (increasingly service-based)

FIGURE 1.3 | ACCCRN TIMELINE

	JAN '09	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN '10	FEB	MAR	APR
		SLD1		HCVA		VA		SS* SLD2								
	INDORE			SLDs				SLDs VAs	SS*						RtR	
	GORAK.			SLD VA		SLD									SLD	
	SURAT		CAC		SLDs			SS*	VA							RtR
						CNF		SLD1	VA		PP			SLD 2		SLD3
													CW	SLD 1		

VIETNAM

2009

02	SLD 1
04-07	HCVA
06-08	City-level VAs
08	SLD2
08	City working groups formed
08	Initial results of SS available
2010	
05	SLD 3
05	IC developed
06-10	Initial results of PP available
08	RS finalized
08	First full IPs developed

INDIA

2009 *INDORE*

04	SLDs and consultations, set 1; CAC formed
04-09	VA
08	SLD - CAC
09	SLD - VA with local officials
08-03/'10	Initial results of SS available
2010	
04-05	RtR workshops
05	IC developed
05-01/'11	Initial results of PP available
08	RS finalized and first full IPs developed

2009 *GORAKHPUR*

04-05	SLDs and consultations, set 1; CSC formed
04-09	VAs and community-level SLDs
07	CSC SLD
08-03/'10	Initial results of PP available
08-09/'10	Initial results of SS available
2010	
03-04	RP-SLD workshops
05	IC developed
08	First full IP proposals developed
10	RS finalized
2011	
01	RS published

2009 *SURAT*

03	CAC formed
06-07	SLDs with CAC
08-12	Initial results of SS available
09	VA
09-08/'10	Consultation with CAC
2010	
04-05	RtR workshop
05-01/'11	PP
05	First IC developed
08	RS finalized and first full IPs developed

MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN '11	FEB	MAR	APR	MAY	JUN	JUL	AUG
SLD3 IC	PP*		IP RSF												
IC PP*			RSF												
IC			RSF												
PP IC			RSF												
SLD 4			IP			SLD 5			RSF						
		VA SS	SLD 2	SLD 3					IP			RSF			PP*

THAILAND

2010

01	Climate workshop
02	SLD 1
07	VA completed
07	SS completed (Chiang Rai only)
08	SLD 2
9-10	SLD 3
12	City partner info for RS goes to TEI

2011

02	First IP developed
05	RS finalized
08	Initial results of PP available

INDONESIA

2009

06	City network formed
08	SLD 1
09-02/'11	VAs
11	PPs selected and launched

2010

02	SLD 2; CWG formed
04-05	SLD3
05-06	SLD 4
06	ICs developed
07	Initial results of PP available
08	Initial results of SS available
10-11	Meetings with LPA on midterm development plan
11-12	SLD 5

2011

02	RS finalized
08	First full IP developed

ACRONYMS

CNF Climate Network Formed
CW Climate Workshop
CWG City Working Group
HCVA Hazard, Capacity and Vulnerability Assessment
IC Intervention Concepts
IP Intervention Proposal
LPA Local Planning Authority
PP Pilot Project
PP* Pilot Project results available
RSF Resilience Strategy Finalized
RtR Risk to Resilience
RP Resilience Planning
SS Sector Studies
SS* Sector Study results available
VA Vulnerability Assessment
VC Vulnerable Community

THE PARTNERS

This publication draws on an enormous volume of work undertaken by organizations and individuals in all ten of the Asian Cities Climate Change Resilience Network (ACCCRN) over the period of February 2009 to February 2011. Although ISET has prepared this report and assumes responsibility for its content, we could not have done so without the efforts of skilled and enthusiastic partners: In India, TARU Leading Edge, a Dehli-based consulting firm with offices in Surat and Indore, and the NGO Gorakhpur Environmental Action Group (GEAG), based in and solely operating in Gorakhpur; Mercy Corps, Centre for Climate Risk and Opportunity Management (CCROM), and Urban and Regional Development Institute (URDI) in Indonesia; the Thailand Environment Institute; and in Vietnam, the National Institute of Science and Technology Policy and Strategy Studies (NISTPASS — an agency within the Ministry of Science and Technology) and Challenge to Change (CtC — an independent international NGO based in the UK). In addition, the active engagement of city level participants, from local government and other organizations, shaped key contributions and provided guidance for resilience planning. These local participants did the heavy lifting for this phase of the ACCCRN project: puzzling through new concepts, searching for data, interpreting and helping ISET to communicate new and often highly abstract concepts, and then applying new ideas and tools in their own work. This publication would have been impossible to produce without their diligent efforts, data contributions, explanation, review, and support.

Each of these partners have contributed to or produced detailed reports, resilience strategies, and other documents on their own. Where we have utilized material from these reports or from interviews with these partners their inputs are gratefully acknowledged. However, the opinions expressed and the conclusions drawn are the responsibility of ISET and of the chapter authors.

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Asian Cities Climate Change Resilience Network

ARUP

Challenge to Change

MercyCorps

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GORAKHPUR ENVIRONMENTAL ACTION GROUP
geag

สถาบันสิ่งแวดล้อมไทย
Thailand Environment Institute

NISTPASS

URDI

CCROM
Southeast Asia and Pacific

Climate change will impose a wide array of stresses on urban areas. Some of these are likely to involve the direct and easily understood impacts of storms, sea level rise, temperature change, and extreme climatic events, but others will involve indirect impacts that reverberate through the systems — energy, transport, communications, etc. — that urban areas depend on. The dynamics of climate change are complex and the specific changes that will occur at the local level are often highly uncertain. Furthermore, cities depend on a wide variety of tightly coupled complex systems that reach well beyond their boundaries. When such systems fail, they often fail in unpredictable ways (Little 2002). As a result, avenues for identifying vulnerabilities and building resilience to less easily projected changes or to the consequences of multiple stresses on different systems require approaches capable of dealing with uncertainty and complexity.

The example of Hurricane Katrina in New Orleans in August 2005 is instructive. Severe hurricanes happen with historic regularity in this region, yet the string of linked failures of dikes, power systems, hospitals, and emergency evacuation procedures were largely unexpected. If failures of this kind can happen in one of the wealthiest countries in the world, the challenges in developing countries are likely to be even greater.

Climatic uncertainties and dynamic urbanization trends present cities in the developing world with new and unfamiliar planning challenges. Developing countries need to invest in urban infrastructure at a more rapid pace to meet the needs of an exploding urban poor population so as to enable private investment that will create economic opportunities for an expanding national labor force. Investments in urban development and infrastructure are extremely costly and largely irreversible. With costs mounting and social, economic, and climate uncertainties, city decision makers face a dilemma: how to guide investment to meet the diverse needs of residents and the urban economy, even under unforeseen climate conditions and unexpected indirect impacts.

In facing these challenges of novelty, uncertainty, and complexity, ISET has followed two basic strategies. First, we have worked with Arup International Development, a key partner in the ACCCRN initiative, to develop a synthetic conceptual and planning framework for urban climate resilience. Second, we have utilized processes for shared learning to bring together the multiple sources of information, techniques, perspectives, and activities required to identify practical courses of action in response to climate change that are likely to be effective despite the uncertainties involved.

The Urban Climate Resilience Planning Framework (UCRPF), developed by ISET and Arup, focuses on resilience as a goal that is not merely responsive to predicted climate impacts, but that also fosters proactive and systemic approaches to preparing for unexpected and indirect effects of global change (see chapter 2). The understanding of urban climate resilience — what it means for an urban area to be "resilient" to climate change along with the more specific factors that contribute to such resilience — have been raised in various international discussions but remain in a formative stage. A recent review of multiple streams of resilience literature, for example, highlights common characteristics that are thought to contribute to resilience generally. These include "…diversity, flexibility, adaptive governance, and capacity for learning and innovation" (Leichenko 2011, p. 165).

Resilience, rather than adaptation, is the focus of the UCRPF in order to direct more explicit analytical attention to interacting urban systems, where direct climate impacts are linked through spatial, physical, and economic connections to effects on urban populations. The UCRPF also focuses on the differential impacts of climate change on marginalized populations (such as the poor, women, and cultural minorities) who often lack secure access to critical systems or depend on systems that are fragile and particularly susceptible to failure when exposed to climate related stress. Beyond impacts, the framework encourages attention to the autonomous actions of social agents, both individuals and organizations, who are able to prepare and respond to climate effects independently. Finally it emphasizes the role institutions play in mediating the relationships among different types of agents and between agents and systems. Within the framework, resilience is defined as high where system characteristics (diversification, flexibility, redundancy, modularity, and safe failure), agent capacities (ability to visualize, act, organize and reorganize, and learn), and enabling institutions combine in ways that enable all groups to access systems and ensure that those systems continue to function as climate conditions evolve. Taken together, the

The UCRPF focuses on the differential impacts of climate change on marginalized populations (such as the poor, women, and cultural minorities) who often lack secure access to critical systems or depend on systems that are fragile and particularly susceptible to failure when exposed to climate related stress.

UCRPF provides insights into *who* (which agent or set of agents), might draw on *what source of authority* (institution), to address *which climate impacts*, and on *what system* or *what group of people*. These factors are explored in more detail in chapter 2, and then find expression through the rest of this volume in the actual practices implemented through the ACCCRN initiative.

Beyond the UCRPF, addressing climate change requires communication, knowledge sharing, and open decision making among stakeholders at multiple scales. Rather than a standard set of actions or interventions, it requires a process of shared learning in which global knowledge and understanding can be brought together with local knowledge to identify courses of action that respond to local contexts. While the need for shared learning processes was intuitively self-evident at the start of the ACCCRN initiative, the components of such a process (the specific mechanisms for such exchange among city actors in relation to climate change) had never been piloted in urban contexts. Prior to ACCCRN, ISET had developed shared learning dialogue (SLD) processes in rural and a few urban settings in other research projects, to bridge the gap between local and global knowledge (Moench and Dixit 2007; Moench, Ahmed et al. 2008). ISET also used SLDs to understand complicated issues regarding natural resources such as water. It had not, however, attempted to apply SLD processes in wider urban contexts, with diverse actors, and at multiple levels of coordination, from local NGOs to national government counterparts. Nor had it attempted to transfer this approach to local partners to adapt and implement as an ongoing tool. As a result, ISET recognized from the beginning that the shared learning approach would need to evolve and be refined over the course of Phase 2 of the ACCCRN initiative.

The development of the UCRPF has paralleled, rather than preceded, the shared learning process and various implementation activities at the city level in ACCCRN. While early conceptualizations of the framework provided the groundwork for guiding local engagement and introduction to climate change and vulnerability assessment, and the shared learning dialogues (described in chapter 4) represent a consistent methodology transferred early on from prior ISET experience, details of the UCRPF were refined through its application in partnership with city and country level actors in ACCCRN. The order of presentation in this publication should be seen by readers, therefore, as logical rather than chronological, and we expect this foundational work to continue to evolve as it is informed by practice.

STRUCTURE OF THIS PUBLICATION

The Urban Climate Resilience Planning Framework presented in this report summarizes the results of work by ISET, Arup, and other partners during Phase 2 of the ACCCRN initiative to develop an integrated approach for understanding urban resilience that can be used to guide planning efforts at the local level. The framework brings together the characteristics of resilience that have emerged from our own and our partners' work and from extensive reviews of the literature. It focuses on the critical roles of *systems, agents,* and *institutions* and the manner in which they are directly or indirectly *exposed* to climate change. It also incorporates the concept of shared learning as part of an iterative process in which analysis feeds into planning, planning into action, action into learning, learning into further cycles of analysis, and so on. This iterative, shared action-learning cycle fosters building and maintaining resilience over time, in the face of rapidly evolving contexts and high levels of uncertainty.

Chapter 2, on the UCRPF, serves several purposes. It anchors in a diverse interdisciplinary literature what is otherwise mainly a report of actual practices in the field, thus providing a reference point for the origins of these practices. It summarizes a synthetic and integrated framework for urban climate resilience planning that is both novel and grounded in practice. It provides a rationale for the innovative methods and tools applied through this phase of engagement and strategic planning at the city level. The UCRPF also highlights the resilience factors that should form the basis of local monitoring in subsequent phases of ACCCRN. Finally, the framework serves as a sort of roadmap to the various subsequent chapters in this volume, which describe the experience of ACCCRN partners as they undertook the various component elements of the framework. In this way, readers can use the UCRPF as outlined in chapter 2 as a guide to the remainder of this volume. The following five chapters describe the experience of ACCCRN partners in putting key portions of the planning framework into practice. Each chapter discusses the participating actors and processes in each country and relates the practices and pitfalls of urban climate resilience planning from the perspective of the main participants.

The resilience planning process can have many entry points. But in order to engage with local ACCCRN partners around climate change issues, partners first needed a better understanding of what those issues might be. So, while the ACCCRN program focused on the intersection of urbanization, climate impacts, and local vulnerability, engagement in all ten cities began by exploring the local implications of emerging scientific evidence on climate change. Right away, the program bumped into some major challenges, as documented in chapter 3. Climate projections are

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The shared learning dialogue was the key tool for engaging local stakeholders in the resilience planning process and integrating knowledge of climate change from outside experts with local knowledge of development issues and planning priorities. The use of ongoing, iterative SLDs provided a backbone to support and guide the diagnosis and planning steps.

poorly understood by non-scientists and poorly represented by the climate science community, and the relevant data proved surprisingly difficult to retrieve in a format that was useful to local planners. Chapter 3 explains some of the implications for resilience planning and offer examples from ACCCRN practice.

The shared learning dialogue (SLD) was the key tool for engaging local stakeholders in the resilience planning process and integrating knowledge of climate change from outside experts with local knowledge of development issues and planning priorities. The use of ongoing, iterative SLDs provided a backbone to support and guide the diagnosis and planning steps. Chapter 4 describes the SLD tool and the process through which it was applied in different cities. In ACCCRN, shared learning dialogues engaged scientific experts, local government officials, civil society, private sector, and community representatives in deliberation on the available climate data and future scenarios, local implications, and potential responses. They provided a novel platform for building shared knowledge and commitment to action that met multiple interests. This platform also linked all the inputs to the resilience planning process: diagnostic studies, vulnerability assessments, local knowledge, community feedback, technical agency inputs, and development and prioritization of proposed actions.

The UCRPF describes the two key steps to building urban climate resilience as understanding vulnerability and building resilience. Iterative SLDs that engage multiple stakeholders at several scales drive both of these steps. The first of these processes may be conceived as the diagnostic phase, involving key agents in the assessment of vulnerability of urban systems and of agents to climate change. The diagnosis involves both an assessment of climate impacts, but also a matching assessment of the characteristics of system elements and linkages that might render them more or less vulnerable to direct and linked indirect impacts. In ACCCRN partner cities, this diagnostic phase took the form of vulnerability assessments, often complemented by more detailed sector studies that focused on specific vulnerability issues to provide more detailed analysis. Early pilot projects further engaged stakeholders and provided preliminary operational lessons; these projects offered small scale funding to experimental local actions addressing high-profile climate vulnerabilities that were identified early on in the diagnostic phase. Chapter 5 describes each city's experience with these elements.

The next step in the UCRPF is building resilience through the development of interventions that respond to the vulnerabilities identified in the diagnostic phase. Resilience building starts with the preparation of a strategy that includes prioritized interventions. In ACCCRN, each of the ten cities prepared a City Resilience Strategy. The inputs for these strategies included the discussions of the SLDs, the results of vulnerability assessments and sector studies, and other research and local plans that may already have existed. The resilience strategies were the main products of Phase 2, and included prioritized proposals for interventions to be funded and implemented in the next phase of the program. The process of developing these strategies, including the links to various inputs and the roles of key participants in their development, is described in detail in chapter 6. The chapter also outlines key lessons for replication of resilience planning in other contexts.

Chapter 7 describes the contents of the resilience strategy documents prepared by the cities and compares their key features. High priority interventions are listed with reference to the key elements of the UCRPF to show how cities' priority proposals compare to the categories of the conceptual framework. These preliminary resilience strategies will be used to guide initial implementation of those proposals selected for funding.

These resilience strategies represent the first efforts of most ACCCRN partners to develop formal responses to climate change. The UCRPF illustrates how these initial planning and intervention efforts should be monitored to form the basis for further learning, revised strategies, and new intervention proposals in the future. The concluding chapter summarizes the key lessons from this initial round of ACCCRN resilience planning so far and points to the next steps in applying the planning framework. This volume provides a record of the ACCCRN experience, a demonstration of the application of the UCRPF, and a set of lessons to help refine resilience planning and replicate it in other cities.

URBAN CLIMATE RESILIENCE PLANNING IN CONTEXT

The notion of urban climate resilience was an abstract one at the outset of Phase 2 of ACCCRN in 2009, and the tools needed to define and achieve it were in a nascent form. But the activities of the program have generated a broad range of experience with these emerging concepts and have helped to refine the tools through practice. Climate resilience strategies created by local partners over this short period are now being used in Phase 3 to select and guide a broad spectrum of actual implementation activities. In total, in all ten cities this work represents a significant and unique contribution — mostly achieved by the cities themselves and their supporting national partners — to the rapidly evolving body of practical experience in responding to climate change. Globally most attention to climate change has focused on mitigation — that is, the reduction of greenhouse gas emissions. Adaptation, though increasingly recognized as essential, has received far less attention. As a result, the body of analysis and of practice is quite limited. The second phase of the ACCCRN program can serve as one of the first examples of what can be achieved with relatively modest levels of investment across a diverse array of cities and governance contexts.

ACCCRN's urban focus also underlines the significance of the resilience planning experience reported in this volume. Work on climate vulnerability and adaptation has focused on rural areas because they are perceived to have lower adaptive capacity and because climate change is likely to have immediate impacts on ecosystems that directly affect agriculture and water resources. In an increasingly urban and interconnected world, however, vulnerability can be a function of a set of complex and geographically distributed systems that are not easily comprehended or managed. And even direct ecosystem-related impacts on rural areas are likely to increase urban vulnerabilities due to migration. While poverty and social marginalization are good indicators of vulnerability, they do not capture the wider sources of risk or the wider opportunities for response present in urban areas. By looking at these broader sources of risk and opportunities for building resilience from the perspective of the evolving urban resilience planning framework presented here, ACCCRN can offer meaningful innovations in both conceptual synthesis and informed practice at a global level.

NEXT STEPS

The next step for the ACCCRN program is implementing resilience interventions, which will take place between 2011 and 2013. The resilience strategies described in this report will guide initial priorities, but the ongoing monitoring and learning from the implementation process — along with better climate data and better linkages to other ongoing local planning processes — should help each city revise its vulnerability assessment and resilience strategy. In this way, the cities will complete and iterate both of the cycles described in the UCRPF.

ISET will work with ACCCRN partners to develop indicators of resilience based on the conceptual elements in the UCRPF, but generated to match local conditions. The indicators will help local climate resilience planners to determine whether their interventions are improving the city's overall resilience and to highlight areas that might need additional attention. Once they have been refined through practice, these indicators should provide useful guidance for other cities that wish to apply the UCRPF.

The processes and tools reported in this volume will evolve further through ongoing practice, feedback, and adaptation by city level partners in ACCCRN during Phase 3. Other cities beyond the ACCCRN program will be able to replicate the resilience planning processes described in this report. Overall, these experiences will make an important contribution to an evolving body of practice that will help cities reduce climate impacts on their most vulnerable populations.

ACKNOWLEDGEMENTS

The concepts in this chapter have been developed in collaboration with the International Development team at Arup (Arup 2011), who are partners in the ACCCRN program. The chapter builds on the thinking contained in the Urban Resilience Framework (da Silva, Moench et al. 2010) which was presented at the Rockefeller Foundation's Urban Climate Change Resilience seminar held in Bellagio November 2010. Arup's input has been particularly helpful in developing the section on urban systems. We would like to specifically acknowledge the valuable contributions of Jo da Silva, Sam Kernaghan, and Andres Luque. This work is also indebted to contributions from previous collaborations with colleagues at ISET Nepal, particularly Ajaya Dixit.

CHAPTER 2

SYSTEMS, AGENTS, INSTITUTIONS, AND EXPOSURE

A FRAMEWORK FOR URBAN CLIMATE RESILIENCE PLANNING

Marcus Moench and Stephen Tyler

FIGURE 2.1 | Systems, Agents, Institutions, and Exposure

The icons below are used throughout this publication to represent the core elements of the framework introduced in this chapter.

SYSTEMS | AGENTS | INSTITUTIONS | EXPOSURE TO CLIMATE CHANGE

INTRODUCTION

The challenges of urbanization and climate introduced in chapter 1 are evidence that as cities all over the world build long-lived infrastructure and other systems in the coming decades, the impacts of unavoidable climate change must be foremost in their consideration. In order to support dense populations and high levels of interaction, cities require inputs from ecological systems; many kinds of social organization; structures that facilitate and mediate interaction and exchange; and complex infrastructures that include links to global networks of transport, finance, communications, and supply. Cities provide opportunities for people to enhance their well-being through greater productivity and access to goods, services, experiences, and ideas, but only if these complex supporting systems and organizations function properly. The uncertainties of dynamic future conditions and the direct and indirect linkages across multiple sectors (that extend well beyond the boundaries of the city itself) make thinking about how to increase urban resilience to climate change in practice a daunting task.

This chapter presents an Urban Climate Resilience Planning Framework (UCRPF). The framework is intended to be a tool to help simplify and analyze complex relationships between urban residents, urban systems, urban institutions, and climate change. It can help clarify the factors that need to be included in diagnosis of climate vulnerability and refine the process of strategic planning to build urban resilience to climate change. The conceptual framework has been synthesized from a wide range of related fields, including ecology, engineering, disaster risk reduction, complex systems theory, and planning, with the goal of prompting new and practical ways of thinking about the challenge of urban adaptation to climate change.

APPROACHES TO CLIMATE ADAPTATION IN CITIES

There is mounting international concern about how to address the implications of climate change for urban areas, particularly in developing countries, where cities are growing rapidly and a high proportion of urban populations are poor or otherwise particularly vulnerable to climate-related disruptions (Balk, Montgomery et al. 2009; Satterthwaite, Huq et al. 2007; UN-HABITAT 2011; Wilbanks, Lankao et al. 2007). With few exceptions, this literature focuses on the likely impacts of climate change and points to the need for local measures to adapt to these projected impacts. In addition, a growing number of guidebooks and manuals are now available to provide advice to local governments on how to assess the impacts of climate change and develop effective responses. (See, for example, USAID 2009; for the U.S., Snover and Whitely Binder et al. 2007, NOAA, EPA et al. 2009; for Australia, ICLEI Oceania 2009.)

A number of recent studies on Asian cities have focused on climate change adaptation in the largest metropolitan areas, where a large share of national populations and economic infrastructure are concentrated (WWF 2009, Asian Development Bank 2010). As models for wider application, however, these analyses have some weaknesses. First, most have relied on methodologies that invest heavily in downscaled climate modeling approaches to derive projections of future local climate conditions, and then propose recommendations that respond to these projected conditions. Most cities in Asia, however, and particularly rapidly growing small- and medium-sized cities that lack the knowledge or resources needed to undertake modeling or easily use modeling outputs, cannot yet employ this method of assessing climate impacts and vulnerability. Moreover, such climate projections tend to be either too detailed or too uncertain to be useful at the local level when formulating urban planning strategies. Climate projections are most useful when they respond directly to local planning priorities in the short-medium term and identify key trends that make existing vulnerabilities worse (see chapter 3 for further discussion of this issue).

A more important drawback to these studies, however, is that the framing of planned adaptation responses in relation to specific climate impacts perpetuates the "predict and prevent" paradigm that has traditionally underpinned geo-hazard engineering. Hence, current approaches to urban climate adaptation have a tendency to focus on technical responses to particular climate hazards, such as defensive coastal infrastructure or zoning coastal areas in response to sea level rise. Climate adaptation tends to be framed in terms of specific projects, which can deflect attention from existing systemic weaknesses or institutional failures

and also overlooks the incremental and compound effect of building resilience though multiple efforts over time. Furthermore, this analytical approach does not readily identify indirect or cumulative effects on complex systems or across different spatial or temporal scales (Klein, Eriksen et al. 2007; Schipper 2007). It is this lack of a systemic analytical approach that the Urban Climate Resilience Planning Framework directly counters in its approach to climate change in urban areas.

In addition, approaches to climate adaptation that focus on impacts often skip over issues of vulnerability. Many studies assume that simple proxies such as poverty adequately represent vulnerability. A more complex and nuanced view of vulnerability recognizes that it results from a combination of capacities at the household, organization, and city level, together with fragility in key systems and the ways in which these factors interact. For example, in the case of New Orleans, the damage caused by Hurricane Katrina was not caused only by the storm, but also by lapses in maintenance of the dike system; destruction of wetlands; the expansion of urban housing into low-lying districts that may have been better left undeveloped; the lack of communications and public transportation systems to evacuate a sizeable low-income, elderly, and marginalized population in these districts; and the absence of an effective emergency preparedness plan at any level of government. A Category 4 storm was not unexpected, and all of the above factors also had been clearly identified in advance, but there was no framework for multiple agencies and jurisdictions to understand and respond to the combined hazards that were all predicted (Bourne Jr. 2004; Fischetti 2001). The impact of the storm on the city's residents was a function of the combined and synergistic effects of these contributing factors that determined their vulnerability.

A further challenge with conventional approaches to urban adaptation planning is that these tend to under-emphasize the role of autonomous adaptation; that is, the actions individuals, households, communities, and the private sector take in response to the opportunities and constraints that climate change presents. Such mechanisms are often not evident from a sectoral or project-based approach to climate adaptation. Moreover, conventional approaches also under-emphasize the importance of mechanisms for systematic learning by multiple actors at different scales as a key element of building capacity for adaptation.

The Urban Climate Resilience Planning Framework elaborated in this chapter places an emphasis on resilience rather than adaptation to suggest more explicit analytical attention to interacting urban systems, in which direct climate impacts are linked through spatial, physical, and economic connections to their effects on urban populations. It also encourages attention to the autonomous actions of social agents, both individuals and organizations, who are able to prepare and respond to climate effects independently and to the institutional structures that enable and constrain the scope and nature of agent activity, particularly in relation to key supporting systems. Finally, the resilience framework emphasizes the importance of ongoing processes for shared learning and capacity building over time as understanding of climate change and experience in building resilience both increase.

The academic literature in various disciplines emphasizes different aspects of resilience and often disagrees about how to define and measure it (Leichenko 2010). The UCRPF uses the following definition developed by the Resilience Alliance (2002), a multi-disciplinary network composed of researchers and practitioners who explore the dynamics of socio-ecological systems:

> *[Resilience is…] the ability to absorb disturbances, to be changed and then to re-organise and still have the same identity (retain the same basic structure and ways of functioning). It includes the ability to learn from the disturbance. A resilient system is forgiving of external shocks. As resilience declines, the magnitude of a shock from which it cannot recover gets smaller and smaller.*

Resilience implies recognition of the interaction between behaviors, systems, and strategies that are intentionally structured or organized, and those that are self-organizing or emerge as a consequence of autonomous behavior in response to deeper institutional or systemic features. A resilience approach not only addresses the vulnerability of systems and agents to specific projected climate conditions (e.g., more frequent heat waves, more intense rainfall), it also builds the capacity of cities to respond to surprise and to unexpected outcomes. In addition, it encourages the establishment of institutions that support the development and maintenance of resilient systems and enable the growth of agent capacity. Although the UCRPF emphasizes resilience rather than adaptation, it is important to recognize that the two are interlinked. Resilient systems are the stable foundations that agents (government agencies, individuals, households, and businesses) require in order to shift strategies and adapt as conditions change.

KEY ELEMENTS OF THE FRAMEWORK

The key elements of UCRPF outlined here are urban systems, social agents, and institutions, and, for each, the degree to which it is exposed to the impacts of climate change. Most of the recent literature on complex adaptive systems has emphasized the integration of social agents and institutions along with biophysical systems and infrastructure as inherent parts of an overriding "system" (Folke, Carpenter et al. 2002; Gunderson and Holling 2002). While the framework borrows from these integrated systems concepts, we find that analyzing component dimensions separately adds clarity and is more practical when working with decision makers and complex urban areas. Within the framework, building resilience means:

- Identifying and ameliorating fragile systems through strengthening those characteristics that reduce their vulnerability to climate impacts;

- Strengthening the capacities of social agents to access urban systems and to develop adaptive responses;

- Addressing the institutional factors that constrain effective responses to system fragility or undermine the ability to build agent capacity.

We separate these factors for purposes of conceptual and analytical clarity, in order to be able to assess the physical characteristics of an infrastructure or ecological system, the motivations that underpin different forms of social organization, and the manner in which institutions structure relationships among agents and between agents and systems. Collectively, these are the factors that contribute to urban resilience, but to understand each requires different analytical approaches,

Urban systems are driven by the dynamic interactions between coupled components where cause-effect relationships cannot always be determined. Technical analysis, measurement, and modeling can provide insights into system behavior, although predicting the behavior of dynamic and adaptive systems is very difficult. Urban systems (infrastructure and ecosystems) are designed and/or managed through deliberate human intervention, but their performance will depend on a multitude of factors that are difficult to manage, including human behavior and institutional context, which often lead to unintended side effects (e.g., pollution, congestion). Urban systems that are already overstretched are more likely to fail, or exhibit unstable behavior as evidenced by erratic power supply and power surges in many cities in Asia.

Human agency differs from system function in that outcomes arise not only from interaction between elements but from purposive decisions. Agents, unlike systems, are capable of deliberation, independent analysis, voluntary interaction, and strategic choice in the face of new information. Agents are actors in the sense that they introduce volition and intent into actions; they behave in ways that reflect their location and structure within society (i.e., as government entities, businesses, communities, households, and individuals), their preferences, and the opportunities and constraints they perceive. Insights into the behavioral patterns of agents can be gained through agent-based modeling or more qualitative forms of social science research. These techniques are quite different from those required to gain insights into systems.

Identifying the institutional factors that underpin how systems are designed and managed and the incentive structures that influence agent behavior requires yet different analytical approaches. Institutional analyses focus on how high-level structural considerations and contexts shape the social space within which agents act (Campbell 1998; Schneiberg and Clemens 2006). The results of institutional analyses complement insights gained from separate analyses of systems and agents. This is also the case with the analysis of exposure, for which the effects of climate change can be systematically identified through scenarios that explore the implications of specific changes in relation to specific systems, specific groups of agents, and specific institutional structures.

On a practical level these four core elements in the UCRPF (urban systems, agents, institutions, and exposure) provide distinct lenses through which to consider urban climate change resilience. Each aligns with specific interests and backgrounds associated with key practitioners and decision makers responsible for planning in urban areas. As a result, separation of these major components provides a practical basis for engaging with key actors in urban areas about climate resilience. Yet, collectively they provide a holistic view of urban resilience: urban systems relate to what will be managed (infrastructure, ecosystems, etc.); agents relate to who will take action or be affected by actions (e.g., businesses, government organizations, NGOs, communities, etc.); institutions relate to how action is structured or enabled (legal or regulatory frameworks and processes, laws, authority, agreements, etc.); and exposure relates to climatic drivers of change (parameters, magnitudes, locations, with what level of uncertainty).

URBAN VULNERABILITY AND EXPOSURE

Before considering the key elements of the resilience framework in more detail, it is important to reiterate that our framework focuses on resilience to climate change specifically, although the principles could be applied to considering resilience to other potential hazards (e.g., pandemics, terrorism). An important part of the resilience framework, therefore, is assessing vulnerability to climate change. Therefore, we start by clarifying what we mean by climate change vulnerability, recognizing that definitions of vulnerability are widely debated and often quite different among the communities working on climate change and other related fields (Fussel 2006; Fussel and Klein 2006; Hardoy and Pandiella 2009; Ionescu, Klein et al. 2009). The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as: "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes" and frames vulnerability as "a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity" (IPCC 2007a). This formulation of urban vulnerability to climate change posits vulnerability as the inverse of resilience. In terms of the elements in the UCRPF, it suggests a focus on those areas where fragile systems and marginalized agents are exposed to impacts from climate change and limited in their ability to adapt by constraining institutions. (See Figure 2.2).

As such, exposure to climate change-related hazards is a key concept that underpins understanding of vulnerability. If urban systems, agents, and institutions are not exposed to shocks and stresses associated with climate change, then resilience to such stresses is not at issue. The question of exposure is, however, more complex than it may at first appear. Some of the greatest stresses on urban areas from climate change are likely to be indirect, incremental, or both. They will emerge as a consequence of distant changes that are translated to urban areas through interlinked systems as a result of global markets, supply chains, and dependency on remote ecosystems or wider infrastructure networks. In addition, exposure to individually minor climate effects, in aggregate or in combination with other stresses, may cause systems to "tip" (i.e., become unstable and lose key structural or functional characteristics — see the following table for examples). This is a central observation emerging from conceptual and applied work on systems resilience (Dakos, van Nes et al. 2010; Gunderson and Holling 2002; Scheffer 2010). Yet, most applied work on adaptation focuses on the types of direct tangible impacts from climate change that people can observe and understand within their locality. Impacts are also likely to be compounded by other changes (such as the process of urbanization, the presence of conflict or on-going environmental degradation) that are themselves unrelated to climate.

Table 2.1 outlines some of the likely direct and indirect ways urban systems may be exposed to stress from climate change. The table is not comprehensive, but is intended to illustrate the types of exposure issues that are important to consider in understanding and evaluating resilience.

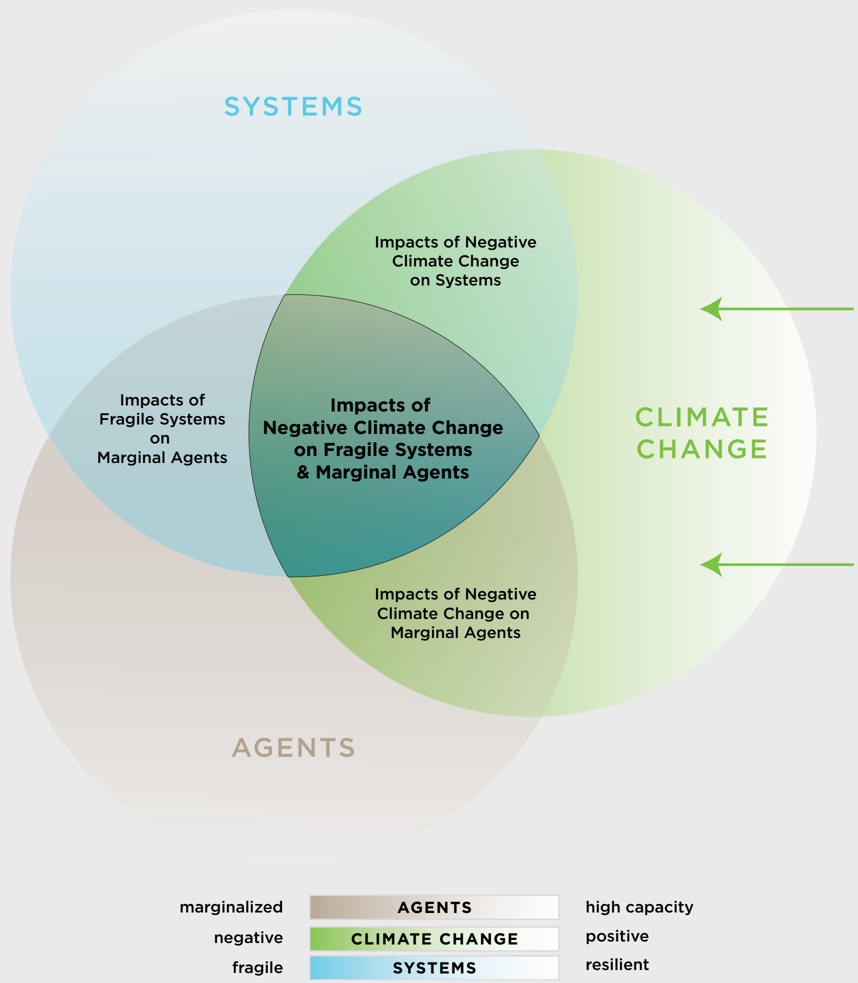
The Urban Climate Resilience Planning Framework considers vulnerability to climate change in terms of climate exposure — both direct and indirect — as discussed above. But it places equal emphasis on the role of system sensitivity or fragility, the capacities of agents, and the institutional factors that shape their spheres of action. This recognizes the distinction between social and physical vulnerability that has been noted as essential in key reviews related to climate change (Brooks 2003). In doing so, it moves beyond the traditional focus on poverty or other forms of social marginality as the main proxy for vulnerability that is common in many other formulations in practice, despite the theoretical nuances of their approaches (see for example Eriksen, Klein et al. 2007; Heltberg, Siegel et al. 2009; Verner 2010). This is particularly important in urban areas where exposed populations will be highly vulnerable if for example key infrastructure systems fail and are unable to recover rapidly.

Vulnerability to climate change occurs when fragile inflexible systems and/or marginalized or low capacity agents are exposed to climate change and their ability to shift strategies is limited by constraining institutions. Resilience and adaptive capacity are high where robust and flexible systems can be accessed by high capacity agents whose ability to shift strategies and address system fragilities as climate conditions change is supported by enabling institutions. Vulnerability, in the Urban Climate Resilience Planning Framework, is therefore a function of not only exposure, but of the characteristics of systems, the capacities of agents, and the nature of the institutions that link them — and for each, the degree to which it is exposed to the impacts of climate change. We explore the details of these key elements in turn below.

URBAN SYSTEMS

For the purposes of understanding the framework, urban systems include both ecosystems and infrastructure systems along with the knowledge required to manage, maintain, and develop them. Ecosystem services (such as water, air, food, coastal defense, and water absorption) underpin city functioning and are mediated and complimented by physical infrastructure (transport, water distribution, drainage, power, communications) (da Silva, Kernaghan et al. 2010). When present, well managed, and maintained, these provide the services that support a wide range of private, public

FIGURE 2.2 | Climate Impacts on Fragile Systems & Marginal Agents



VULNERABILITY (of cities or specific agents) = f

(exposure, fragile systems, constraining institutions, marginalized & low capacity agents)

TABLE 2.1 | Patterns of Exposure to Climate Change

EXPOSURE CHARACTERISTICS	TEMPERATURE		SEA LEVEL RISE	
IMPACT DESCRIPTION	Direct impacts on urban systems, agents, and institutions.	Indirect impacts through coupled systems.	Direct impacts on coastal cities.	Indirect impacts on non-coastal cities through coupled systems.
WATER SUPPLY EXAMPLES	Water quality (salinity, pathogens, nutrients, algae, etc.), water availability through changes in evaporation. Food storage, worker productivity and health, transport system reliability, energy demands for cooling and production. Institutional impacts on design standards, customary working hours, etc. Potential direct impacts on key sectors such as tourism.	Ability to pump water if electricity system fails due to temperature.	Salinization of coastal aquifers and sources, impacts on water treatment and waste disposal facilities.	Water availability from coastal sources.
OTHER EXAMPLES	Food storage, worker productivity and health, transport system reliability, energy demands for cooling and production. Institutional impacts on design standards, customary working hours, etc. Potential direct impacts on key sectors such as tourism.	Food availability (impact on agriculture), spread of disease, long-distance transport issues, regional energy demand (base and peak). Impacts on productivity and product availability from other regions.	Inundation of low-lying infrastructure and land areas affecting multiple systems. Changes in the dynamics of streams and estuaries (some of the most productive ecological zones). Potentially major impacts on local agriculture. Inundation of ports. Migration of coastal populations.	Disruption of global transport systems through impacts on ports and coastal infrastructure. Population inflows due to displacement from coastal regions.

PRECIPITATION VARIABILITY & EXTREME EVENTS	
Direct impacts	Indirect impacts through coupled systems
Floods, droughts, storms affect water supply reliability, turbidity, design standards for water infrastructure, reliability and safety of existing supply and sewerage infrastructure, etc. Functionality of water rights systems potentially affected. Supplies for marginalized populations uncertain.	Regional impacts on availability and water rights systems (upstream-downstream relations), major floods and droughts, etc. Significant issues in allocating water in large transboundary basins (physical and institutional).
Local agricultural productivity and reliability, disaster frequency, displacement of populations, disruption of infrastructure	Food costs and availability, disruption of regional transport and communication networks. Changes in availability and cost of inputs for weather dependent economic sectors. Overall costs of disasters on national and global economies.

sector, and community-based activities that contribute to human well-being and generate economic prosperity. However, one or more of these systems, or the linkages between them, may have critical weaknesses or fragilities with respect to climate impacts. For example, urban food supplies may depend on vulnerable local floodplain agriculture and/or on multiple forms of transportation infrastructure supplying markets. Direct or indirect impacts from climate change could impact multiple systems or cause cascading disruptions throughout several systems affecting large sections of the urban population as well as the wider economy.

Although not climate-related, the March 2011 tsunami in Japan illustrates these types of interconnections. Interruptions to supply chains that were of central concern for many businesses are a primary example of the disruptions that could occur (The Economist 2011). In this case, the complexity of supply chains hid high levels of global dependency on a small number of Japanese manufacturers (damaged by the tsunami) for critical components. The nuclear radiation risk at Tokyo Electric Power Company's (TEPCO) Fukushima Dai-ichi plant and the loss of power due to it and several other nuclear power facilities shutting down affected tens of thousands of people. This was a combination of off-site power being affected, as well as direct inundation and damage to the plant itself. Operators were faced with a catastrophic, unprecedented emergency scenario with no power, reactor control or instrumentation, and very limited communications both within and external to the site (IIEA 2011). Similar issues could emerge in relation to food, energy, communications, health, and other services. The point is that spatial analysis of direct local climate impacts alone is insufficient to understand the vulnerability of urban systems. It must be combined with systems analysis that recognizes the interdependency between systems as well as their links to assets, resources, and networks outside the municipal boundary.

GENERAL CHARACTERISTICS

Resilient systems are able to maintain their functions and linkages in the face of shocks and stresses resulting from climate change, recognizing the inherent uncertainty in predicting the future (Male: 2009). It is important to distinguish between resistant or robust systems, which provide protection (e.g., sea walls) or are designed to ensure continuity of operation in the face of extreme events and change; as opposed to resilient systems which accept that some failure or operational disruption may occur but that functionality is retained and can be rapidly re-instated (McBain, Wilkes et al. 2010; O'Rourke 2007). This also recognizes that resilience is achieved by incorporating learning from previous events in the progressive adaption of urban systems. For instance, the need to provide stand-by power generation for a hospital may become evident as a result of a sub-station being flooded in a previous event, yet may ultimately be an interim step to shifting to more flexible decentralized power supply that may combine off-grid and feed-in local generation.

From the study of complex engineering and ecological systems, characteristics that are widely cited as contributing to the resilience of systems include the following (Alberti, Marzluff et al. 2003; Andersson 2006; Berkes 2007; Ernstson, van der Leeuw et al. 2010; Folke 2006; Folke, Carpenter et al. 2002; Gunderson and Holling 2002; Leichenko 2011; Liu, Dietz et al. 2007; Meadows 1999; Resilience Alliance 2007; IIEA 2011):

Flexibility and diversity

Flexibility and diversity refer to the ability to perform essential tasks under a wide range of conditions, and to convert assets or modify structures to introduce new ways of achieving essential goals. A resilient system has key assets and functions physically distributed so that they are not all affected by a given event at any one time (spatial diversity) and has multiple ways of meeting a given need (functional diversity).

Redundancy, modularity

A redundant and modular system is one that has spare capacity for contingency situations in order to accommodate extreme or surge pressures or demand. It also has multiple pathways and a variety of options for service delivery; or interacting components composed of similar parts that can replace each other if one, or even many, fail. Redundancy is also supported by the presence of buffer stocks within systems that can compensate if flows are disrupted (e.g., local water or food supplies to buffer imports)

Safe failure

Safe failure refers to the ability to absorb sudden shocks (including those that exceed design thresholds) or the cumulative effects of slow-onset stress in ways that avoid catastrophic failure. Safe failure also refers to the interdependence of various systems that support each other; failures in one structure or linkage are thus unlikely to result in cascading impacts across other systems.

In addition, rapidity — the speed with which services can be re-instated — is often cited as a key characteristic. However, this is largely dependent on the capacity of local actors to mobilize and act, which we address as agent characteristics.

These characteristics of resilient systems are attributes that reflect the likely ability of a system to continue to fulfill its intended function, or be rapidly reinstated following a disruption. They should be seen as guidelines for thinking about complex urban systems in new ways, rather than as detailed technical specifications. Each context and system will be different, and it is impossible to provide specific prescriptions for all conditions, though there is a growing body of research looking at the resilience of specific systems and the wider consequences and costs of disruption or failure due to climate change (Brunner and Suter 2008; American Lifeline Alliance 2005; McBain, Wilkes et al. 2010). The point is to use these general characteristics to think about issues of climate vulnerability in a more comprehensive manner than can be achieved by considering direct impacts alone. Table 2.2 suggests how these general characteristics might be translated into performance specifications in relation to water supply. From these examples, it can be seen that the system characteristics should not be considered as mutually exclusive categories. In any given system, a particular desired performance factor might be ascribed to more than one category (in some systems, for example, modularity is similar to diversity, e.g., multiple water pumping stations in various locations).

Critical Urban Systems as Gateways

The functioning of the modern urban area depends in fundamental ways on what we refer to as critical urban systems. The notion of critical infrastructure is well understood as those facilities, systems, sites, and networks necessary for the functioning of the city and the provision of essential services on which daily life depends (McBain, Wilkes et al. 2010). Here we prefer to use the term critical urban systems in order to more explicitly recognize the role of ecosystems as well as infrastructure in contributing to water and food, drainage, waste absorption, and coastal defenses.

These critical urban systems are often highly interdependent so that failure of one system can have a direct and damaging effect on another. For example, water treatment and distribution relies on power supply, so that loss of power also results in loss of water. Failure of a critical urban system may not only have significant effects locally, but also may result in cascading effects beyond the urban area, either regionally or nationally. The scale of impact caused by failure needs to be considered as a result of cascade effects due to both system interdependency, as well as the degree of reliance on specific systems.

Critical urban systems are also dependent on the institutional structures within which they exist, whilst, at the same time, the operation of institutional structures relies on critical systems continuing to function. This co-dependency between urban systems, institutions, and agents is critical. During intense periods of crisis (which are often short-term events), failure of food or water supply, power, transport, and communication systems will fundamentally inhibit the ability of key institutions or decision makers to function. For example the effectiveness of emergency services may rely on road networks or telecommunications for access and information. More fundamentally, access to food and potable water is essential to survival of individuals and functioning of local authorities.

Since the function of institutions is likely to be impaired and agents' ability to act compromised if the underpinning critical urban systems are fragile, patterns of co-dependency are unidirectional, particularly during times of extreme stress. Over longer time horizons, however, the directional nature of dependencies becomes more balanced since the design, maintenance, and operation of critical systems also depends on the capacity of agents and the strength of institutions.

The understanding of systems, agents and institutions as co-dependent and hierarchically ordered underpins our approach to the UCRPF. This approach draws on Amartya Sen's entitlement framework and related work on livelihoods that emphasizes command over assets and access to services as central to well-being and the ability to respond during crises (Dreze and Sen 1989; Dreze and Sen, et al., eds. 1995; Scoones 1998; Sen 1999; Twigg 2001). Figure 2.3 illustrates this functional dependency distinguishing between core systems and those systems and institutions which more broadly enable diverse agent responses. We include land as a core system in addition to ecosystems in recognition of its unique

TABLE 2.2 | Characteristics of Resilient Systems

SYSTEM CHARACTERISTIC	FLEXIBILITY, SUBSTITUTABILITY, AND DIVERSITY	REDUNDANCY AND MODULARITY	SAFE FAILURE
FLEXIBILITY AND DIVERSITY	The system can meet service needs under a wide range of climate conditions. Key elements are spatially distributed and can substitute each other but are functionally linked.	Spare capacity to accommodate unexpected service demand or extreme climate events. System components and pathways provide multiple options or substitutable components for service delivery.	Failure in one part of the system will not lead to cascading failures in other elements of the system. Key service delivery can be maintained even under failures.
EXAMPLES (FOR WATER SUPPLY)	Multiple, geographically distributed water sources (ground and surface water). Pumping stations in multiple sites with overlapping service. Demand side management to ensure water is used efficiently. Expandable fleet of water tankers.	Reservoir storage capacity exceeds demand under drought conditions. Groundwater recharge exceeds withdrawal rate. Large stocks on hand to buffer annual variability or other supply disruptions. Backup systems for water pumping. Rainwater harvesting systems to supplement water supply.	Protection and monitoring of source quality under conditions of climate stress. Failure of one pumping station does not lead to distribution system failure. Distribution network interlinked so local failure will not lead to major service interruptions.
OTHER EXAMPLES	Transportation: multiple modes and capacities for transporting key goods and people. Food supply sourced from diverse geographic areas.	Transportation: multiple access routes. Communications: redundant cellphone transmission towers. Energy: backup generators for crucial services. Food and other essentials: maintain high stock/flow balance in case of disruption.	Dikes can be opened to flood retention zones outside city.

locational attributes in cities and the many related urban systems and institutions designed to respond to or enhance land as a locational asset.

The hierarchical relationship of dependencies is widely recognized in the engineering literature on cities. As Godschalk comments, for example: "A city without resilient physical systems will be extremely vulnerable to disaster" (2003, p. 137). In addition, this formulation highlights the link between the resilience of the foundational critical urban systems and the capacity to adapt to changing conditions that assured access to such systems provides. "Access to infrastructure…determines access to resources (natural and human-made)" (Ruth and Coelho 2007, p. 326). When populations have secure access to basic ecosystem services (water and food), to energy, to transport, and to communications, the markets, financial services, educational systems, and higher-level organizations that enable them to shift strategies can operate and evolve as conditions change. If the critical systems fail, the higher-level ones will also collapse. Regular failures, even if only short-term, can compromise the function of higher-order systems and therefore limit adaptive capacity.

We use the term "gateway" to capture this relationship. This is analogous to Sen's and others' use of the term "entitlement" (see above). Access to durable lower-level core systems provides the enabling foundation for agents to reach and build broader, higher-level systems and services that allow much more diversity and opportunity to enhance well-being — and to respond to climate (or other) stresses. If these core systems fail, or are inaccessible to some agents, the gateways close.

Failures of systems at the base of the pyramid have rapid cascade effects on higher levels. As a result, the resilience of lower-level systems to disruption is central to the functionality of higher-level systems and organizations. In contrast, downward dependencies are of a very different type. Downward cascade effects take the shape of failures in the design, creation, and management of lower-level systems that occur gradually over time. Adaptation, in fact, often involves the gradual reshaping of lower-level systems by activity emerging from higher levels.

In the second phase of ACCCRN, sectoral studies of vulnerable systems were completed in each city as proxies for complete systems analysis, to inform initial resilience strategies and action planning. The experience with these studies (see chapter 5) has helped to highlight the importance of the interdependencies described above and the need for more careful analysis of linked urban systems in different parts of the pyramid as part of vulnerability assessment.

Below we expand on the roles and interdependencies of key foundational systems at the base of the pyramid.

Ecosystems and ecosystem services

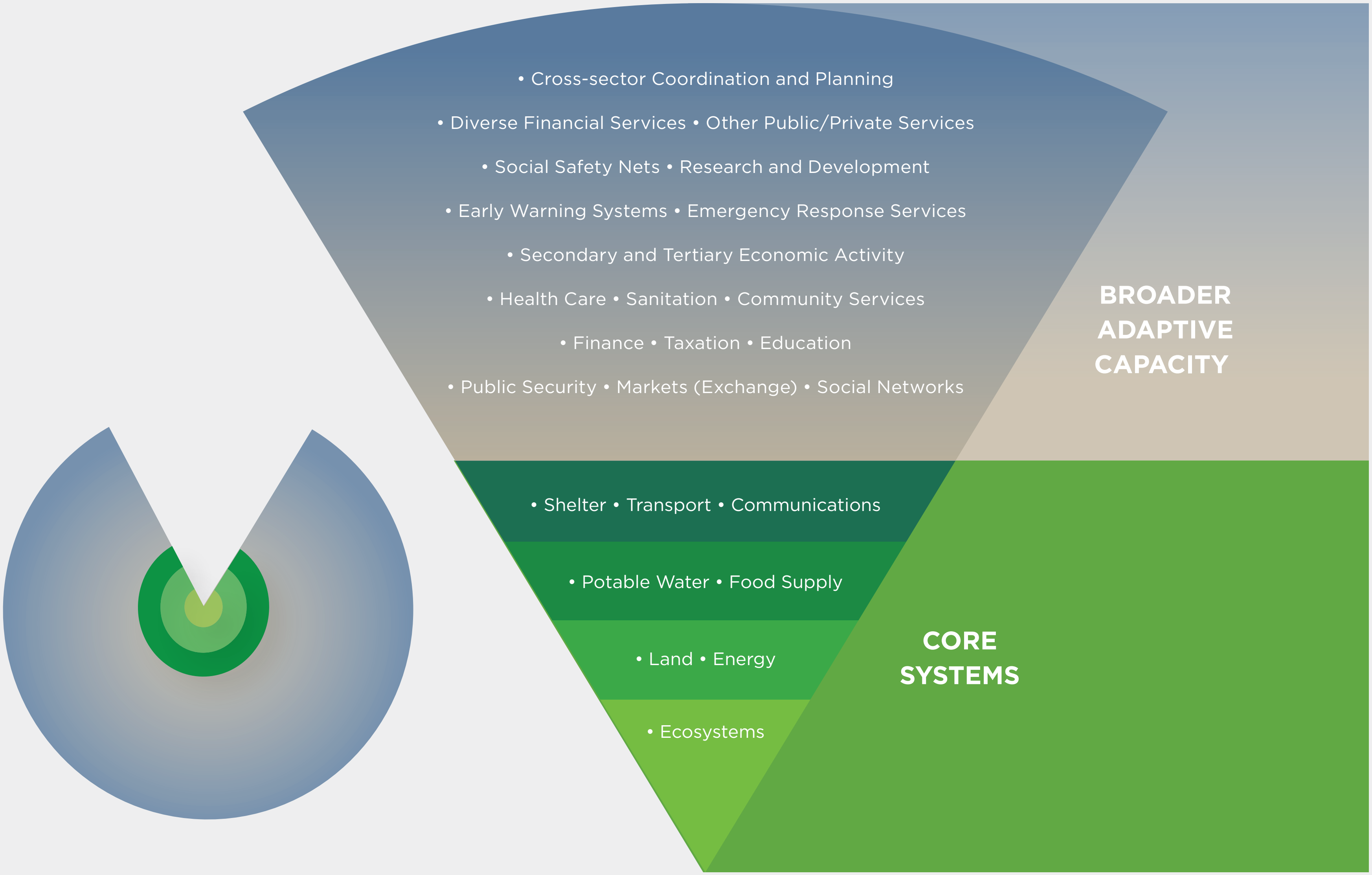
Ecosystems underpin all human activity. Their condition and ability to provide key services (food, water, clean air, temperature mediation, flood moderation, etc.) are fundamental to supporting urban populations, even if they are remote from the urban area (The Desakota Study Team 2008). Coastal cities (e.g., Da Nang and Quy Nhon in Vietnam) depend heavily on dune or mangrove ecosystems for buffering flooding and storms, while the conditions of riparian areas and the upstream watershed may influence floods and water supply for cities in major river basins (e.g., Gorakhpur and Indore). In many cites peri-urban agriculture is a vital component of food supply (e.g., Can Tho), but one that may be threatened by urbanization. More broadly, high seasonal temperatures elsewhere could interfere with food supplies for cities, significantly affecting global food security (Battisti and Naylor 2009).

Water

Potable water is essential to human survival and requires both sufficient quantity and quality to support urban populations. Demand

FIGURE 2.3 | Hierarchy of Systems

Resilient core systems are the gateways on which the higher level systems that contribute to adaptive capacity depend.



may be high due to urban agriculture and industry. Some urban areas are able to rely largely on local ecosystems (groundwater, lakes, and rivers) for water, but these may be threatened by pollution or upstream urbanization. Water distribution relies on energy as well as pipe networks. In Indore, for example, water is pumped a distance of 80 kilometers with a 500-meter lift to supply the municipal utility. This makes Indore much more dependent on energy and transport systems than a city with a local water supply.

Food systems

Urban food systems are often ignored or taken for granted (Pothukuchi and Kaufman 1999) . In most cases, work on food systems focuses on rural areas and agricultural policies. In urban areas, although attention to urban agriculture is increasing, attention has focused primarily on questions of access for the poor and on public health. As cities grow, however, the "foodshed" on which they depend has expanded geographically. Whereas most food used to be produced locally, now it largely comes from regional and global sources; urban food systems therefore rely heavily on transport and communication/information systems, making specialized cooling and storage facilities essential, particularly for fresh food. All these systems depend on energy. As a result, urban food systems are likely to be vulnerable to cascade effects from disruptions in energy, transportation, and communication systems. In addition, since the food systems for individual urban areas are increasingly linked to global systems, the effects of changes in production, price, and other variables in those global systems are often rapidly transmitted to urban consumers.

Energy systems

Energy systems are a necessary precondition for the operation of other systems. Transport, water supply, communication, and shelter systems all depend in fundamental ways on energy, so failure to the energy system presents the potential for major cascade effects. In phase 2 of ACCCRN, the cities of Surat and Indore evaluated a broad array of green and conventional energy options as a way of increasing both the resilience of the city as a whole while also reducing carbon emissions (Singh 2010). Energy systems represent a mix of modular and networked components that are often interdependent. Internal combustion engines for example, are highly modular, hence diesel generators are frequently used as stand-by power supply. Yet, they provide only a short-term solution since ultimately their operation depends on access to fuel through electric pumps at petrol stations. National power grids are increasingly interlinked at a super-network level to provide spare capacity and redundancy. In urban areas there is an increasing shift away from centralized to decentralized networked power supply, to reduce dependency on massive central systems. Coal power stations, for example, often depend on rail to transport fuel and water systems for cooling. Hydropower depends on water resource systems, natural gas on long-distance pipelines, and so on. As a result, the resilience of energy systems is often a complex topic in its own right and the potential for cascade effects within energy systems as well as between them and the other systems they support is often high.

Communications and information

Cities are increasingly intense hubs of communications and information, posing challenges for resilience (Allenby and Fink 2005). Numerous other systems (including disaster response, energy, transport, water supply and delivery, food, etc.) depend directly on information infrastructure, compounding the "interdependency problem" and creating a large potential for cascade effects between systems (Amin 2002; Little 2002). As the ability to communicate information over distances has increased in speed, affordability, and accessibility, a plethora of new institutional arrangements have emerged that in diverse ways are fundamental to urban life (Allenby and Fink 2005). Communication systems often have both modular (cell and cell towers) and networked (landline) components.

Transportation

Transportation systems are essential for moving supplies needed to sustain urban life and for moving people to enable productive activity. Most transportation systems are based on embedded networked infrastructure, even air and marine transport. While the transport itself may be modular (a truck, car, or train) roads, railways, ports, and piped systems are networked and often have critical points where redundancy is low and bottlenecks can occur. There are, however, major differences in the degree of dependency on specific pieces of critical infrastructure between transportation systems. With highways, for example, much of the functioning is modular and alternative routes exist, whereas pipeline and rail systems are tied to rigid networks. Transportation systems have direct interactions with the energy systems required to link ecosystems services with urban populations. Water supply systems, for example, depend on: a) hydrologic system dynamics; b) water transportation systems (canals, dams, and pipelines, which are also often linked to communication systems); and c) energy production and utilization for pumping. Food supply systems also depend in a similar manner on transport and energy systems to link ecosystem-based food production with urban consumers. Due to these linkages, the potential for failures to cascade across systems is often high.

Shelter

Shelter is often one of the more dynamic parts of the urban landscape. Shelter is modular — frequently torn down and rebuilt or transferred in ownership. However, the tenure and development rights for the land on which buildings are located may be far less flexible — location is fixed but ownership and use may be changed with some degree of difficulty. Shelter is fundamental to household vulnerability, as it provides protection from flooding or high temperatures, support to livelihoods, and opportunity for rainwater harvesting. In a contemporary urban area, most shelter systems are only habitable if other networks function well. They depend on power systems, water supply, sanitation, and communications.

Urban resilience is an emerging field, and developing a better understanding of the complex inter-relationships between these critical systems is essential to identifying the factors that ensure resilience. A recent engineering paper comments that a "particularly troubling characteristic of these tightly coupled, complex systems is that they predictably fail but in unpredictable ways" (Little 2002, p. 113). It goes on to point out that often "large catastrophic events occur as a consequence of the same dynamics that produce small ordinary events" and that much "depends on how tightly coupled the infrastructure components are, how potent the effects are, and whether or not counter measures such as redundant capacity are in place" (Bak, as cited in Little 2002, p. 113). A key challenge is that urban systems cannot keep pace with rapidly expanding populations, and infrastructure is too often planned, designed, constructed, and managed in isolated sectors rather than as part of an integrated system. There is insufficient consideration of the potential for major cascade effects between such systems. However, it appears that the potential for severe climate disruptions that could affect multiple systems simultaneously in many cities is high. Heat waves, for example, that disrupt power supply could also disrupt transport, communications, water supply, and food systems, and could make houses and other shelter less comfortable. As a result, the starting point for understanding urban

vulnerability to climate change is analysis of these critical urban systems that enable agents — the actors within urban areas — to function.

AGENTS

Agents, or actors in urban systems, include individuals (e.g., farmers, consumers); households (as units for consumption, social reproduction, education, and capital accumulation); and private and public sector organizations (government departments or bureaus, private firms, civil society organizations). They have identifiable but differentiated interests and are able to change behavior based on experience and learning. This means that even if system function is stable and predictable over time, agents will respond differently to new information. They have different motivations, different decision-making practices and act at different levels. In order to work effectively with agents it is important to recognize what opportunities and constraints they face and what incentives they respond to. Agent behavior can be changed, but depending on the circumstances, it may not be any easier than modifying complex technical infrastructure systems.

Agency is generally understood as the human capacity to make decisions and choices and to take action. The act of making decisions and choices and taking action is the exercise of agency. Concepts of agency underpin the agent-based modeling techniques that are increasingly widely used in socioeconomic research to improve understanding of social dynamics. This field grew out of work by researchers such as Thomas Schelling on game theory (1981) and Robert Axelrod on the prisoner's dilemma (1984) and later many other topics (1997). Agent concepts also underpin the emerging body of work on complex adaptive systems (CAS) such as the stock market. Most urban areas can be understood as complex

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Agents develop the capacity to act through experience, gradually acquiring a repertoire of responses to stresses and shocks. The awareness of hazards, the ability to learn new responses, and the ability to acquire information needed to assess hazards and outcomes are all therefore important elements in strengthening the capacity of agents.

adaptive systems like those described above. Note that while CAS theory is built around the action of agents, in our conceptual framework we consider a narrower perspective on systems and separate out agents for special consideration.

While cities generally have a formal government, there is also a very wide and complex array of social organizations — from large government departments and business firms down to cultural associations and households — that continuously make decisions shaping the nature of the city. Our concept of agency infers strategic and often independent decision behavior by different agents. As a consequence, in many cities, particularly those that lack strong planning or coordination capacities, urban structure is an emergent property that parallels Krugman's concept of the "self-organizing economy" (Krugman 1996). That is, the structure of many elements in urban areas emerges as an aggregate consequence of individual agents' behavior, rather than as a result of intentionally planned organization. The structure of urban markets, for example, emerges as a consequence of numerous interactions between individuals with needs or demands, producers creating products, and the network of wholesale and retail organizations that link the two. Markets often have a very clear structure but it is generally not pre-planned. Overall, recognition of agency and the role individual agents play in creating structure relates closely to conceptual frameworks for understanding urban complexity (Batty 2005, 2008), urban evolution (Marshall 2009), and the self-organizing characteristics of resilient socio-ecological systems (Folke, Carpenter et al. 2002).

The actions agents can take are constrained by access to the services provided by urban systems (ecosystems, infrastructure) and by the institutions that link agents and systems. Those individuals and groups who are socially or economically marginalized — due to income, gender, age, class, caste, religion, or ethnicity, for example — have less access to the ameliorating services provided by urban systems and are likely to be more vulnerable to similar climate impacts. As noted below, institutions have a role in creating many of these marginalizing factors.

The key capacities of resilient agents summarized:

RESPONSIVENESS capacity to organize and re-organize in an opportune fashion; ability to establish function, structure, and basic order in a timely manner both in advance of and immediately following a disruptive event or organizational failure.

RESOURCEFULNESS capacity to identify and anticipate problems; establish priorities, and mobilize resources for action. This includes the capacity to visualize and plan, which may require collaboration. It also includes the ability to access financial and other resources, including those of other agents and systems.

CAPACITY TO LEARN ability to internalize past experiences, avoid repeated failures, and innovate to improve performance.

Many agents are, in essence, primarily the consumers of services produced by urban systems — they depend on urban systems and demand products, but are not proactively involved in the creation, management, or operation of those systems. Other agents are directly concerned with critical urban systems. In the case of water supply, for example, these might include the municipal utility, key regulatory agencies, private water market suppliers, and civil society organizations involved in water related advocacy or other activities. The resilience of urban areas depends on the capacities of agents as autonomous decision makers and as organizations linked to system operations. Discussion in this chapter focuses on agents associated with critical urban systems.

Key capacities that contribute to agent resilience and adaptation include the capacity to organize and re-organize in response to threat or disruption, the capacity to visualize and act, and the capacity to learn (see, for example Diduck 2010; Gunderson and Holling 2002; O'Brien, Hayward et al. 2009; Tanner, Mitchell et al. 2009; Wilbanks and Kates 2010). They also involve the resourcefulness of agents, including their access to and their ability to mobilize financial and other resources.

It is apparent that all these capacities are tied to typical human behaviors at the level of the individual, household, or organization. In cities, however, these capacities are challenged at any scale by the complexity of interactions and interdependencies, by the volume and detail of information that goes into decision making, and by the potential magnitude and variety of resources that are available to agents to support their actions. The ability of individuals and households to undertake meaningful and effective independent actions to build resilience is still significant, but in an urban context, independent actions that are structured through collective mechanisms become more important (e.g. markets, voluntary organizations). These can be challenging to manage and enable effectively. For example, self-organizing mechanisms for service provision can emerge in cities through the independent actions of many agents, such as private water markets. Such self-organized responses are typically important for resilience because of their flexibility and diversity, but may need management or support from enabling institutions (e.g. to assure water quality). These interventions must recognize the strategic behavior of participating actors and take care not to weaken precisely those characteristics that contribute to resilience in the first place (e.g., through unnecessary regulation or entry restrictions).

Where the capacities of individual and household level agents become a crucial factor is in the case of marginalized groups. These agents are constrained by lack of resources in terms of personal assets that can be readily converted to allow them to respond or shift response strategies to either anticipated climate events or unexpected disasters. Such assets include cash income as well as other assets that can be substituted for cash in critical situations: convertible capital assets (livestock, jewelry), credit, social networks, etc. These marginalized groups may also lack access to the critical systems introduced above, further constraining their resourcefulness. They may lack safe drinking water or access to communications networks, transportation services, or financial services. They may lack rights to productive ecosystems (farmland, fishing, harvesting forest products). They may be isolated by ethnicity, caste, or religion from access to mainstream support services and prevented from setting up strong social networks for collaboration and advocacy. While it is also possible to find marginalized organizations with analogous constraints that will limit their resilience, individuals and households are particularly vulnerable because of these constraints on their ability to access resources. Typically, institutional structures reinforce marginalization (see discussion below).

High capacity agents have the ability to anticipate and to take action in order to adjust to external changes and stresses. Organizations have the authority and mandate to take action, as well as the financing to do so. Agents' ability to act is facilitated by adequate resources and by access to supporting systems, including the ability to access resources provided by other agents. Agents develop this capacity through experience, gradually acquiring a repertoire of responses to stresses and shocks. The awareness of hazards, the ability to learn new responses, and the ability to acquire information needed to assess hazards and outcomes are all therefore important elements in strengthening the capacity of agents.


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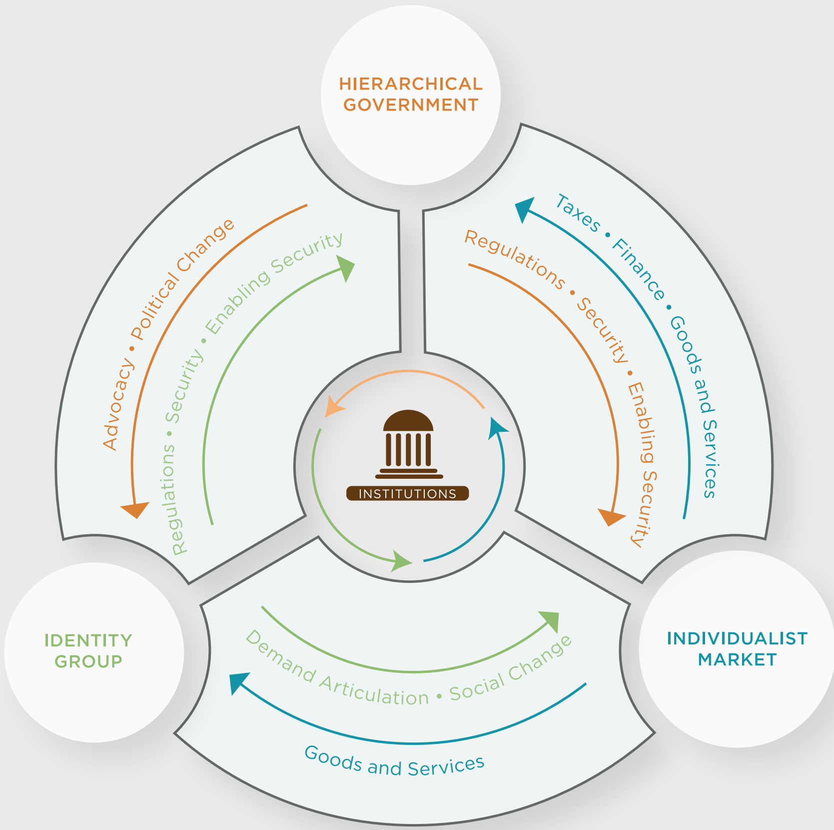
The Agency Model

If the resilience of agents can be largely considered in terms of the capacities described above, it sometimes helps practitioners to think more concretely about what these capacities look like and how they can be augmented if they consider specific examples of agent behavior. To help identify key agents associated with urban systems as we describe them above, and the kinds of behaviors that could be linked to these resilience capacities, analysts can refer to cultural theory. This body of social theory recognizes the manner in which forms of organization translate into roles and the behavior of organizations within society (Douglas 1987; Robinson, Hewitt et al. 2000; Thompson, 2008; Thompson, Ellis et al. 1990; Verweij and Thompson 2006).

The most fundamental distinction is between hierarchical (typically large government or corporate) organizations, individualistic market actors (businesses, households, and individuals), and identity-bound (typically interest, community, and cultural groupings) forms of organization. Each of these groupings has spheres of activity and forms of social engagement that reflect underlying organizational logic. Government entities, for example, tend to have independent sources of financing (taxes), a primary accountability to higher levels of government and political leadership, and a narrowly defined organizational mandate. As a result, they tend to focus on service delivery, planning, and regulation. Their over-riding concern is with control (internal and/or external). Market actors, in contrast, survive through the sale of goods and services and, for this reason, exist in a competitive sphere where the primary focus

FIGURE 2.4 | Agents Diagram



The way people organize influences how they see the world and the types of actions they can take. **Identity groups** (communities, civil society organizations, etc.) often advocate for change; **market actors** (individuals, businesses, households) produce goods and sell services; **government entities** produce public goods and regulate. These functional characteristics determine who can do what (and why they might) to build resilience.

is on opportunity. Finally, identity-bound organizations survive by mobilizing social commitment to that identity. As a result, they tend to play a major role by voicing the concerns of their membership and advocating solutions. Lacking the ability to tax their members or sell products, they do not have the financial resources required to implement large-scale activities or develop innovative products themselves. They do, however, play key organizational and political roles and advocate for other actors to meet their needs.

By recognizing the logic underpinning different forms of organization, this agency model helps to clarify the types of actions each form of organization may reasonably be expected to take, as climate and other conditions affecting urban areas change. Identity groups can be expected to advocate for relief or support in response to climate change's impacts on people and communities. Market actors will jump into new niches where climate conditions create customers for the products they make or can envision (e.g., air conditioner sales). They will also enter niches governments have been unable to fill. In a similar manner, city government hierarchies will respond to the social and political pressure for the products or services that the private sector is unable or unwilling to provide, or where equity, ideological, or political considerations provide incentives for a government role in service provision. In many cases, the public and private sector are both involved in and either collaborating or competing for the delivery of key services. The dynamic pressures and opportunities that emerge and catalyze action between different forms of organization represent the basis for autonomous adaptation processes.

In addition to improving the understanding of urban dynamics under changing conditions, the agency model locates proposed responses (in this case projects aimed at fostering resilience) in a social and political economy context, making it possible to explore each response's likely success given particular social conditions; to posit who will drive the response and who will benefit; and to identify alternative and complementary arrangements or response strategies. The accompanying graphic illustrates the relationships. The agency model also helps to identify what kinds of actions different groups are likely to take in order to better specify the capacities and tools they need to increase resilience. On a very practical level, practitioners can use the agency model to identify who might actually have an incentive to do what to build resiliency and why they might do it. For example, private business enterprises and households are most likely to be interested in market opportunities and in reducing their own risk exposure to climate impacts. Cultural and social organizations may be concerned about members' vulnerability to flooding or storms and therefore advocate for special responses (e.g., the Da Nang Women's Union has proposed to fund Storm Resistant Housing for low income households using innovative credit tools). Agents are motivated by the structural incentives inherent in different forms of organization and by the interaction between different forms of organization. As a result, the tripartite categories are useful for designing interventions and understanding motivations.

The categories are also a reminder for identifying different types of agents who might get ignored or lost in a typical planning process. If, for example, private sector organizations operating in informal water markets play a major role in urban supply (as they do in the ACCCRN city of Indore and in most other Indian cities), both the organizations and the water system infrastructure they operate (wells and tankers) need to be central features in the resilience planning process.

Overall, the agency model helps provide a systematic basis for identifying: 1) how different classes of agents relate to different systems (who, what, where, and why); 2) what categories of agents may be missing in an analysis; and 3) which groups of agents may be disempowered, lacking in capacities, or otherwise marginalized.

Building Capacity through Interaction Among Agents

As the agents diagram (Figure 2.4) indicates, different types of agents play different roles in relation to critical systems within the urban environment. Hierarchical government entities are generally the primary organizations directly in charge of planning and regulation, and often of the operation, maintenance, and management of many core systems. These functions often interface or overlap with the role of the private sector. The private sector tends to be heavily involved in systems where business models exist that enable agents to earn a return through innovation, management, and service provision. Identity groups play a particularly important role in articulating the demand for key services and as advocates to ensure other agents are aware of both urgent and emerging problems. The balance between these three forms of organization is important to resilience.

At a societal level within urban areas, each of the agent resilience capacities described above is an emergent property that depends heavily on both the characteristics of individual agents and the interaction among agents. The capacity to visualize, for example, depends on the ability of individual organizations to access and interpret information about conditions in the future. It may also depend on exposure to ideas or examples of how things could be done differently. Finally, it often depends on interaction with other forms of organization and the different perspectives they bring regarding the nature of emerging problems, potential solutions, and emerging opportunities. All these are likely to be enhanced where different forms of organization are present in a relatively balanced manner within urban areas (Moench, Dixit et al. 2003; Verweij and Thompson 2006). Similarly, the ability to act often depends on the mix of capacities the private sector and government bring to a problem, coupled with the societal support articulated through identity group actions. A similar situation applies to the ability to organize and reorganize and the ability to learn. In each of these cases, the balance of organizational forms brings opportunities for innovation from dialogue, contestation, and collaboration—building capacities that, together, contribute to urban resilience.

Table 2.3 explains further how agent capacities can be operationalized and provides some examples of what urban resilience might look like from the perspective of agents.

There are many ways to augment capacities of agents, some that involve only the independent agents themselves and others that involve strengthening collaborative behaviors between agents. For example, new mechanisms such as shared learning dialogues (explored in more detail in chapter 4) can augment learning capacities for many agents. While the specific potential for building agent capacities and the mechanisms for doing so will vary between cities depending on cultural, spatial, and economic contexts, a key factor that structures agent capacities and their impact on systems is the role of institutions. We address this element next.

INSTITUTIONS

The concept of institutions in social sciences refers to the rules or conventions that constrain human behavior and exchange in social and economic transactions. Institutions are created to reduce uncertainty, to maintain continuity of social patterns and social order, and to stabilize forms of human interaction in more predictable

TABLE 2.3 | Characteristics of Agents that Foster Resilient Systems

AGENT CHARACTERISTIC	RESPONSIVENESS
PERFORMANCE DESCRIPTION	Ability to organize, reorganize, and act; ability to establish function, structure, and basic order in a timely manner, both in advance of and immediately following a disruptive event or organizational failure. Evidence of action in response to disruption or the threat of it.
EXAMPLES (FOR WATER SUPPLY)	Government entities respond rapidly to customer service disruptions or larger disasters. They monitor system condition and devote required finances to maintenance (leak detection, supply sources). They monitor water resource conditions and respond to projected changes in supply, demand, or the behavior of other agents either directly or through regulatory and other incentive structures. Market actors present and provide supply, management, and other services in response to demand and resource availability. They are able to quickly respond when disasters occur. Identity groups proactively lobby government and market actors to improve things that affect their members, like water quality, environmental protection, or supply availability.
OTHER EXAMPLES	Government, market, and civil society actors organize and respond rapidly to disasters and signals from other sources including: 1) projections regarding the impacts of climate change as a whole or within sectors; and 2) changes in the needs of populations (implicit or poorly articulated demands). Changes in conditions catalyze action — e.g., if floods increase, government actors change zoning regulations, markets shift exposed regions to low vulnerability uses (agriculture versus housing), civil society advocates for flood plain protection. New forms of organization emerge in response to needs — such as the climate coordination offices established under ACCCRN in many cities.

RESOURCEFULNESS	CAPACITY TO LEARN
Capacity to identify and anticipate problems, establish priorities, and mobilize resources for action. This includes the ability to access financial and other resources, including those of other agents and systems.	Ability to internalize past experiences, avoid repeated failures and innovate to improve
Government actors build planning, technical, and other capabilities for water management. They mobilize government financial and technical resources and deploy them in response to water problems. They proactively work with other actors both within and outside government to address issues that cross sectors or scales. Market actors identify potential market opportunities in underserved areas. They provide a steady stream of innovative water technologies and services to meet emerging needs. Identity groups build membership and mobilize political support to voice and address emerging issues.	Government actors: The experience of prior droughts, floods or extreme storm events is incorporated in planning and implementation activities. Water supply projections and scenarios are routinely included in planning. Plans are revisited regularly and refined based on emerging information. Systems are in place to ensure required information is collected, analyzed, and made available. Market actors: Prior failures and emerging demands lead to design changes in water supply services and technologies, including environmental management. Identity groups: civil society organizations regularly access water resource information and have the capacity to analyze it and use it as a basis for advocacy.
Individuals and organizations have the ability to communicate and access social networks for information, finances, and capacities. They mobilize the finances required to shift livelihoods or change the design of structures as climate conditions make existing ones unviable. They convert existing assets to new uses — in coastal areas, for example, farms might be converted to fish farms.	Urban planning is effective and is based on long-term scenarios regarding the potential implications of climate change. Plans are regularly updated with involvement from a broad spectrum of actors in government, the private sector, and identity groups. Academic research is supported and is evaluated in planning decisions. Organizations exist that have a basic mandate to provide high-quality information on an on-going basis to all actors. Groups are not marginalized in ways that inhibit their ability to learn.

ways. Institutions in social science are the target of much analysis in economics and political science (see, in particular, North 1990 and Ostrom 1990 — both Nobel prize winners for their work).

The word "institutions" also is sometimes used in everyday speech to refer to organizations structured to focus on a particular purpose (e.g., financial institutions, educational institutions). This leads to some confusion. In this text, we use "institutions" to mean the rules of the game, or the mechanisms to enforce those rules, while organizations, groups, and individuals are the players.

The institutional characteristics that contribute to resilience and adaptive capacity in urban areas are poorly understood. What is clear, however, is that institutional relationships are central factors that influence the resilience of systems and agents in many ways. Whether or not systems can be managed or shaped in a flexible manner as conditions change, whether or not groups of agents can organize in innovative ways that respond to needs as they emerge, how societies respond both during and after extreme events — all these are shaped by institutions. Similarly, the balance between agents — individualist (market), identity group (advocacy, NGO, etc.), and hierarchical (government) — depends heavily on institutions. Whether or not that balance encourages diversity, innovation, responsiveness, and flexibility or contributes to rigidity will have major implications for the resilience and adaptive capacity of urban areas.

In cities, three key institutions that shape urban systems are land tenure, markets, and rights of organization and standing. Land tenure is the system by which predictable rights over the use of land are defined, formalized, valued, transferred, or exchanged, which can lead to changes in ownership, land use, or to the construction of structures, industrial facilities, or infrastructure on the land. Markets for land, goods, services, and labor are, in most cities, closely linked from the local to the regional, national, and global scales. The ways that markets work — what can be traded, what is valued, what kind of information is available to buyers and sellers, etc. — help shape the dynamism, economic potential, and innovation of cities. Rights of organization and standing determine the array and balance of actors present and their relationship to key systems. Urban areas that depend on upstream sources of water supply may, for example, lack the authority to have any say in how those upstream sources are managed. Similarly, poor communities residing in exposed flood plains often lack the official registration or tenure required to formally engage with government for flood control or compensation purposes. In some regions, institutional frameworks enable local communities to create collective organizations with the authority to charge taxes or fees to members to achieve specific objectives (such as delivering water, regulating a groundwater reservoir, or supporting a local disaster response unit). In other regions, such institutional frameworks do not exist. Other forms of institutions also play major roles in shaping urban systems. Codes and professional standards, for example, play a heavy role in guiding design decisions for virtually all urban infrastructure systems and can have important consequences for urban areas. As the Global Report on Human Settlements points out, "in terms of urban planning, failure to adjust zoning and building codes and standards with an eye to the future may limit the prospects of infrastructure adaptation and place lives and assets at risk" (UN-HABITAT 2011).

Institutions are central to the Urban Climate Resilience Planning Framework because they condition the interactions of the agents in the system. Institutions of property, of social inclusion or marginalization, and of social welfare influence the vulnerability of particular communities, as do institutions that govern rights of organization, the legal or informally recognized "standing" to engage (i.e., who is seen as a legitimate "stakeholder"), and the standards to which systems are designed and managed (as with building and engineering codes). Access to key systems, resources, services, utilities, and opportunities in cities of the developing world is contingent on whether these are provided as subsidized services or on a market basis.

The role of institutions is particularly important in strengthening adaptive capacities of agents. What are the expectations and norms surrounding disaster management, for example? Do state organizations provide first response, or are local organizations equipped and trained to do so? While disaster response is undertaken by organizations, the training, skills transfer, financing, and self-reproducing aspects of community-based disaster risk management are all based on institutions of decentralization, shared norms, and collective responsibility for local emergency response. As another example, the migration of farm laborers in times of drought depends on institutional structures that organize the labor market, through processes of communication, recruitment, transport, and remittances. Those institutions facilitate labor migration as an adaptive response.

Institutional reforms can play a big role in resilience. For example, planning decisions such as slum clearance and resettlement may increase or decrease climate vulnerability depending on the institutions governing rights, compensation, participatory planning and decision making associated with the resettlement process. With inadequate consultation or participation, minimal rights, and only token compensation, resettlement could increase impoverishment and vulnerability, but under different institutional conditions, the outcomes could be significantly different.

Similarly, market-oriented innovations to increase resilience may run up against institutional barriers. Innovative building techniques often exist that would respond to changes in climate and would be popular with consumers. Market actors, however, are often constrained in their ability to deploy such techniques due to codes, insurance regulations, planning conventions, and professional standards. This has, for example, been a major factor limiting the spread of straw-bale construction in the United States, a "climate-friendly" building technique for residential housing.

Social marginalization — the process whereby some social groups are excluded either formally or informally from access to critical urban services — is also a function of institutions. An example of an institution that fosters marginalization is the requirement for legal registration of residence, which can make it impossible for migrants to gain access to social benefits or to government compensation for climate hazards such as flood damage. Social norms that view women as unsuited for formal responsibilities (such as political office, property ownership, voting in public meetings) are also institutions that foster marginalization and increase women's vulnerability. This is also often the case with ethnic or caste distinctions.

From studies of economic behavior, collective action, social marginalization, and decision making, the key aspects of institutions linking agents and systems that need to be considered in assessing whether they enhance or constrain resilience appear to be those outlined below. The key issues are summarized, and then explained in further detail with examples:

Rights and entitlements

Institutions that differentially constrain rights and entitlements (i.e., the practical and operational abilities of agents, as individuals or groups, to organize, to exercise control over assets [tenure], and to access to systems or services) for different groups may increase the vulnerability of groups that are disadvantaged, and thus constrain resilience. Examples of institutions that can limit rights and entitlements, either legally or through custom and practice, include the village panchayat in India, the concept of the extended family as a core socioeconomic unit, as well as structures such as the quasi-governmental "districts" that manage many systems and deliver services in the United States (Thomson 2000).

Decision-making processes

Decision-making processes that are transparent, accountable, representative, and fair enhance resilience. This is particularly true with respect to the decision-making processes that govern urban systems management and agent access to those systems. It also includes recognition of the right of different groups to engage as legitimate participants in decision-making processes. Dispute resolution mechanisms should also exist to manage inevitable conflicts through a process that all parties consider fair.

Information flows

Key information for planning, making judgments about risk and vulnerability, and for assessing adaptation options enhances resilience when it is available to agents who have to make these decisions (including households). In the absence of reliable or sufficient information, or if information is available to some groups but not others, vulnerability will increase.

Processes for learning and change

Institutions that facilitate, rather than hinder, the generation, exchange, and application of new knowledge enhance resilience. Many institutions (such as building or other professional codes) are designed to resist change — to preserve and maintain existing structures, authority, social conventions, and ways of doing things. Current practices are generally less risky because they are known to work, but resilience requires innovation in order to reduce risk in the face of change.

Rights and entitlements come in many forms, from tenure rights over land and habitation to rights to access water, and even to cultural norms of reciprocity that constrain actions and to the right to organize in different ways and have that recognized as "legitimate." The state often universally assures certain kinds of basic rights, such as rights to protection and security, education, and voting rights, or access to drinking water. However, in some contexts even these rights may not be available equally to all. And other rights, such as rights of social organization, land tenure and rights of occupancy, and access to health care or food, may be limited or depend on socioeconomic privileges or ability to pay.

Consistently differentiated rights or access to services between different identifiable social groups creates marginalization. All societies have some forms of marginalization (especially in relation to income and social status). The question for determining relative levels of climate resilience or vulnerability is whether socially marginal groups are at higher risk to climate impacts, for example due to inadequate shelter, inability to access credit, inability to obtain official registration or land title due mainly to their ethnic, gender, or social status. In general, marginalized groups lack access to critical urban systems or capacities that therefore render them more vulnerable. They may lack legal land tenure that would enable them to claim a connection to the public water distribution system or the electrical grid, for example. This would then tend to put them at greater risk — especially as a result of extreme climate events — for water quality problems or interruptions to energy supplies. Institutional solutions would be to ensure that legal access to critical services does not discriminate by social or gender conditions, and that economic barriers to access can be countered by special subsidies or support programs (such as lifeline rates for water or electricity service).

An important right that can enhance resilience is that of groups to self-organize in order to respond to climate hazards (e.g., to improve local drainage, or to deliver disaster preparedness training). The ability of self-organizing groups to assess fees or levies on members in order to undertake investments in service delivery, maintenance, or resilience investments may be constrained by institutional limitations or by limits on the organization of civil society.

Decision-making rules and procedures are crucial institutional features that affect how agents and systems interact. What are the decision-making mechanisms in key organizations dealing with urban systems? Key criteria include transparency, representation, accountability, and fairness. Those agents most affected by decisions (e.g., infrastructure design or location, urban land development, public health services, etc.) should be able to see how the decision was made and that the process followed the norms of formal or customary legality. They should be able to have their interests represented in the decision-making process. Mechanisms for holding decision makers accountable ensure that all participants recognize the process as legitimate. Institutions like the judiciary are set up to deal with many of these issues. The absence of these mechanisms will lead to intensified conflicts, more exclusions, and the likely result that those excluded from access to resources and assets will have increased vulnerability to climate impacts.

Institutions such as the judiciary, or customary law, serve important roles in ensuring accountability and fairness in decision processes. But not all urban residents have access to, or can work with these institutions. In many cases, representation of interests in decision making is one-sided, leading to asymmetrical benefits and even further impoverishment of disadvantaged groups. In the absence of institutions that foster accountability, these groups become more vulnerable.

Agents need access to information in order to make informed decisions and take actions themselves. But information access is often constrained, either for strategic reasons (e.g., to give an advantage to certain actors) or due to inattention and lack of effective mechanisms for sharing information with agents who need it. As discussed in chapter 3, for example, governments often restrict the use of emerging scientific information on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climate change due to a variety of technical and political considerations. In addition, even when information is available, agents often have limited ability to understand and use it effectively. This is particularly the case with technical information, such as that on climate change, where uncertainties about future conditions are as important "data" as specific projected conditions. Thus, effective mechanisms for communicating such information to agents and translating it into formats they understand are an important aspect of "access."

Urban vulnerability is high where systems are fragile, agents are marginalized, institutions confine rather than enable responses, and exposure to climate change is high. The institutional factors that contribute to resilience are those that ensure that underlying systems are resilient, that agents have access to the benefits from systems, and that agents are both enabled and guided so that actions that may be rational at an individual or organizational level.

Resilience increases as agents' capacity for learning increases, as described above. But institutional structures that foster learning and change are important tools to assist in the achievement of this capacity. Many institutional structures are designed to preserve the status quo rather than to facilitate change. This is sensible when risks of failure are high and current practices are known to work. For example, poor farmers are often decried as "backwards" because they are reluctant to adopt innovative practices. This is a sensible strategy, however, when failure of an unfamiliar crop or farming practice would mean that your family goes hungry. To overcome this risk aversion would require institutions to transfer knowledge and backstop risks (e.g., farmer-to-farmer extension and coaching practices, insurance programs).

Similarly, in an urban context, public and private support for applied research, for publication and presentation of new evidence, and for facilitating critical assessment of new knowledge and its implications all foster resilience by speeding the introduction of effective innovation. Processes that test and evaluate new low-cost storm- or disaster-proof housing construction techniques, and that then speed modifications to building codes or standards if they are proven effective are one example of such innovation. In the absence of these types of institutions, professional norms and legislated codes or standards typically act as barriers to innovative practices. Institutions capable of fostering evolutionary change, and of adapting to new information themselves, should be encouraged.[3]

Table 2.4 provides illustrative examples from the water sector, but analysis of other critical systems would follow analogous lines. Because the range of potentially relevant institutions is often large, analysis should focus strategically on: 1) institutions that are related to critical or fragile systems and the role of different agencies in developing, managing, or operating those systems; 2) rights of access to the services from these systems and decision processes for their management; 3) frameworks for dispute resolution that specifically respond to the nature of the system and the nature of agents, 4) information needed by decision-making agents (managers and users) in order to adapt to changing climate hazards; and 5) the processes and incentives to generate and use new knowledge to improve the effectiveness of other institutions and of system-agent interactions.

Stepping back to view institutions in the larger perspective of urban resilience to climate change, urban vulnerability is high where systems are fragile, agents are marginalized, institutions confine rather than enable responses, and exposure to climate change is high. The institutional factors that contribute to resilience, then, are those that ensure that underlying systems are resilient, that agents have access to the benefits from systems, and that agents are both enabled (so that they can shift strategies and build system resilience) and guided so that actions that may be rational at an individual or organizational level. This includes ensuring that specific actions or interventions are not maladaptive and do not undermine the resilience of systems or marginalize other agents. As a result, analyzing institutions for their contributions to resilience should focus on how they affect the specific characteristics of systems and agents that have already been identified as contributing to resilience and adaptive capacity. These include in the case of urban systems: flexibility and diversity, redundancy and modularity, and safe failure; and in the case of agents: responsiveness, resourcefulness, and the ability to learn. Rights and entitlements, decision-making processes, access to and the ability to use information, and processes for learning and change are core institutional factors that, in most contexts, will influence relationships among agents and the ability of agents to act and manage or change systems.

TABLE 2.4 | Characteristics of Institutions that Foster Resilience

INSTITUTIONAL CHARACTERISITCS	RIGHTS AND ENTITLEMENTS
PERFORMANCE DESCRIPTION	Structures of rights and entitlements do not systematically exclude specific groups from access to critical systems or capacities. They enable groups to form and act, and foster access to basic resources.
EXAMPLES (FOR WATER SUPPLY)	Water supply systems and investments are intended to make potable water widely available to all social groups in the city. Lifeline tariff structures ensure it is affordable even to the poor. Community groups may also have the authority to establish water management organizations and, in coordination with other actors, raise funds and implement management activities. They also have the right to access information and the standing to engage in water management debates. Private sector organizations have clarity regarding ownership of water related assets, the right of access to information, and standing to participate with other agents in water related initiatives.
OTHER EXAMPLES	Standardized structures and processes that enable groups to form organizations (public sector, private sector, community, etc.), raise funds and undertake activities in relation to emerging needs. The “district” model of the U.S. is an example.

DECISION MAKING	INFORMATION	PROCESSES FOR LEARNING AND CHANGE
Decision-making processes related to key urban systems are transparent, representative, and accountable. Diverse stakeholders have a way to provide input to decisions. Dispute resolution processes are accessible and fair.	Agents have access to relevant information in order to determine effective actions and to make strategic choices for adaptation.	Institutions encourage inquiry, application of evidence, critical assessment, and application of new knowledge.
Water allocation process follows clear rules and procedures. Water supply and distribution investments reflect the interests of all urban residents. Water supply company or public utility is accountable to legitimate government agencies and can be sanctioned for unjustified actions. Formal or informal systems are in place to mediate water related disputes as they emerge. This includes disputes between agencies of the government, between the government and the private sector and between individual users. Because water issues often involve highly technical issues, some regions have established specialized “water courts” or mediation mechanisms.	Government agencies have access to and the authority to use current global scientific information in planning water supply. Basic standards regarding water delivery norms (quantity, quality, reliability, affordability) are set. Standards are also set with respect to the protection and maintenance of the environmental systems that deliver water services. Basic principles regarding the right to organize and the rights of different groups to water and to engage in the inevitably political debates over water management are clear.	Water utility or government works with university to support applied research into groundwater recharge, or salinization rates, and impacts on water supply. They have the authority to work with civil society and the private sector to develop and test innovative approaches to managing water resources to ensure sustainability under changing climate conditions. Costs of alternative supply options (reservoirs, pipelines, demand management) are widely shared and publicly discussed.
Mechanisms for providing public input to decisions (hearings, meetings, local consultations). Specialized structures are in place for transparent resolution of disputes in relation to key systems and the agents that have an interest in their management.	Basic principles regarding access to public systems. Standards in many arenas (environmental protection, construction, etc.). Norms on freedom of information.	Recurrent processes that allow changes in codes and regulations as climate conditions change.

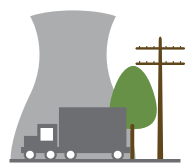
FIGURE 2.5 | Core Elements of the UCRPF

EXPOSURE TO CLIMATE CHANGE

Exposure to climate change encompasses the direct, indirect, and incremental pathways through which systems and agents are exposed to impacts from climate change.

*this icon is also used to signify climate change throughout this report

SYSTEMS



Systems are the foundations that enable people to adjust as conditions change. *Characteristics* of systems make them resilient and accessible.

AGENTS

The *capacities* of agents (individuals, households, communities, businesses, government organizations, NGOs, etc.) that help them adjust as conditions change, along with the *agency model* that explains the motivations of different groups.

INSTITUTIONS

The rules and social conventions that guide interactions of agents with each other and access to systems.

The resilience of systems depends on their flexibility, diversity, redundancy, modularity, and safe failure characteristics. Similarly, the ability of agents to respond and adapt depends on their responsiveness, resourcefulness (including the ability to access resources), and capacity to learn. These factors are summarized in Figure 2.6.

Diagnosing vulnerabilities and identifying points of entry for building resilience requires an understanding of the relationships between urban systems and agents as mediated by institutions, along with the manner in which these are exposed to climate change. The diagnostic process is illustrated in the left loop of the Integrated Framework for Urban Climate Resilience Planning diagram (Figure 2.7). It requires an iterative shared learning process in which the characteristics of systems, agents, and institutions are integrated to develop a conceptually grounded but practical set of insights. Ideally, this would be composed of systematic analyses that focus on each of the core components (critical systems, agents, institutions, and climate exposure) and on the factors that are identified in the previous sections of this chapter as contributing to resilience.

The emphasis in this analysis should not be on comprehensiveness but on relevance. Which systems are most fragile and why? What agents and organizations are directly linked to these systems? Which agents are most vulnerable or marginalized? What are the institutions supporting or constraining the actions of agents in vulnerable systems or marginalized social situations? The framework serves as a guide to the factors that should be integrated into the analysis. However, it is not a directive analytical tool: it does not specify the exact nature of these relationships, which vary in every case. Nor does it specify the type of analysis that should be done. By understanding the logic of the exercise, practitioners can apply analytical tools with which they are already familiar (e.g., geographic information systems to analyze flood plain inundation under various sea level rise or hydrology scenarios; causal chain analysis of systems failure; gender analysis of vulnerability to specific threats, etc.).

The diagnosis that results from exploring vulnerability in this way from multiple perspectives can then be translated into a practical basis for action by linking it with a strategic planning process in order to identify specific measures that build resilience. This process is illustrated in the right loop of Figure 2.7. Bringing together the analysis of vulnerability with a strategic process for building resilience results in an integrated framework for urban climate change resilience planning. As the diagram illustrates, this process is iterative: it consists of an initial cycle of analysis focused on systems, agents, institutions, and exposure, which contributes first to shared learning and then feeds into a cycle of resilience planning and implementation. Results from this cycle of planning and intervention then provide a basis for subsequent cycles of shared learning in which understandings of vulnerability and resilience improve and are fed into planning and implementation.

A key element of the Urban Climate Resilience Planning Framework (UCRPF) is that diagnostic and intervention cycles are linked and driven through processes of shared learning. Shared learning dialogues, developed through ISET's experience over a number of years, primarily in South Asia, are key tools for building understanding of new and complex information (such as climate change), and for sharing diverse perspectives on relevant information in order to reach strategic decisions. Arup has employed similar approaches to working with groups of cities through a series of multi-stakeholder participatory workshops informed by analytical inputs. In the context of the framework, these processes are critical to build engagement and commitment among diverse stakeholders in multiple sectors, from different technical disciplines, and to combine scientific and technical knowledge with local experience. Shared learning processes, as with the other processes in the framework, are intended to be iterative. Diverse groups of stakeholders meet repeatedly to share and assess information addressing climate impacts, systems fragility, agent capacities, and institutional weaknesses. The goal is to develop consensus about priority interventions for effective ways to build resilience. The experience of applying shared learning dialogues in ACCCRN is discussed more fully in chapter 4 of this publication.

A key element of the UCRPF is that diagnostic and intervention cycles are linked and driven through processes of shared learning. SLDs are key tools for building understanding of new and complex information and for sharing diverse perspectives on relevant information in order to reach strategic decisions.

The other chapters in this volume present more detailed information on vulnerability assessment and resilience planning practices as applied in the ACCCRN program. They demonstrate how, in each of the ACCCRN cities, multi-stakeholder groups worked together to share existing knowledge and to develop new information through vulnerability assessments, sector studies, pilot interventions, and resilience planning. The process of implementing resilience interventions in ACCCRN is just getting underway in mid-2011, but is intended to be iterative, as shown in the framework diagram. It will feed back to revised assessments of vulnerability and to shared learning on the effectiveness of early interventions in order to design and develop new ones.

In sum, the UCRPF advances understanding of what resilience means in an urban context. This responds to an important gap in global discourse on climate change, in which the term resilience is increasingly used to imply a strategic approach for responding to climate change impacts, but is not defined in a practical or operational sense. We believe this new framework offers a practical alternative to a linear "predict and prevent" strategy that is burdened in most cases by weak data and scientific uncertainty. The UCRPF advances both conceptual clarity and applied understanding of resilience in an urban context by examining urban vulnerability through the lenses of systems, agents, and institutions, offering specific points of entry for building resilience that a wide range of local organizations can easily incorporate in their work.

In addition, the UCRPF recognizes that resilient outcomes depend on ongoing processes. Resilience cannot be achieved through a one-time linear approach based on prediction and prevention of specific impacts. Instead resilient outcomes are the product of ongoing processes that build capacities and strengthen knowledge through shared learning. Resilient outcomes will ultimately only be achieved through processes that progressively strengthen urban systems, institutions, and agent capacities.

The framework points to a diagnostic process that integrates vulnerability assessment and shared learning to build engagement and capacity. Diagnoses of vulnerability lead to the identification of specific interventions to address the fragility of systems, the capacity of agents and the weaknesses of key institutions. Cycles of planning and implementation built around mechanisms for monitoring and shared learning ensure broad access to information for multiple agents and build their capacity for independent action. Investments in studies to gather knowledge on climate impacts, on key vulnerabilities, and on monitoring the effectiveness of interventions all help foster evidence-based decision making and innovation. The application of the concepts and planning framework itself will build many of the capacities and institutional features that contribute to urban climate resilience.

FIGURE 2.6 | **System Resilience and Agent Capacity**

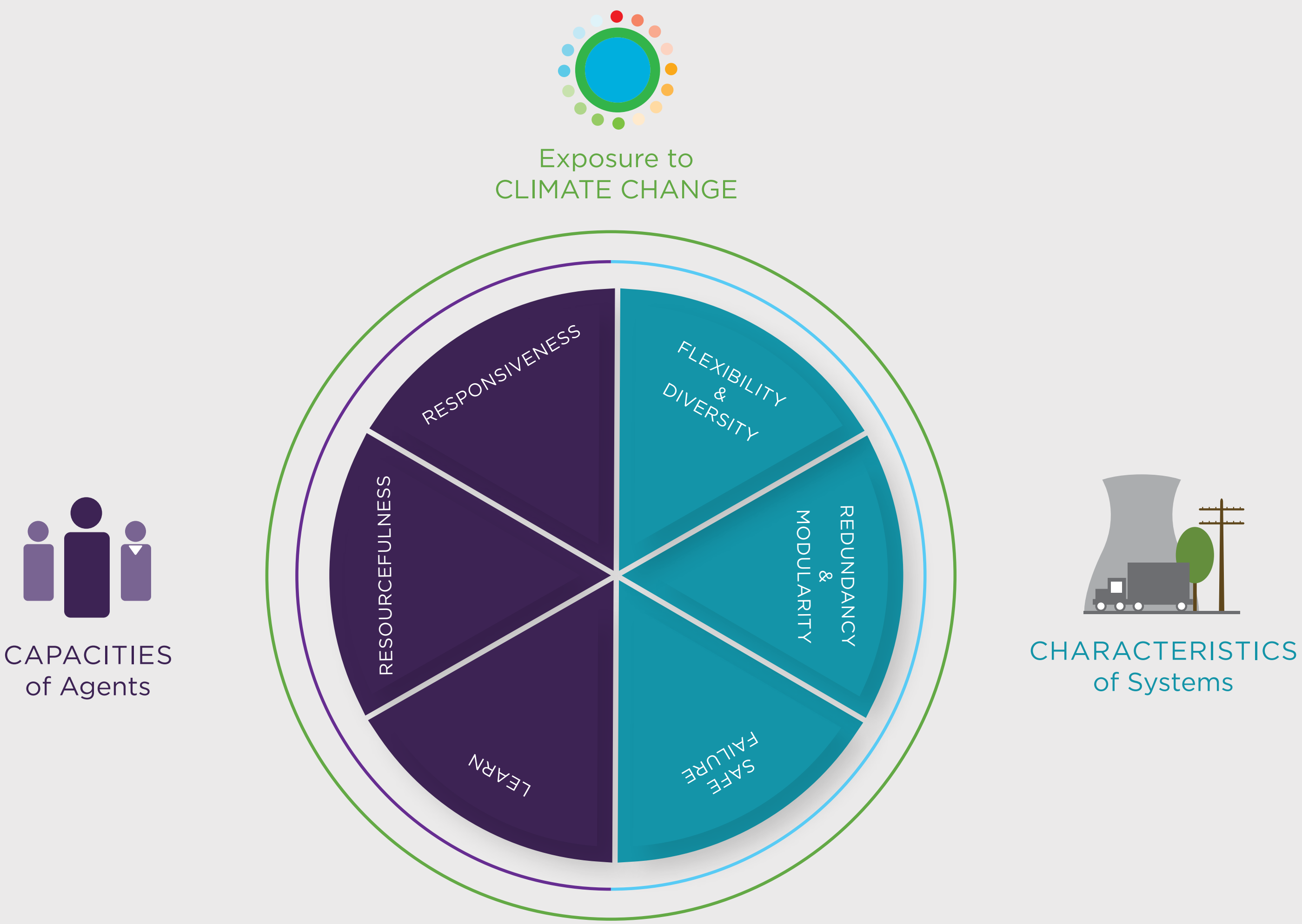
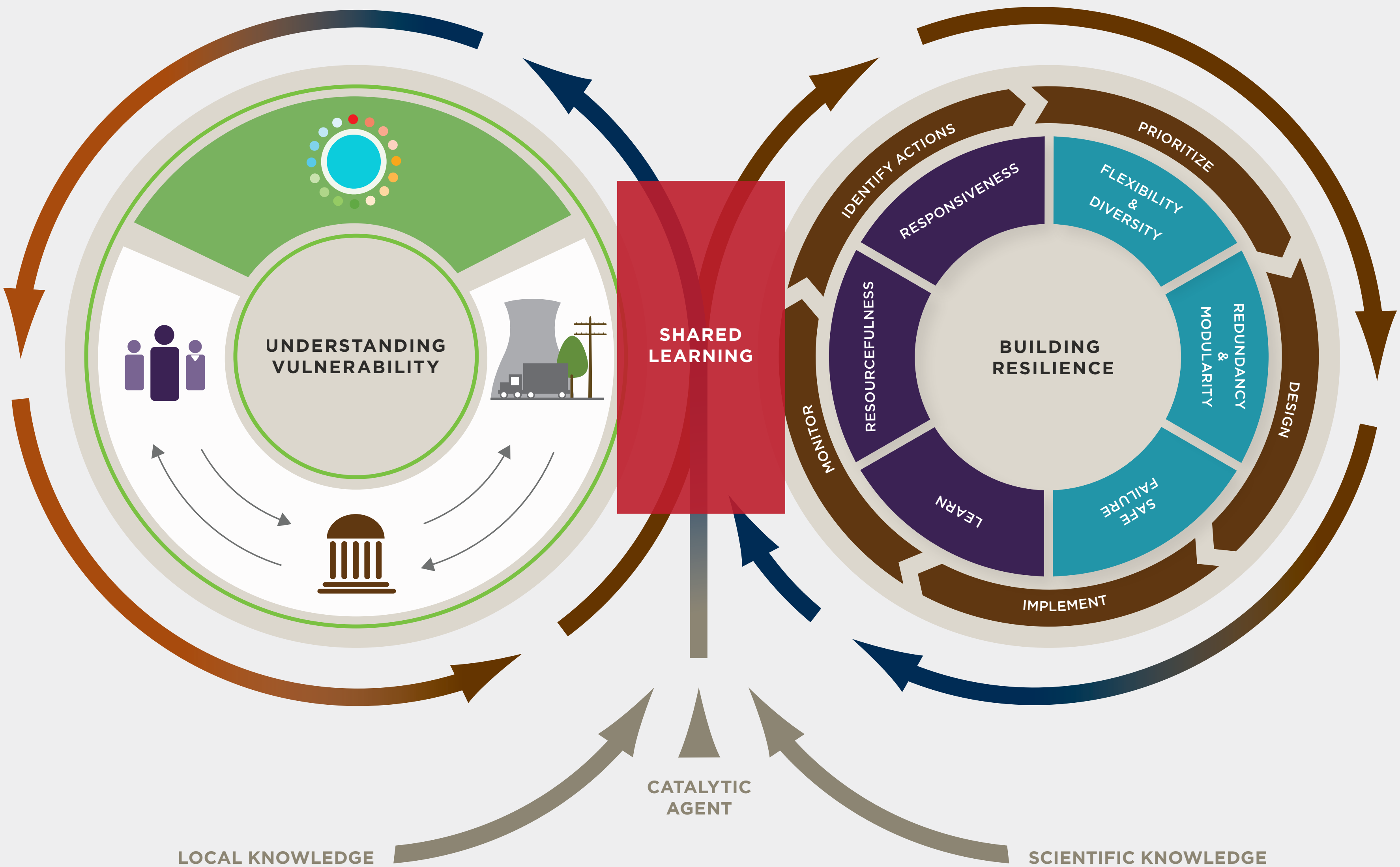


FIGURE 2.7 | The Urban Climate Resilience Planning Framework



ENDNOTES

[1] John Holland, a leading researcher in the growing field has coined the following definition for them:

> *A Complex Adaptive System (CAS) is a dynamic network of many agents (which may represent cells, species, individuals, firms, nations) acting in parallel, constantly acting and reacting to what the other agents are doing. The control of a CAS tends to be highly dispersed and decentralized. If there is to be any coherent behavior in the system, it has to arise from competition and cooperation among the agents themselves. The overall behavior of the system is the result of a huge number of decisions made every moment by many individual agents (Waldrop, M. M. 1994).*

[2] Evaluating whether or not marginal groups are at higher risk to climate impacts is important to do on a case-by-case basis. While higher levels of risk are logically correlated with social marginality, this is not always the case. In earthquake areas, for example, wealthy populations may be at higher risk because they reside in fragile high-rise buildings constructed of brick and cement while more marginalized populations use traditional building materials such as grass, wood and mud. Similarly, in the climate case, relatively wealthy urban residents may be at more risk if they reside in beautiful (but exposed) coastal areas. Similarly, if global food systems are disrupted wealthy apartment dwellers may be more vulnerable than marginalized groups living in flood plains or peri-urban areas where some level of agriculture and local production is still possible.

[3] For a discussion of self-adjusting or adaptive policies, using analogous processes, see Swanson and Bhadwal 2009.

AUTHOR'S NOTE

Some of the observations in this chapter come from questionnaires distributed to all ACCCRN partners (see the section in this chapter called "Climate Information in ACCCRN: Observations — Hindsight is 20/20), in addition to notes from the shared learning dialogues/workshops, correspondence, and my (and other ISET staff's) experiences of working with various partners. All the responses to the questionnaires are held in strictest confidence and sources of information are concealed. This is done to protect the honesty, integrity, and ability to continue to speak freely of those who responded to my inquiries. Only my opinions and observations will be directly acknowledged in this report. Additionally, the information in this report is contextualized by my observations and experiences as a climate scientist and in interacting with other climate scientists concerned with effective information communication.

CHAPTER 3

ONLY DEATH IS CERTAIN, YET YOU STILL GET OUT OF BED IN THE MORNING

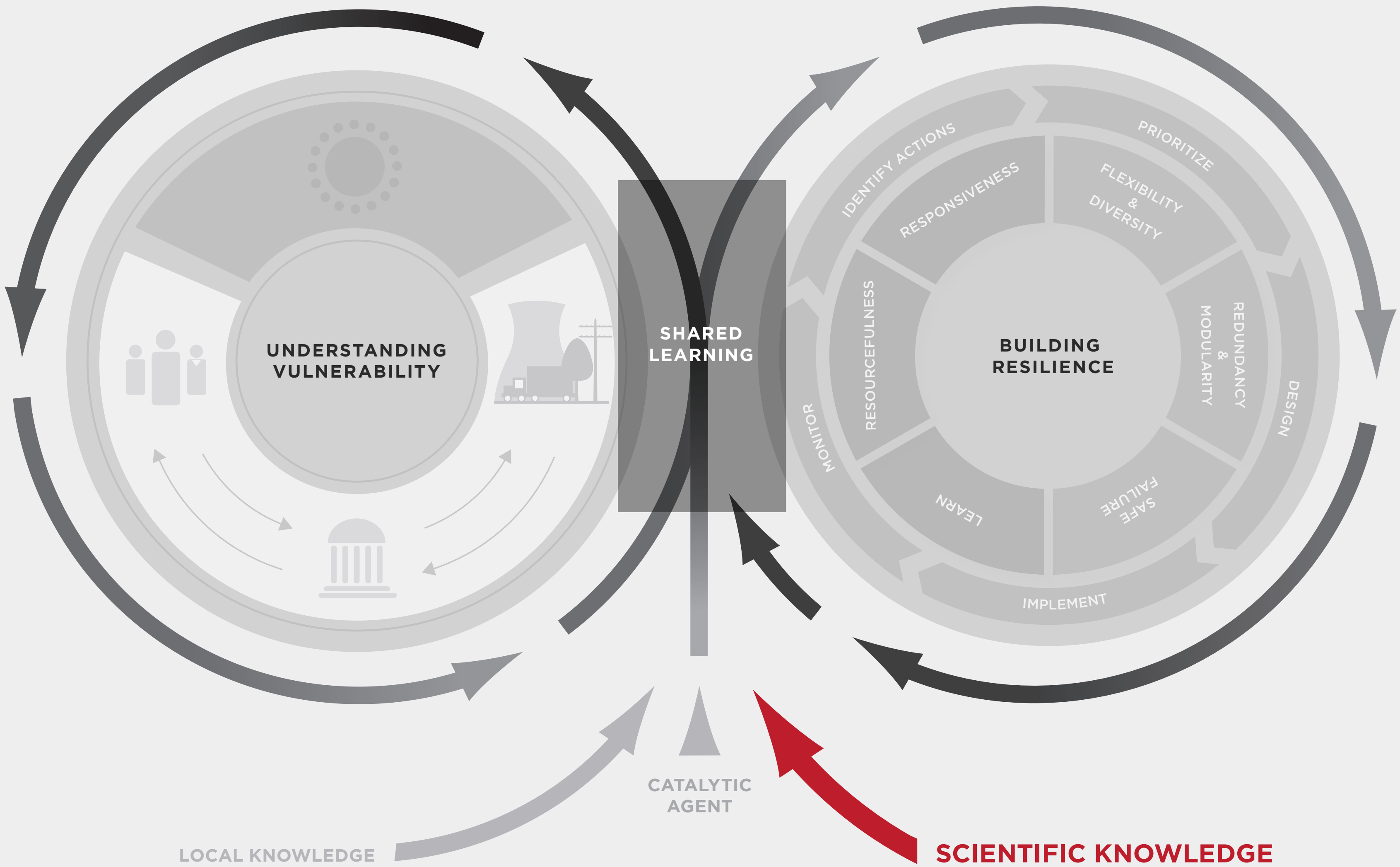
Communicating Climate Information in Adaptation and Resilience Practice

Sarah Opitz-Stapleton

with Greg Guibert, Karen MacClune, and Stephen Tyler

FIGURE 3.1 | The Urban Climate Resilience Planning Framework: Scientific Knowledge

The diagram below illustrates the various elements of resilience planning. This chapter focuses on the right arrow that enters the double loop, labeled “scientific knowledge.” Climate information — its availability, its quality, and the level of uncertainty — strongly shapes urban resilience processes. Resilience building can be improved by incorporating reliable climate information and acknowledging the uncertainty in that information. The absence of good climate information, however, does not prevent the development of robust resilience processes.



INTRODUCTION

This chapter reports on the challenges of communicating climate information in adaptation and resilience programs. The observations and reflections in this chapter do not come from the ACCCRN program alone. They are gleaned from a variety of programs in other countries and contexts, interactions with climate scientists and non-climate scientists, and reviews of the processes by which climate information has entered policy discourses, from the local to the global scale.

This chapter debunks the following myths about climate information:

- The more information about historical and future climate trends the better when making adaptation decisions.
- Decision makers cannot act unless uncertainty is low.
- Climate science and the information it produces are apolitical, objective, and above ethical discourse.
- It is the responsibility of the decision maker to know how to access, interpret, and use climate information.
- Climate information is readily available and pertinent to the desired scales and timeframes for adaptation decision making.
- Decision making on development strategies, infrastructure, and investment readily integrates and benefits from physical science information.

The chapter then discusses common challenges in accessing, interpreting, and utilizing climate information in general and then more specifically in each ACCCRN country. Finally, the chapter presents new directions for effective communication and use of climate information and provides some online resources for accessing reliable climate information.

GENERAL CONFUSION AND DISCOMFORT ABOUT CLIMATE INFORMATION

INTRODUCTION

Large-scale adaptation and resilience planning projects have only recently begun to emerge as global climate discourses begin to acknowledge the need for adaptation alongside mitigation. These projects have proven daunting, not least because some of the basic questions surrounding climate change and adaptation have yet to be answered with any real consensus among either academics or practitioners. These questions, addressed in other chapters in this report, include:

- What is climate resilience?
- How do we assess when climate resilience is needed and when it is occurring?
- What distinguishes development that simply incorporates principles of disaster risk reduction and sustainable and ethical ecological management from actions, policies, or interventions that truly support climate resilience? Is there a continuum of climate resilience planning?

Buried deeper still in these questions are issues concerning the nature of climate change and what information various decision makers need to conceptualize and frame their specific approach to dealing with change. Such questions include:

- Where can one find location-specific climate projections?
- By what criteria does one judge the reliability of either historical or future climate information?
- What are the assumptions and uncertainty associated with particular sets of data or information?
- How can analysts and decision makers deal with these uncertainties?
- What questions do decision makers and adaptation/development researchers need to ask climate scientists?
- What questions do climate scientists need to ask decision makers and adaptation planners?

In the early 1990s, before the topic of climate change entered wider discourse, it was framed largely as a scientific question, because most of the people concerned with understanding climate change were physical and atmospheric scientists. The prime concerns for most climate scientists were *proving* that climate change was occurring, the extent to which humanity was responsible, and developing "credible" models so that people and governments would pay attention and take action. Understanding climate impacts as an area of research and interest was a distant secondary priority and focused almost exclusively on physical impacts. The ramifications of climate change for people, human systems, and ecosystems were rarely explored, except to justify to policy makers the need to reduce emissions. While mitigation and using climate science to support the need for immediate mitigation understandably remain the highest priorities, changes over the past decade in the atmosphere-land-ocean systems make adaptation critical and unavoidable. Even if emissions were to stop, the changes already set in motion will require adaptation and planning for certain sectors, populations, and regions of the world (Lowe, Gohar et al. 2010).

Until recently, most climate scientists did not think about *communicating* climate information or understanding the role it could and should play in decision making and adaptation planning (personal communication with multiple climate scientists). Even now, only a few do, although a growing number are actively working to try to address the issues associated with communication and information usability.

At the World Climate Conference in 2009, participants affirmed the need for stronger partnerships between climate information producers and users and more user-oriented information. A Global Framework for Climate Services has been proposed to guide climate scientists in making information more usable and accessible. However, much of the framework is still focused on the production of information and model improvement (WCC-3 2009).

This chapter chronicles the process of utilizing climate information in the ACCCRN program, and the perceptions of the participants, through the lens of the wider debates and discourses in the climate science and policy communities. It starts with some of the most common misconceptions about climate information and decision making. Observations from other initiatives suggest that ACCCRN experiences are not unique and that there is a need for more systematic and effective communication of climate information. Because of the increasing role and prevalence of web-based climate products, the chapter concludes with some suggestions of key criteria for credibility and communication and suggest a selection of websites that appear to meet these criteria.

> *"Even if emissions were to stop, the changes already set in motion will require adaptation and planning for certain sectors, populations, and regions of the world"* (Lowe, Gohar et al. 2010).

MYTHS AND OTHER STORIES ABOUT CLIMATE INFORMATION AND DECISION MAKING

There are a number of myths with considerable influence in the process of climate information production, dissemination, and use, only some of which are covered here. Many of the myths associated with information and decision making are not limited to just climate information and its role, but are common in other fields that seek to influence policy, such as disaster risk reduction, economics, or health sciences. The field of policy science has been investigating many of these issues, described on the next page in the context of climate change, and making recommendations for a number of decades (see Sarewitz 1996 or Averill and Dilling et al. 2010), which are sometimes implemented and sometimes ignored.

Lost in Translation and Speaking in Tongues

A key challenge to communicating climate change science and translating information outputs is simply that climate scientists and non-climate scientists speak different languages, even when they are using the same word. Terms such as: forecast, prediction, projection, scenario, and uncertainty have very different meanings to climatologists and meteorologists than they do to lay people. To make matters worse, their meanings are not even consistent among scientists and across disciplines. These inconsistencies in language use muddle the field of climate science and are confusing for non-scientists (Bray and von Storch 2009; Connolley 2007; Klemens 2009; MacCracken 2001; Opitz-Stapleton 2010a). On the next page are climate science definitions of the words that are commonly encountered in accessing climate information, compiled from a variety of sources. These definitions reflect what climate scientists generally mean when using these terms, not what lay people may understand. However, it is important to remember that even meteorologists and climatologists are confused about this terminology and may not use it consistently, which underscores the importance of dialogue among those engaged in adaptation work and climate scientists in order to find common language and understanding before an adaptation project commences.

From the list of climate science definitions, it is apparent that Global Climate Models (GCMs) and Regional Climate Models (RCMs) produce *projections* and not predictions because the models utilize scenarios of potential greenhouse gas (GHG) emissions to see what might happen to the climate system if a particular emission scenario is used. The words "prediction" and "forecast" are most appropriately used with meteorology because weather models are conditioned on current and historical conditions, not on scenarios of possible futures. This is a very important distinction to communicate in climate adaptation work — because it means that real probabilities cannot be assigned to any of the climate model outputs. At best, the likelihood or possibility of a particular projection occurring in the future can be discussed and must be based upon:

1. Knowledge about the model that produced the projection — its assumptions, how well it can replicate key features of the historical climate for the region of interest;

2. Which emission scenarios were used to make the projection(s);

3. If there are multiple projections from multiple models against which to compare and contrast a single projection;

4. The subjective degree of confidence in the projection, based on the decision maker's risk preferences;

5. The types of communication with the climate scientists who produced the information and their credibility; and,

6. The decision maker's understanding of the severity of the implications and impacts of that projection for the area, group of people, or timeframe of interest (Dessai and Hulme et al. 2009; Gay and Estrada 2009; Kinzig and Starrett et al. 2003).

Adding to the confusion of disciplinary differences and lack of common climate terminology is the fact that in many languages, there is no substantial differentiation between the concept of climate, season, and weather. Even many English speakers tend to conflate the concepts. Because the mental mindscape of these cultures does not distinguish between these concepts, often only one word is used interchangeably for talking about them. In Hindi, for example, *mausam* means weather, season, and climate. In Thai, **อากาศ** *(aa-gàat)* signifies both weather and climate, although there about 13 different terms used for season. The cultural constructions — and misunderstandings of cultural

Climate Science Definitions: *What a climate scientist might mean when s/he says…*

PREDICTION A probabilistic statement that something will happen in the future based on what is known today. A prediction depends only on the current and historical conditions of weather and climate, not on any guesses about future concentrations of greenhouse gases. The statement of probability — such as 70 percent chance of rain tomorrow — is a statement of how certain the scientist is that the event will occur.

FORECAST A statement about the "best prediction" based on experience, knowledge of all predictions, and the credibility of the person making the forecast. For example, a TV weather forecaster might say that there is a 70 percent chance of rain tomorrow afternoon by 3pm because 70 percent of the model predictions indicate rain, and a cold front is moving in overnight.

PROJECTION A statement about the possibility or likelihood of something happening, given both the starting conditions (what is happening today) and a certain set of plausible, but not necessarily probable, future conditions. It is an "if this happens, then this might happen" statement. It is very hard to assign objective probabilities to projections because they are conditioned on scenarios of things like population growth or emission rates, which are educated guesses.

SCENARIO An educated guess about possible future conditions based on research. The greenhouse gas (GHG) emissions used in climate models are scenarios of potential future levels of GHGs, based on other scenarios of population growth, economic growth, technology and land use. The GHG scenarios are concerned with long-term trends, not short-term fluctuations.

UNCERTAINTY The inability to say exactly how climate will change in a particular year in the future for a particular location (or even the planet). It does not mean though, that a statement of likelihood cannot be made about an event.

PROBABILITY A statement about the odds of whether an event will happen, based on knowledge of the constraints surrounding that event. For example, what are the odds of rolling a four on a six-sided die? Because there is some knowledge about the constraints and past experience about how the event works, there is some certainty about the event and the odds can be verified.

LIKELIHOOD A subjective assignment of probability to an event for which one has limited knowledge and no ability to verify the results. For example, you have the test results of one student's exam and she received a 98 percent. What are the odds that the median score of the whole class' test results is 75 percent? Because there is no information about the distribution of that class of students' test scores, the odds of the event being one value and not another cannot be verified. All the information that exists is the single draw and limited knowledge or past experience about test score distributions that makes it difficult to definitely describe the constraints around the event or any future event. The key distinction between likelihood and probability is that likelihood can't be completely verified because it is based on very limited knowledge and usually used to describe future events not in the realm of common experience. Possibility and subjective probability are other terms that mean the same as likelihood.

constructions — are real barriers for communicating climate change concepts and information to people, everyone from local government to fishermen and farmers, especially across languages.

"There are Known Unknowns …but there are also Unknown Unknowns"

One of the most frequent requests from decision makers at all levels, both within the ACCCRN program and in other contexts, is for greater accuracy and precision in location- specific climate projections. Yet, because of a lack of high resolution projections for many locations and uncertainty in projections at any scale, it is impossible to predict exactly how much rain is likely to fall in a location in Gorakhpur, India on July 23, 2050 or exactly how the Asian Monsoon System will change in the future, due to the complex land-ocean-atmosphere dynamics that govern that system.

Climate change projections contain multiple sources of uncertainty. Some of the sources are:

1. Projections of human change, growth, and emissions are based on simplified, educated assumptions regarding future energy pathways and development regimes, whose effect on GHG emissions would alter both the foundational design and outcomes of many of the scenarios. Additionally, climate and integrated assessment models poorly incorporate human land use, especially for food, fuel, forestry, and land use change, even though these play significant roles in terrestrial-atmospheric interactions. Politics is another unpredictable factor that will greatly influence national and global energy choices. Understanding and trending all these factors requires constant adjustment and integration into the scenarios used to drive climate models and integrated impact assessment models. The combination of so many assumptive scenarios of changing conditions and drivers of climate change compounds uncertainty throughout the modeling effort.

2. Climate models (or any model, for that matter) are only approximations of reality: some of the climate physics — the interactions between the land, ocean, and atmosphere — are well understood, but others are not. The more we study the climate system, the more we are beginning to realize how complex it actually is and how much we have yet to learn. Even those interactions that are well understood are not necessarily easily represented in models because they are non-linear processes and difficult to describe mathematically. Most interactions are represented by mathematical equations in the models, but due to computational resources or incomplete understanding, other interactions are merely represented by parameters. Finally, the resolution of climate models is too coarse to capture local climate processes at this time. When climate projections are downscaled to the scale of 5 to 10 kilometers, the introduction of error in the model increases through the merging of extremely small-scale processes with large-scale climate processes.

3. Each GCM and RCM models these physical processes in slightly different ways and uses different sets of starting information. This variability is why different models will give different climate projections for the exact same emission scenario. Furthermore, some models are better at replicating the historically observed climate signals in different regions of the world than others. Models that better replicate the mean Asian Monsoon behavior from 1960 to 1990, for example, provide greater subjective confidence that their climate projections are more likely to accurately capture near-term (out to 2050) future conditions than a model that does not replicate the historical and current monsoons. Confounding

What Climate Change Means to Villagers in Gujurat, India

ISET worked with Utthan, a local NGO, on a community-level adaptation project in coastal Gujurat, India. During dialogues with participants, local villagers highlighted three aspects of climate where they believe changes are occurring:

1. Increases in the number of rainy days and in rainfall intensity
2. Longer winter cold season
3. More variability between seasons

The perception of a longer cold season highlights the difficulty in communicating weather and climate information in Hindi. During the 2007 to 2008 winter cold season, a cold spell lasted a little longer than in previous years. Actual weather records for the region, and for much of India, indicate a shortening of the cold season and fewer cold spells over the past few decades. However, due to different conceptions of weather and climate, one recent incident is perceived as an indicator of "climate change" to villagers, even though an individual event can't be construed as climate change in the Western scientific construct.

this simple rule however, is that since no one single model is better at projecting the entire future earth condition than all the others, this could indicate that even models that poorly resolve historical regional climate may ultimately be more accurate in determining long-term future regional projections. Only time will tell. Finally, it is important to remember that no model, ensemble of models, or average of model results, will ever produce a truly accurate *prediction* of the future earth climate system, whether regional, local, or global.

Adaptation processes will be more robust against a variety of potential changes if they consider the trends and ranges of multiple projections rather than a single, specific projection. Many climate scientists are fairly confident that climate change will fall somewhere within the range of the existing model projections, at least up until about 2050. What diminishes confidence in the projections beyond 2050 is lack of knowledge about the evolution of population, technology, policies, and emissions. If these factors continue to increase faster than the A2 SRES scenario, as they have in the past decade, the trends and ranges of the projections could be much worse than currently projected — temperatures will likely be higher, storm intensity and frequency greater, and precipitation much more variable.

Finally, the scenarios used to drive climate models, and the models themselves, are constantly being updated, thereby altering the levels of uncertainty embedded in each model and changing the degree to which scientists have more or less confidence in the results. All model projections that will be included in the next Intergovernmental Panel on Climate Change (IPCC) AR5 assessment of 2013, for example, are being driven by an entirely new set of scenarios known as representative concentration pathways (RCPs). The RCPs will allow a much broader range of emissions, policy, technology, and socioeconomic scenarios to be tested than was allowed using the SRES scenarios. There are some critical differences between the RCPs and the former SRES scenarios (Moss, Babiker et al. 2007; Moss, Edmonds et al. 2010).

FIGURE 3.2 | Mean Projected Annual Temperature Changes For South and Southeast Asia

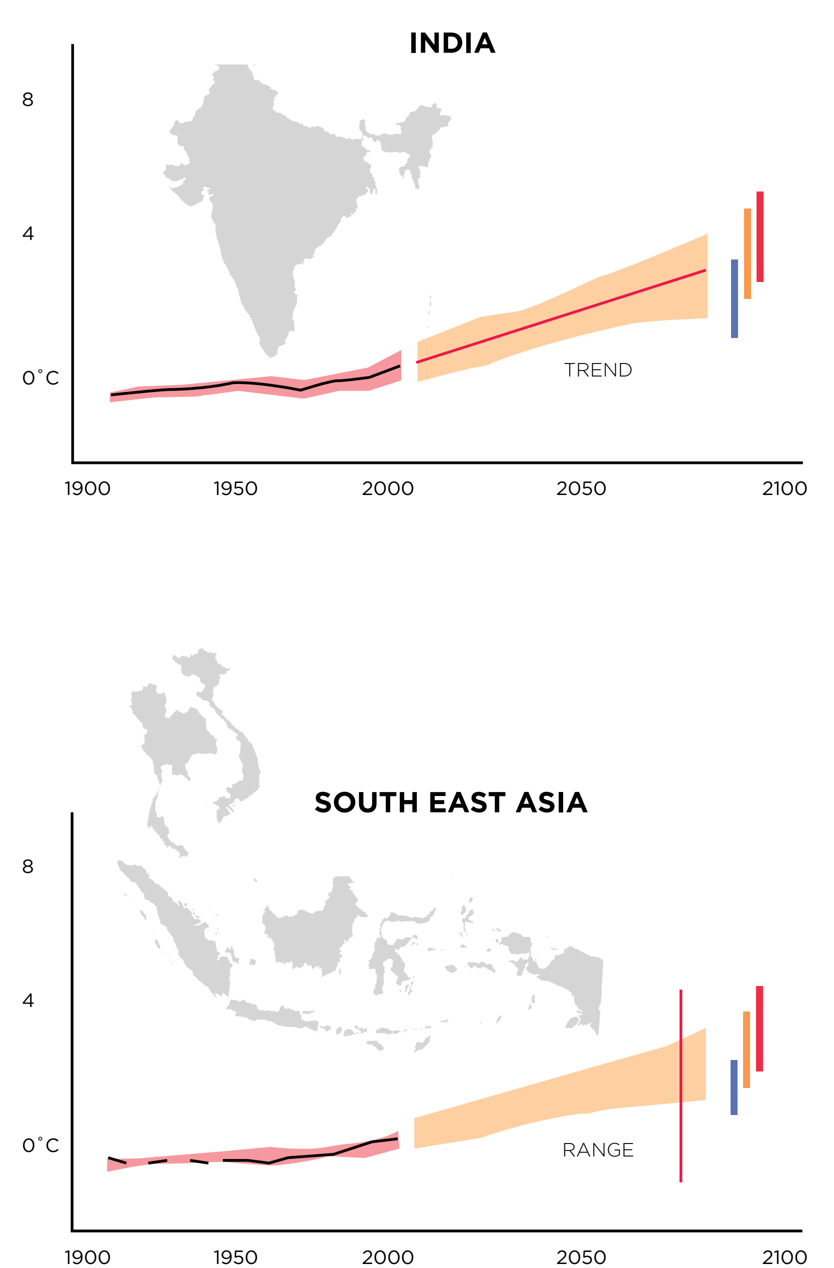


Figure 3.2 represents a compilation of projections from the 20+ GCMs. The colored bars on the right represent the ranges of the projections for the SRES scenarios: blue (B1), orange (A1B), and red (A2) (figure adapted from Christensen, Hewitson et al. 2007, p. 882). GCMs and RCMs are driven by different scenarios of potential greenhouse gas emissions based on scenarios of population growth, energy choices, and economic development. There were four primary emission scenario families — A1, B1, A2, and B2 — used in the third and fourth IPCC assessments.

One difficult aspect of building urban climate resilience is learning to accept and incorporate uncertainty in planning efforts. Vulnerability assessments and resilience planning may benefit from climate information presented in terms of trends, ranges, and model bias.

TREND The direction in which a variable is moving over time. For example, is annual precipitation for Southeast Asia expected to increase by 2030?

RANGE The spread in the compiled projections for a number of different models, for example, of the precipitation in South Asia. The range of the models could be something like -8% to +23% change in annual precipitation by 2030, when compared to the average annual precipitation between 1960 and 1990.

BIAS The amount by which a model over- or underestimates a variable, such as rainfall or temperature, during a model simulation for a historical period when compared with actual observations of the simulated variable. Model biases may or may not carry forward into future projections and require acknowledgement in climate projections.

The RCPs are based on the amount of energy being trapped by the earth's atmosphere (radiative forcing) in order to map a broad range of possible climate outcomes. Any number of different combinations of GHG emissions, policy, technology, and socioeconomic scenarios can be created to lead to the end result of four different energy amounts by 2100. Because of this, climate modelers and integrated assessment/vulnerability modelers will be able to use any combination of scenarios they choose. The ability to test a broad range of plausible pathways will lead to numerous possible future outcomes according to the models. This implies, although it will not be known until many model results are available, that the uncertainty surrounding climate projections and impact assessments is likely to *increase* in the IPCC AR5, not decrease. In response to pressure from policy makers, the climate community will release projections for the near-term (2020–2035) and the long-term (2100–2300). It is hoped that the near-term projections will prove more useful to decision making timeframes. At the same time, by running the projections much farther into the future, climate scientists are allowing policy makers to see when and how mitigation policies might begin impacting the climate system.

The Information Janus: Duelling Expectations between Climate Scientists and Non-Scientists

The confusion in language and interpretation is reflected in climate scientists' and adaptation specialists' expectations of climate information and how it can support adaptation efforts. Expectations for information typically reflect the following sentiments:

More precise and probabilistic information is necessary before adaptation decisions can be made. Because many climate scientists are not actively involved in decision making processes or adaptation research, they often have the perception that adaptation cannot happen until "accurate and precise" climate projections are available. Yet decision making in all circumstances, from personal finances to national trade policy, is fraught with uncertainty. For example, economists cannot exactly predict what next year's gross domestic product (GDP) growth rate will be. They base their projections on observations of current conditions and scenarios of what they think might happen in the next few years, and policy makers partially decide national budgets by using these projections despite their considerable uncertainty. Furthermore, because of uncertainty, most decision makers — from individuals to national-level policy makers — employ judgements when choosing one course of action over another. Because it is not possible to objectively determine the probability of an outcome in many real world situations, many people rely on their knowledge, their perceptions of the opportunities and constraints in their lives, and the information available to them to subjectively determine the tradeoffs between courses of actions. In this sense, many decision makers rely on likelihood to make decisions and not the objective probabilities that many scientists try to provide (Gay and Estrada 2009; Kinzig and Starrett et al. 2003).

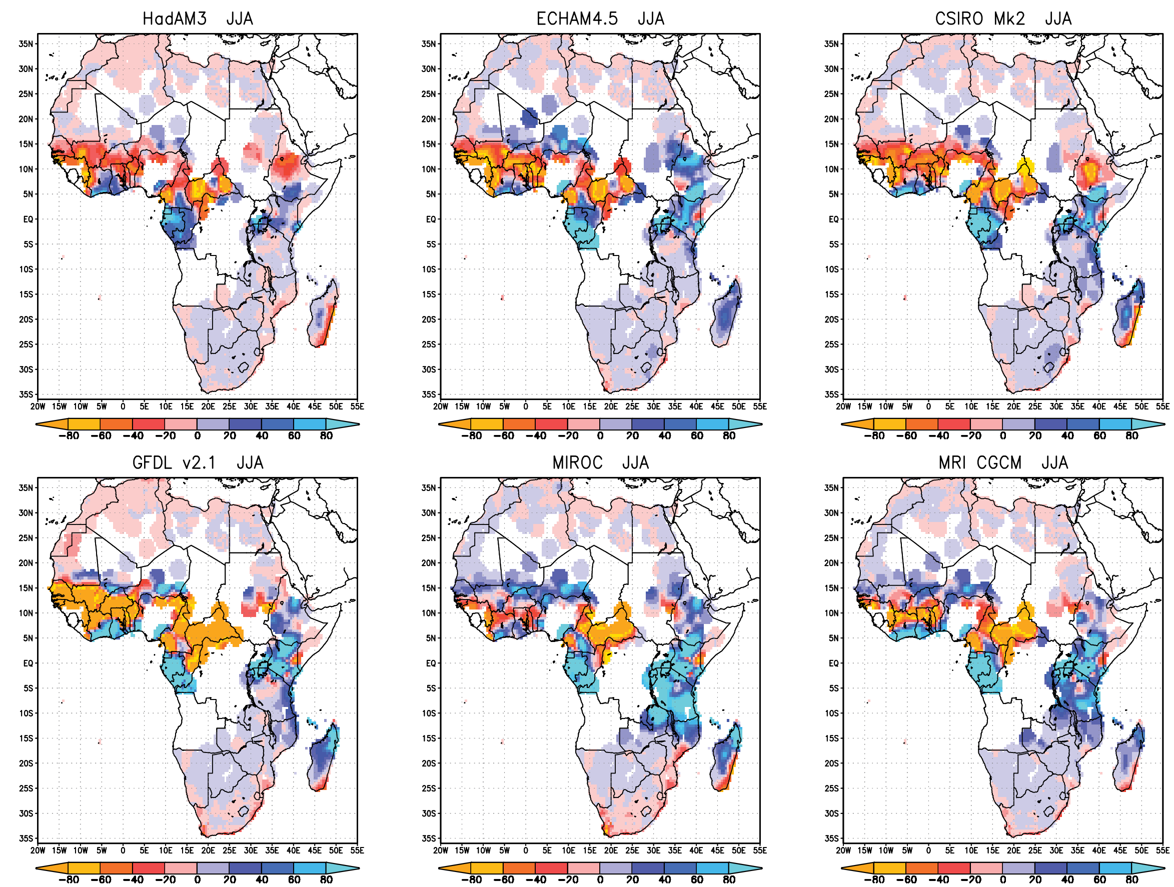
Adaptation interventions and policies have to incorporate both known uncertainty and elements of surprise. Even when the formal odds or probability of a particular climate event or range of events are unknown, decision makers can choose actions that:

- Are robust against a range of possible future circumstances, including both shocks and slow-onset challenges;

- Can be modified as more information becomes available and social, environmental, and climate processes evolve; and

- Rely on redundant systems or institutions that can support and substitute services when another system is disrupted.

FIGURE 3.3 | Six Different Climate Projections



Six different climate projections of changes in mean June-August precipitation for the periods of 2070–2090 (top 3 models) and 2080-2099 (bottom 3 models) compared to 1960-1990 for Africa using the *same* A2 scenario, from 6 *different* GCMs. Each projection is slightly different, highlighting the need for using multiple models to acquire both trends and ranges (Figure from Christensen, Hewitson et al. 2007, p.870).

Some actions, like poverty reduction or ecosystem restoration, serve to reduce both current and future vulnerability, and may require little, if any, climate information to be implemented. Other decisions related to costly infrastructure or land use planning should incorporate what historical and future climate information is available, but should ultimately rely on the principles just discussed to ensure that they meet multiple future challenges beyond climate change.

Decision makers think climate scientists should make information useful to their contexts. Conversely, climate scientists often think decision makers should use the information as it is presented. A predominant myth in many fields of science is that the role of the scientist is merely to provide information and that it is up to the user to know how to interpret it. Yet, the implications of climate change for all aspects of life mean that climate change and impacts information cannot only be communicated through the traditional peer-reviewed journal article forums.

Diverse groups of decision makers without science or technical backgrounds, such as city level partners in ACCCRN, bear the primary responsibility for developing and implementing adaptation strategies. They often want and expect climate scientists to have the information they seek and explain how to use it. Some common threads of conversations with government officials and NGO representatives at the International Council for Local Environmental Initiatives (ICLEI) Resilient Cities 2010 Conference in Bonn, Germany, were that they do not know where to get historical or climate projection information, how to interpret it, how to use it to inform their decision making. They also expressed frustration that climate scientists are not more forthcoming with information or explanations. In general, the development community often has limited familiarity with physical sciences and low science literacy. The current low capacity of many decision makers and adaptation researchers to understand the complexities of climate information directly influences how they articulate their needs and information expectations to climate scientists.

By the same token, many climate scientists have little training or expertise in social, policy, or development sciences. As a result, there is often a mismatch between the geographic and time scales of climate information and decision making needs. Climate scientists have focused on the more distant future (2070-2100) because climate change (in climate science framing) is about changes in long-term trends and variability. Furthermore, it is not yet easy to attribute any particular flood, drought, or storm event to climate change because statistically long enough records do not exist for many locations. Decision and policy timeframes are often more immediate, 10 to 20 years at the longest, and more local than the scales offered in climate projection information. Thus, decision makers tend to discount or minimize information about the distant future or potential impacts (Barsky, Podestá et al. 2008; Marx, Weber et al. 2007) due to their limited ability to influence strategies, either because of short election cycles or external circumstances. With limited political time horizons (5-10 years) in contrast with climate change impacts being discussed on 70 to 80 year frames, it becomes clearer why concerted action on adaptation and mitigation is hard to initiate. Misunderstanding on the part of climate scientists about decision time and geographic scales, as well as decision processes, can lead some scientists to expect that decision makers should bear full responsibility for navigating, interpreting, and using climate products.

The debates among scientists on the differences between applied and basic science, and the roles scientists should serve in influencing policy. Many climate scientists would consider themselves basic scientists with a mission for developing new insights into climate systems and impacts of emissions on weather and climate. However, the implications of climate change are very much applied, and scientists are uncomfortable with translating the results of their research or describing sources of uncertainty in data into language that can be understood (or misunderstood) by a variety of users. Furthermore, scientists who do try to be more vocal in bringing their research results to non-scientific audiences face the risk of being shunned by fellow scientists for being advocates and shattering the illusion of science as an apolitical, objective endeavor. Worse, vocal scientists risk attack by special interest groups who, in hoping to disprove climate change, often challenge the integrity of the scientists — as happened in Climategate. It is no wonder then that many climate scientists shy away from tailoring their products to specific users' requests or communicating their results to non-scientific audiences (Morgan, Dowlatabadi et al. 2009).

Top to Bottom: Frameworks for Adaptation and When to Use What Information

The Second IPCC Assessment recommended a framework for approaching adaptation research (see box on page 85). The whole framework, including the methodology recommended for conducting the assessments, is based on a top-down, linear approach. Such frameworks begin with the assumption that the root problem is climate change and that an assessment should begin with the climate science and then move to developing scenarios of future climate hazards and impacts (Füssel 2006; Füssel and Klein 2006). This approach requires access to current (and historical) climate conditions and future climate projections. However, it has become clear since the late-1990s that such an approach has limited application and is ill-suited to deal with the messy complexity of local reality (especially in developing countries) in which data do not exist, are difficult to access, or are inadequate for making certain types of decisions. Furthermore, because the impacts — and responses to them — are inherently local, the top-down climate science approach is not well suited for learning from or incorporating on-the-ground experiences. Individuals and communities have different perspectives and experiences of their local climate and hazardscapes that are not yet accepted as scientifically credible or widely allowed to contribute to climate science efforts (Pennesi 2007).

However, the historically accepted prescriptions of "successful" adaptation and resilience frameworks or methodologies (Lim and Nordström 2002; Lim, Spanger-Siegfried, et al., 2010; UNFCCC Secretariat and Stratus Consulting 2005) are now beginning to be tested. When the IPCC, the UNFCCC, and other organizations offered these frameworks and methodologies as ways of guiding research, implementation, and funding priorities, very few true adaptation programs existed. Most frameworks did not go beyond the initial steps of investigating vulnerability and risk, and identifying and prioritizing adaptation options to actual implementation of strategies.

"To assess uncertainty — to judge its magnitude and find out its origins — is ultimately the responsibility of the decision maker. Climate research simply provides all the relevant information" (Kropp and Scholze 2009, p. 28).

Programs that incorporate implementation are beginning to emerge now, allowing these recommended frameworks to be tested. Preliminary experience indicates the need for strong, bottom-up approaches that assess current vulnerability and critically examine the opportunities, constraints, and experiences that guide adaptation behaviors at various scales. This bottom-up approach then needs to be integrated with the top-down climate science approach. However, the evidence base is still insufficient to determine fully what elements of adaptation frameworks work, why they work, and their gaps. Even with a solid framework in place, questions remain about how to determine if an intervention contributes to adaptation and builds capacity and how to monitor the intervention beyond the lifetime of the program. Furthermore, the collection of knowledge emerging from actual adaptation interventions has yet to be incorporated by integrated assessment models or climate models, because feedback from many adaptation practitioners does not make it into peer-reviewed publications.

The Political Beast — Local Mice to Global Elephants in the Room

While frameworks and prescribed methods for building resilience to climate change can help adaptation planning, politics and culture greatly influence all aspects of climate adaptation and mitigation, including the production of climate projections. Climate science must be critically examined within science, policy, and public discourse because of the far-reaching implications of climate change and of mitigation and adaptation actions. Yet many scientists strongly maintain the illusion that the scientific method ensures objectivity, openness, skepticism, disinterestedness, and distance from politics (Averyt 2010; Berkhout 2010).

While many in the adaptation and science communities know about the Conference of Parties (COP) negotiations (though the majority of those negotiations occur behind closed doors), few know that both the emission scenarios driving the climate models and the projections released through the IPCC processes are partially negotiated through policy processes (IPCC 2008). In fact, the new RCP scenarios that are being used to drive the models feeding into the IPCC Fifth Assessment, as well as the decision to generate near-term (to about 2035) projections, were developed in response to requests from the global policy community to make the science more useful to the policy process (Moss, Babiker et al. 2007). The IPCC is at the boundary between science and public policy, specifically designed to inform and influence global, national, and local policy discourses about mitigation and adaptation.

7 STEPS FOR CONDUCTING CLIMATE IMPACTS AND ADAPTATION ASSESSMENTS

The IPCC lays out a general framework for conducting a climate impacts and adaptation assessment:

1. Definition of the problem
2. Selection of the method
3. Testing the method
4. Selection of the scenarios
5. Assessment of biophysical and socioeconomic impacts
6. Assessment of autonomous adjustments
7. Evaluation of adaptation strategies

Definition of the problem includes identifying the specific goals of the assessment: the ecosystem(s), economic sectors(s), and geographical area(s) of interest; the time horizon(s) of the study; the data needs; and the wider context of the work. The selection of analytical method(s) depends upon the availability of resources, models, and data… Development of the scenarios requires, firstly, the projection of conditions expected to exist over the study period in the absence of climate change and, secondly, the projection of conditions associated with possible future changes in climate… (Carter, Parry et al. 1995, p.825).

With climate science thrust into public policy and media spotlights, acrimonious debates have arisen about its autonomy and authority to make claims. The debate about the appropriate role of climate science in informing and influencing policy negotiations will continue for the foreseeable future.

Many scientists strongly maintain the illusion that the scientific method ensures objectivity, openness, scepticism, disinterestedness, and distance from politics.

National debates regarding the authority to produce, control, and release legitimate weather and climate data echo the international discourses, but are also influenced by the growing commercialization of data. Meteorological departments, while frequently underfunded, must meet national government mandates that require — either explicitly or implicitly — that groups and decision makers within that country use government-sanctioned projections and data produced by the meteorological departments. They often charge for data, but the pricing schemes and the official data request processes often are not transparent. Yet, as more climate information, including projections, becomes available via the Internet, it becomes harder for governments to control what information is used to support policy. In addition, because using non-sanctioned projections could undermine the credibility of the analysis in the eyes of local policy makers, NGOs or other organizations involved in adaptation work may use only government-sanctioned projections, which would limit their ability to develop adaptation interventions that are robust against a wide range of possible climate futures.

Each of the misconceptions and issues discussed in this section have manifested in some form in the various ACCCRN city contexts. The next sections describe the various processes related to procuring, understanding, and utilizing climate information in the ACCCRN urban resilience initiative and the challenges that have arisen.

Cities engaged in the ACCCRN process are learning to anticipate how climate change might exacerbate and alter their current vulnerabilities, to identify urban populations most affected by changing conditions, and to develop climate resilience strategies and actions that will be robust against a variety of climate impacts. Program partners understand that building urban climate resilience is a continual process, realizing that as the climate begins to change, their cities, as well as their response options, will need to constantly evolve. ACCCRN is intended to build local capacity and ownership to ensure that resilience plans, strategies, and actions are sustainable and can advance after the formal program ends.

OBSERVATIONS — HINDSIGHT IS 20/20

Partners' perceptions about their own abilities to find, interpret, and utilize climate information in the various ACCCRN contexts is influenced by their (as an individual or an organization) understanding of climate information and biases toward how it should be used in various contexts. ACCCRN national and international partners were presented with a questionnaire designed to elicit: 1) their perceptions of the process by which climate information was utilized in each country and/or city context; 2) feedback on the evolution in their understanding of how climate information could have been used at various points in the project; and 3) their recommendations for what should be done differently in accessing, interpreting, translating, communicating, and using climate information at various stages of the adaptation process.

The perceptions of the process of utilizing climate information, as gleaned from the questionnaire responses, both reflect how the process evolved *and* influenced its evolution in each city context and in the overall project itself. Following the discussion of perceptions, this chapter describes the processes — the actual steps by which information was incorporated in each country context. (See Author's Note for information on confidentiality.)

The role and usage of climate information in ACCCRN is a delicate subject for many partners and, indeed, can be a sensitive topic in many other programs outside of ACCCRN. This sensitivity reflects the differentiated access to and understanding of climate information, the political nature of climate projections and impacts, the diverse perspectives on the appropriate role of information, and the debate over what constitutes adaptation in practice. It is also a function of the inevitable politicization of climate information and science in the world at large.

ACCCRN — IN THE BEGINNING…

When the Rockefeller Foundation (RF) began developing a program for building urban resilience to climate change, it hired a consultant to help select cities according to a vulnerability ranking. The consultant employed MAGICC-SCENGEN, a statistical downscaling packaged software, to generate climate scenarios for 2030 and 2080 for approximately 50 cities in Asia. These basic scenarios examined temperature (increasing or decreasing) and precipitation (drier or wetter) trends for each of the candidate cities. Additionally, the consultant examined current frequency, intensity, and tracks of cyclones and created some scenarios of how various changes in climate might alter them. The cities were then ranked according to the magnitude of possible changes in temperature and precipitation according to the downscaling, with cities facing extremely large or relatively little change being struck from the list. They then used all of this information to outline potential impacts to health and other sectors for each of the 50 cities. From this ranking process, and other criteria such as the expression of interest from city governments, RF selected the ten current ACCCRN cities.

Almost universally, respondents to the questionnaire indicated that when they first engaged with the ACCCRN program, they expected city- or location-specific historical climate data and high resolution climate projections to be available and readily accessible in a useable format for vulnerability and risk assessments and shared learning dialogues. Partners (including RF) assumed climate information would play a supporting role to adaptation research, rather than being a primary input component of the process, since they thought this information already existed. A few of the technical supporting partners, having previously worked in Asian contexts, did not expect location-specific data to be readily available, but did assume that national meteorological agencies and/or research universities would be willing to share what data did exist with few bureaucratic barriers. All partners expressed the hope that the information would eventually be used to guide the policies and interventions that the program might develop, but were unclear in the beginning as to exactly how the information might help guide the process. However, the actual types of information (precipitation, temperature, sea level rise, hydrological data, or tropical cyclone projections, among others) that partners expected to be available, and their expectations about how they could use it, varied depending on the location of their city and preliminary understandings of potential, location-specific impacts.

At the start of Phase 2, the planning phase, in January 2009, few partners (national and international) knew much about GCMs or RCMs, climate projections, uncertainty, or about the critical ocean-atmosphere patterns that influence Asian climate. As a result, ISET prepared a general guidance manual — *General Climate Change Projections for South and Southeast Asia: ACCCRN Guidance Note* — that was distributed to partners at the Second Regional Partners Meeting at the beginning of May 2009, weeks before the Vietnamese and Indian partners were about to begin their vulnerability assessment work. ISET also made a presentation to partners at the meeting. However, the guidance manual and presentation were both prepared without any dialogue with partners, and there was minimal feedback from partners about what they learned or if these products were useful to them in finding and interpreting climate data.

Soon after the Second Regional Partners Meeting, Indian and Vietnamese partners moved ahead with the shared learning dialogues (SLDs), the primary stakeholder engagement process in the ACCCRN project (see chapter 4 for a more detailed discussion of the SLD process), and vulnerability assessments. The timeline left little time for dialogue and clarification of partners' understanding and expectations of the available climate information before it was presented to city partners at the SLDs and in the vulnerability assessments. As the assessments progressed, it became apparent that project partners at all levels had divergent capacities for accessing, understanding, and utilizing climate information. National partners began to encounter difficulties both in finding data they needed and in determining what data was available. Conveying the information to city partners in a meaningful manner that did not treat the projections as factual futures was also a significant challenge for national partners. In order to address these challenges, as well as confusion about other methodologies, such as the vulnerability assessments or SLDs, ISET held a methods workshop in Boulder, Colorado in October 2009. The workshop was ambitious in scope, covering a broad suite of methods being employed for different project objectives over a short period of time. Not all national partners were able to attend, but those who did expressed a greater capacity for understanding, interpreting, and conveying climate information to city partners.

> *"Access to information is low because of translation. The concept is very difficult too. Not just about changing rainfall – it's about changing lifestyle, how cities grow. The point is not to look at what will happen to the weather, but rather what will happen to us. And that concept is difficult – the combination of the social, development, and climate."*
>
> *– comment from an ACCCRN partner*

COMMON CHALLENGES AND CONSTRAINTS

While there are differences in how partners accessed, interpreted, and utilized climate information in each of the ACCCRN cities, partners share a number of common challenges and constraints. These include:

- Limited data — both historical and climate projections — for the ACCCRN cities or the surrounding areas. (Several of the reasons for lack of data are mentioned below.)

- Users' perception (slowly beginning to change) that climate projections are finished, prepared products that are self-explanatory and easily obtained.

- Bureaucratic hurdles in accessing data for the shared learning dialogues, stakeholder consultations, and vulnerability assessments within the necessary timeframes. Furthermore, data request processes and politics around which datasets were released and sanctioned for use were obstacles as significant as the lack of data.

- Data is tailored to and remains the purview of the discrete climate science community, available only through archives such as the WCRP CMIP3 multi-model database, IPCC Data Distribution Center, or peer-reviewed journal articles to which partners have no functional access.

- No consistent sets of climate projections run with the same emissions scenarios or for the same future time-slices for any of the ACCCRN countries, because there are no standardized, regional climate model runs. Since climate projections between the countries are so different, no comparisons can be made.

- A heavy emphasis on how climate change will exacerbate current vulnerabilities and only a minimal focus on how climate change might create new, unknown situations and/or vulnerabilities. This was partially a result of the difficulty in accessing climate data by program deadlines. Partners created extremely limited scenarios of future vulnerability and potential impacts from analyses of current vulnerability and what projection data were available.

- Misunderstanding about how scientists define “climate change.” The language and translation barriers described earlier are the likely cause of some city partners attributing recent events, such as flooding, to climate change, when in fact they might be due to infrastructure and land use patterns, or well within the bounds of historic variability.

- Lack of explanation from the climate information providers about how the historical data and climate projections were produced or what assumptions, biases, and uncertainties are associated with the data. When climate scientists released data to partners, it was often in the same format as would be given to their peers.

- Confusion among project partners about the difference between climate projections and climate impacts. Many partners expressed the desire to know how climate change might impact their cities and expected climate scientists to be able to provide the localized impact data, without realizing that while impacts research builds off of climate model research, the two fields are separate. Climatologists produce projections of future climate based on GCMs, RCMs, and statistical downscaling; they frequently do not have the time or expertise to do climate impacts modeling. Climate impact scientists have separate, integrated impact assessment models to examine climate impacts for a region based on climate projections. The two modeling communities interact and support each other’s research, but do different work and produce different products.

- No clearly articulated expectations on the part of international and national-level partners as to who was primarily responsible for collecting historical climate data and climate projections. In some instances, international partners were better placed to access certain types of data; in others, national partners were more easily able to collect historical climate data because of in-country bureaucratic processes, but the tasks were not allocated between them when ACCCRN began.

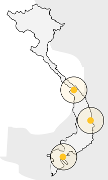
- Varying expectations and levels of experience and capacity among partners. City partners had particularly unrealistic expectations and limited experience and capacity to interpret, understand, and utilize historical climate information and climate projections in adaptation work. This led to a few instances of over-interpreting data and higher levels of confidence in the data than were warranted. These situations challenged the ability of the technical supporting partners to replace misinterpreted data and diplomatically educate and support national partners in climate information gathering and usage. The capacity of partners has grown throughout the course of the program.

- Limited communication among partners about the processes involved in accessing and utilizing climate information in various contexts. Few partners actually know much about each other’s processes or challenges.

COUNTRY BY COUNTRY: PERCEPTIONS AND PROCESS

The next sections discuss in greater detail the nuances in perceptions and processes as they occurred in each country context, and in some instances, in different cities within the same country. Each country section opens with a description of the agencies and research entities in that country that are primarily responsible for monitoring, collecting, and disseminating historical climate data and that are engaged in climate science research.

VIETNAM



VIETNAM

PERCEPTIONS AND PROCESS

IMHEN Institute of Meteorology, Hydrology, Environment

MONRE Ministry of Natural Resources and Environment

The Vietnam Institute of Meteorology, Hydrology, and Environment (IMHEN) under the Ministry of Natural Resources and Environment (MONRE), is the national agency with primacy for maintaining and collecting historical climate data and issuing climate projections. The national government assigned IMHEN to develop the official climate change scenarios for Vietnam — preliminary projections based on existing studies and statistical downscaling by 2009 and projections based on RCMs by the end of 2010. Subsequent work will include updating these climate change scenarios every five years (MONRE 2009). IMHEN has also recently signed a memorandum of understanding with SEA START to collaborate on generating high resolution climate projections for Southeast Asia. A number of research organizations, such as Can Tho University, the Southern Institute of Water Resources (SIWRR), and the Institute for Water Resources and Environment (IWE), are engaged in various aspects of climate change research, from sea level rise and flood mapping projections to physical and social impacts work. Despite the existence of other organizations, IMHEN remains the only agency with the authority to develop specific climate projections for use in official government planning documents (e.g., adaptation plans). ■

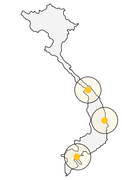
PERCEPTIONS

Vietnamese partners pursued a different strategy from other ACCCRN countries in accessing climate information due to institutional arrangements within the country. Perceptions reflect these unique institutional arrangements and climate scientists' early engagement in the ACCCRN process:

1. Communicating uncertainty is difficult, as is communicating long-term climate change when it is beyond the immediate horizons of concern for local partners. It is especially difficult to communicate this information at the grassroots level — to groups such as women's unions or fishermen's unions — or to policy makers, as different styles of communication seem to be required to make information relevant to each group's needs.

2. Many parts of Vietnam lack historical data of sufficient length and quality, making it difficult to verify the robustness of the climate models in use; correct for biases in the projections; evaluate potential changes in extreme event frequency, duration, or intensity; or run hydrological models to examine future flood risk.

3. Level of trust in information sources and views about the accuracy of data from different sources strongly influence the data people are willing to accept as credible and utilize in decision making. Most partners were very reluctant to use data from sources other than IMHEN.



4. Despite climate scientists' early engagement in the Vietnamese process, miscommunication and delays in accessing city level datasets hampered some research efforts and frustrated project partners.

5. City partners had some limited understanding of uncertainty, but sometimes expressed fright at what they perceived to be a "severe" scenario about which they felt they could do nothing. As a result, city partners tended to place more emphasis on planning for scenarios in their "comfort zone" of capacity.

6. Cities incorporated climate projections into resilience strategies by acknowledging where climate change is likely to exacerbate current vulnerabilities related to droughts, storms, flooding, and storm surges. However, there was relatively little exploration of new issues that could arise due to climate change — such as the impacts of extended high temperatures on infrastructure or the energy grid, or the economic impacts of losing one rice crop per year that would normally be exported.

PROCESS

Given IMHEN's mandate, Vietnamese national partners have engaged substantially with IMHEN since the initial methodology workshop in March 2009, and they attempted to use its products during the course of the vulnerability assessment and the city resilience planning processes. Other climate science experts from universities and research institutions participated in the initial and subsequent methodology workshops, in some of the SLDs, and in the vulnerability assessments. These other partners (Can Tho University, SIWRR, and IWE) were contracted to provide city-specific assistance according to their expertise and previous level of engagement in other climate research initiatives in Vietnam.

At the first methods workshop in March 2009, partners had not yet formalized their contracts, yet strongly felt the need to begin developing a shared understanding of methodology and research language. IMHEN had not yet completed city-specific projections, but gave partners an overview of climate research in Vietnam, including the policy process, and provided broad regional projections from existing research. SIWRR and Can Tho University (CTU) had been collaborating with SEA START on a project funded by the World Bank to investigate potential climate impacts for Can Tho. They provided other partners with sea level rise and flooding scenarios for the city, along with the results of the impact assessment documenting how alterations to temperature and precipitation regimes could affect rice crops.

Partners finalized their contracts throughout March and April of 2009. IHMEN agreed to oversee the vulnerability assessments for the cities of Quy Nhon and Da Nang, including providing climate and sea level rise projections under different emissions scenarios, some mapping of the direct flooding implications of

VIETNAM

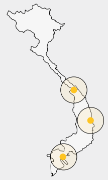
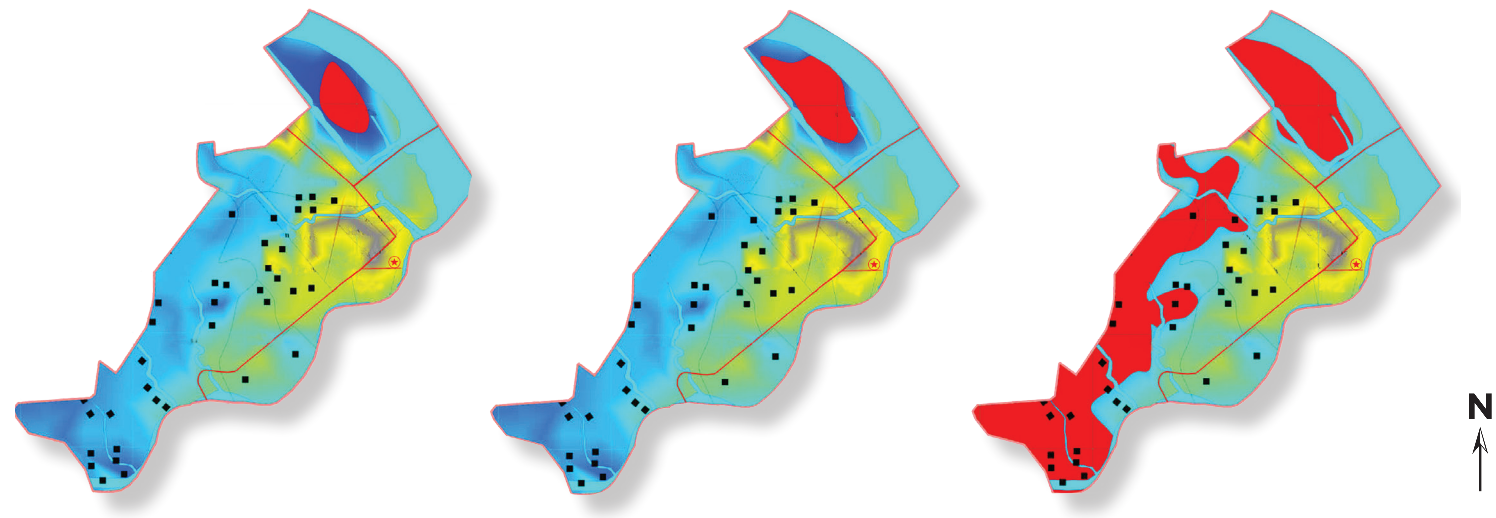


FIGURE 3.4 | Sea Level Rise in Ninh Kieu District, Can Tho City
According to Multi-Model Averages Using the A2 Emissions Scenario



2050
Sea Level Rise: 30.8mm
Flooding area: 5.8 km2 (19.1%)

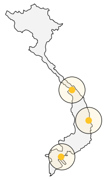
2070
Sea Level Rise: 48.9mm
Flooding area: 6.6 km2 (21.7%)

2100
Sea Level Rise: 85.9mm
Flooding area: 15.2 km2 (49.8%)

SLR, and an overall review of the final assessment. IWE conducted the city level vulnerability assessments for Quy Nhon and Da Nang, which included identifying current hazards, vulnerable groups and locations, and assessing future vulnerability using IMHEN's projections. SIWRR was involved in some simple hydrologic modeling in Da Nang and Can Tho as part of the vulnerability assessments, and more extensive modeling in Da Nang and Quy Nhon as part of detailed studies of the water sector. CTU conducted the city level vulnerability and impacts assessments for Can Tho. In all three cities, Challenge to Change (CtC) led community-level hazard, capacity, and vulnerability assessments (HCVAs; see chapters 5 and 6 for more information) to ascertain the vulnerability of the most poor and marginalized populations in select wards of each city. NISTPASS provided overall project guidance and coordination, while ISET provided technical advice per partners' requests.

Between March and June 2009, IMHEN worked to generate city-specific projections using a combination of the statistical downscaling software MAGICC-SCENGEN 5.3 and rescaling techniques. The agency originally hoped to have high resolution projections available from PRECIS (an RCM) to partners by summer 2009. Lateral boundary conditions from ECHAM5 and HadAM3P (GCMs) would have been used to drive PRECIS, generating multiple projections and providing a broader range of possible climate futures than if only one GCM was used to drive the RCM. However, complications with model parameterization and initialization extended the length of the model runs and precluded using these particular projections in the vulnerability assessment and SLD work. IMHEN has been working closely with the UK Hadley Center to address these model complications and expects to have results available around the end of 2010 or the beginning of 2011 (personal communication with Dr. Van of IMHEN). Additionally, IMHEN has contacted the U.S.-based University Corporation for Atmospheric Research (UCAR) to begin running another RCM, the Weather Research and Forecasting Model.

IMHEN ran MAGICC-SCENGEN with output from all 17 GCMs included in the package for the emissions scenarios A2, A1F, and B2 for the following years: 2020, 2050, 2070, and 2100. For each emissions scenario and time period, the multi-model mean projection was retained for precipitation and temperature. All of the projections were produced on a monthly timestep, allowing for an assessment of potential changes in seasonal variation at each time period. Daily timesteps could not be run due to lack of historical data for each city, which also prohibited assessment of changes in extreme events. IMHEN also analyzed twentieth-century sea level rise trends in tidal gauge stations and from satellite (TOPEX/Poseidon) data. SLR projections were generated using MAGICC-SCENGEN for the same emission scenarios and time periods as the temperature and precipitation projections. IMHEN generated simple flooding scenarios for the three cities conditioned on the SLR projections, digital elevation maps of the cities, and current flood levels. These climate and SLR projections were not



available to partners until the end of May 2009, after some of the vulnerability work had begun.

However, due to the delay in availability of IMHEN's results, and in response to a request from CtC in April 2009 for simple, preliminary projections for Vietnam that could be used in the HCVA work, ISET wrote a general guidance manual — *General Climate Change Projections for South and Southeast Asia: ACCCRN Guidance Note* — that was distributed to partners at the Second ACCCRN Regional Meeting that May.

National and some city level partners reconvened for a second methodology workshop in June 2009, to discuss the progress of the vulnerability assesments and HCVAs and the projections released by project partners. At this workshop, the political complexities surrounding climate information, ownership, and the ability to use particular sets of information in policy contexts came to the surface. Discussions at the meeting centered on the following:

- The flood map scenarios developed in accordance with the different emissions scenarios for different time periods only included the current city administrative boundaries. However, each of the cities has plans to annex surrounding areas and develop them. Future climate risk scenarios need to incorporate likely city development and growth plans to better account for risk and guide city partners in deciding what types of growth to allow and where.

- The SLR and flooding scenarios did not incorporate storm surge and high tide considerations. City partners expressed some skepticism about the future risk scenarios without the incorporation of these other factors.

- Partners highlighted the difficulty of collecting and reconciling hydrological and meteorological data for the cities from various official levels, from city to national agencies. It was noted that the simulations of future flood risk, and to some degree the statistically downscaled climate projections, are very sensitive to differences in historical hydrological and meteorological data.

- Partners debated how to reconcile uncertainty in climate projections, especially for long-term time horizons such as 2050 or beyond, with the policy process in Vietnam. Local- to national-level planning is conducted on five-year horizons, with many city decisions and socioeconomic plans effectively limited to 2015 or 2020 at the longest.

- IMHEN is the only agency authorized by the national government to produce climate projections that can be used in the National Target Program, Vietnam's climate policy program. However, several climate projections are available for the city of Can Tho due to the city's research collaborations with SEA START and the World Bank. These alternative projections provided different ranges of change in temperature and precipitation than those provided by IMHEN.

> Partners were uncertain how to reconcile the national mandate to use only IMHEN projections for official policy purposes when other projections exist that could enhance what is officially available. Partners also started to discuss how to handle other sources of climate projection data that are becoming available online, and what role these could play in Vietnamese climate policy. Vietnamese project partners are still negotiating the complex policy terrain dictating which sources of climate information are officially sanctioned and allowed to influence policy at the city level on up to the national level.

After producing the final vulnerability assessments in the fall of 2009, Vietnamese partners did not revisit climate data before producing their resilience strategies over the following year. However, this data has proven invaluable to the project and to other adaptation initiatives in Vietnam. Prior to IMHEN's analysis for ACCCRN, little high resolution or downscaled projection data existed for any of Vietnam, and most of what did exist had not been produced by Vietnamese government agencies, limiting its use for official policy purposes. The IMHEN analysis provided a relatively high-resolution, government sanctioned dataset on which the ACCCRN cities could base their climate and vulnerability analyzes and resilience strategies.

Unlike in India, Indonesia, and Thailand, the Vietnam ACCCRN program was able to access some climate projection data for all three cities in a fairly timely fashion. National policy limitations constrained the data to a small subset of available models. Obtaining data from a central national agency proved both advantageous and complicated. Perhaps because the data was limited in scope, or perhaps because it was delivered in a more "packaged" format (i.e., impacts to seasonal rice crops, hectares of land flooded, etc.), Vietnamese city partners seemed to be less confused and concerned in applying the results in their vulnerability and resilience analyzes than in the other ACCCRN cities. However, the partners made little attempt to explore the potential for new climate-induced risks; analysis to date has been limited to the potential for exacerbation of existing risks.

Perhaps more importantly, involving climate information producers from project inception, while leading to some of the described conflicts, created rich dialogue among partners. Despite differences in backgrounds and research objectives, partners began to understand and appreciate the challenges of conducting urban adaptation work.

INDIA

INDIA

PERCEPTIONS AND PROCESS

IMD Indian Meteorological Department

IITM-Pune Indian Institute of Tropical Meteorology

CWC Central Water Commission

NCMRWF National Centre for Medium Range Weather Forecast

Bureaucratic and administrative barriers can play a significant role in limiting access to information, especially in the timeframe needed by partners. While there are extensive systems in place for collecting climate data in India (barring northeast states such as Uttar Pradesh and Bihar), the data is spread across different agencies. The bureaucratic challenges of data acquisition are due to the existence of four different sources of official data — the Indian Meteorological Department (IMD), the Indian Institute of Tropical Meteorology (IITM-Pune), the Central Water Commission (CWC), and the National Centre for Medium Range Weather Forecast (NCMRWF).

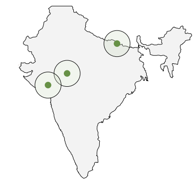
The IMD, NCMRWF, and IITM-Pune are in the Ministry of Earth Sciences, yet have different mandates and sometimes competing research foci. The CWC monitors river flows and issues water level and inflow forecasts for operation of some major reservoirs, principally in floodprone states. It also focuses heavily on flood forecasting and warning. Information from the CWC is transmitted to relevant state-level authorities and other agencies connected with flood protection and management using telephones, special messengers, telegrams, and wireless. How it is transmitted in any given circumstance depends on the flood situation and existing communication facilities.

IMD is the primary weather forecasting institution in the country. It monitors weather conditions and provides current information targeted to weather sensitive sectors, such as agriculture and irrigation. To the general public, it provides 48-hour weather forecasts through Farmers Weather Bulletins and the Agrometeorological Advisory Service in consultation with agriculture experts working in state agriculture departments. It also produces seasonal crop weather calendars. More generally, the IMD plays a significant role in predicting and providing early warning for severe weather phenomena such as tropical cyclones, heavy rains, cold snaps, and heat waves.

The NCMRWF has a more limited and targeted focus than the IMD. It provides medium range weather forecasts using deterministic methods and also supports the Agro Advisory Service for farmers, yet has its own set of weather stations. Finally, the IITM functions as a national center for basic and applied research in monsoon meteorology of the tropics in general, with special reference to monsoon meteorology of India and the surrounding regions. When it comes to developing climate projections for India, both IITM and IMD are in various stages of running RCMs.

Each of the above agencies has different systems for collecting, reporting, archiving, cleaning, and disseminating data. Local IMD offices operate the weather stations, and are in charge of monitoring the station

INDIA

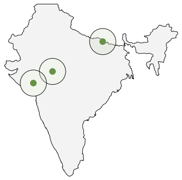


instrumentation and collecting and transcribing data for stations that are not automated. The local IMD office reports the data collected to the state-level IMD office, which then reports the data to the national office in New Delhi. The variations in data collection make it difficult for those requesting information to know who might have that information, how it was collected or generated, and the sources of uncertainty and error in each dataset. The data request process is different for each agency. It can depend on who is requesting the information (international organization or in-country organization) and can be quite lengthy, often requiring personal visits to agency offices. These processes make it difficult for project partners or others to access potentially relevant information in a timely and predictable manner. Furthermore, the datasets themselves are expensive to acquire, which although not a barrier to ACCCRN partners, is a challenge to organizations involved in adaptation work that have not budgeted for datasets and are unaware of costs. ■

PERCEPTIONS

National and international partners engaged in India reported the following observations about conducting vulnerability assessments and SLDs and assisting the cities in crafting resilience strategies:

- It is challenging to communicate to local partners what uncertainty is, its implications, and the issues surrounding data quality, micro-climate processes, and recent variability. City partners had and continue to have difficulty understanding historical data and projection limitations and did not know how to craft interventions that are robust to a range of climate futures.



- City partners initially had difficulty accepting that climate change could have implications for their cities in the absence of city-specific climate projections.

- The current climate hazards that the cities face shape city partners' views about future climate hazard risk. For instance, in Indore, water scarcity is currently a pressing concern. The limited climate projections available for the city indicate that annual rainfall might increase, although possibly through extreme rainfall events that could exacerbate problems with waterlogging. Because water scarcity is such an issue, city partners expressed excitement over the possibility of increased rainfall and ignored the issue of extreme climate events or the potential impacts of such events.

- National partners would like to explore other ways of communicating climate information, especially in trying to relate the information to potential impacts on daily life, micro and macro-impacts, and the ability to plan and strategize. Visual tools, such as the maps displayed in Figure 3.2, are quite helpful in displaying possible changes to precipitation and temperature. However, partners with access to projections from only one GCM or RCM cannot display ranges or uncertainty. Multiple maps are needed to portray ranges, yet can be confusing to city partners.

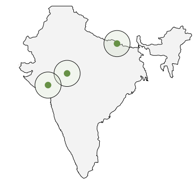
- Checking the authenticity of data and the credibility of the source has been difficult, especially as climate information products become more widely available online, but are often presented without adequate explanations. Furthermore, there can be discrepancies even between official datasets generated at the local agency office and those held by the national office, making it difficult to know which datasets should be utilized.

PROCESS

In India, national partners took the responsibility of contacting the various meteorological agencies and researching climate information to incorporate into the vulnerability assessments, stakeholder consultations, and city resilience strategies. How each partner went about finding and incorporating climate information was dictated by their previous experience in handling climate information and the overall research expertise of the organization. TARU, which has considerable expertise in rapid vulnerability assessments and spatial vulnerability mapping techniques, initially selected limited climate projections that were available as GIS layers. Gorakhpur Environmental Action Group (GEAG) had prior experience with climate information and understandings of uncertainty and expectations for data usage and was more cautious in data selection and interpretation. Due to the ACCCRN structure, TARU engaged with Surat and Indore city partners, and GEAG engaged with city partners in Gorakhpur, with ISET supporting both organizations.

When national partners began with their vulnerability assessments in the three cities in March-April 2009,

INDIA

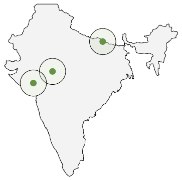


© TARU

It is challenging to communicate to local partners what uncertainty is, its implications, and the issues surrounding data quality, micro-climate processes, and recent variability.

they were uncertain as to what data (climate, hazard, demographic, etc.) would actually exist for the cities or who would have that data. Furthermore, as the first phase of the rapid assessment involved semi-structured interviews with slum dwellers, partners chose to focus on perceptions and experiences of historical and current hazards in order to build profiles of current vulnerability. Researchers did not attempt to introduce concepts of climate change, historical climate data, or projections of future climate to the interviewees; and thus, had not collected any climate data prior to the start of the vulnerability assessments. Stakeholder consultations with key individuals from the municipal corporations and other city agencies were also initiated during this time. National partners relied on individual interviews and consultations with small groups (e.g., 2-3 individuals) to build current vulnerability profiles and gather data (see chapters 4, 5, and 6 for more detail). Indian stakeholders and partners initially did not engage large, mixed focus groups in a dialogue and discussion of vulnerabilities and climate change as happened in the other ACCCRN contexts.

Secondary data, including official datasets related to demographics, historical climate data, hydrological data, etc., were collected simultaneously during the semi-structured interview process. Partners approached agencies that they thought might have data, although



they were not sure what they would be able to access. At the start of the secondary data collection, partners were more concerned with assets and exposure information, as well as information related to the magnitude and extent of previous climate hazards. Historical climate data was collected from a variety of sources, depending on the city, in order to assess regional historical variability and to make hazards assessments.

GORAKHPUR

In Gorakhpur and the surrounding area, historical rainfall, temperature, and flood data are collected by four different agencies: the local IMD office, the agricultural department, the local revenue department, and the *panchayats* office. GEAG, in collaboration with ISET under a previous project (Risk to Resilience), had access to historical climate data and statistically downscaled precipitation projections (run for 2010-2050) based on a single GCM (methodology available in Opitz-Stapleton and Gangopadhyay 2011). GEAG utilized this data in preliminary vulnerability assessments and for initial flooding and waterlogging estimates for the city, which were presented to the city advisory group, the steering committee, and to all ACCCRN partners at the Second Regional Partners Meeting in September 2009. ACCCRN national and international partners questioned GEAG's results as presented, because GEAG did not display any climate projections, only current vulnerability profiles.

From the Risk to Resilience project, both partners knew that historical climate data for Gorakhpur was limited and had considerable amounts of missing data. Furthermore, as the projections were based on a single GCM and two emissions scenarios (A2 and B1), the range of the projections was limited. GEAG contacted the local IMD office to supplement existing datasets, while ISET contacted the national IMD office for additional data. The local IMD supplied rainfall data for 1995 to 2008 and temperature data for 1991 to 2007. ISET obtained district-wise and 1°x 1° daily gridded rainfall data for 1901 to 2004 from the national IMD office. In doing so, partners discovered that the national and local IMD historical rainfall datasets did not match, even though they are ostensibly from the same weather station. The local IMD office attributed the discrepancies to manual data collection and entry before sending files to the national office, although Gorakhpur recently acquired an automated system that should have been sending measurements directly to Delhi. For many meteorological agencies, national offices perform data cleaning and quality control, not the local offices, leading to data discrepancies about which organizations requesting information may not be aware. After comparison of the historical data, GEAG and ISET opted to use the national IMD data files, supplementing missing data with data from the Global Historical Climatology Network (GHCN) and Climatic Research Unit (CRU) archives.

GEAG requested additional climate projections in January 2010 from ISET to provide a more comprehensive range of possible future temperature and rainfall to city stakeholders and to inform the city resilience planning processes. Due to time constraints, ISET was unable to generate additional projections

Projection Data Used in Indore and Surat

Temperature and Precipitation:

- CGCM3
- CNRM
- MPI
- GFDL
- PRECIS (driven by HadAM3P) for the following emissions scenarios A1B, A2, B2
- CGCM3, CNRM, MPI-ECHAM5, and GFDL run using emission scenario A2 scenario A2 (Source: CSAG 2010).

FIGURE 3.5 | Gorakhpur A2 Future Mean Rainfall Scenarios (Projection Data Used)

Temperature

CSAG: SRES A2 Emission Scenario (2046-2065):

- CGCM3
- CSIRO
- CNRM
- MIUB
- MPI — ECHAM5

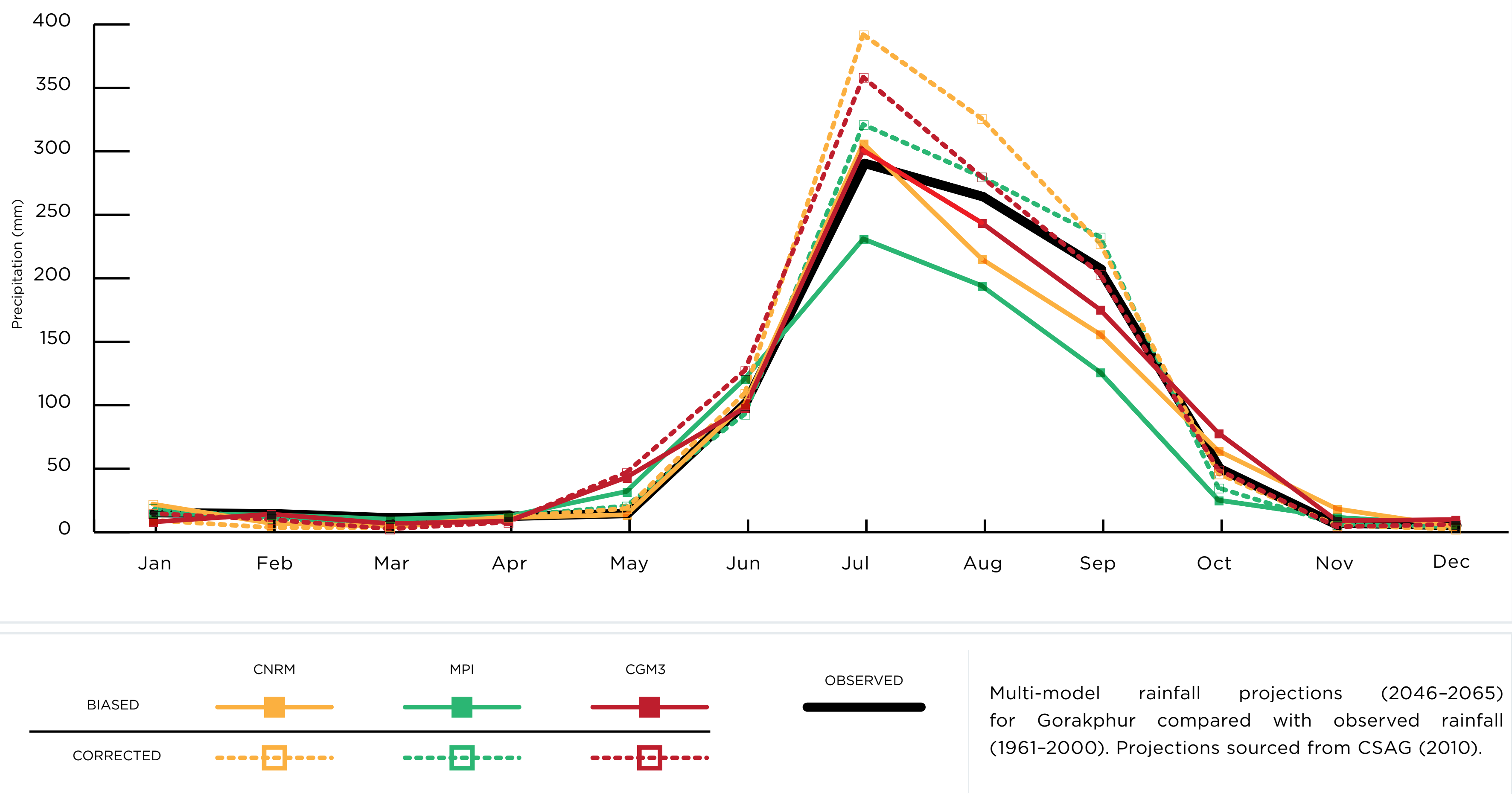
Precipitation

ISET: Risk to Resilience Project:

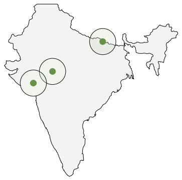
- CGCM3
  - SRES A2: 2010-2050
  - SRES B2: 2010-2050

MPI-ECHAMS: SRES A2 (2046-2065):

- CGCM3
- CNRM
- MPI — ECHAM



Multi-model rainfall projections (2046–2065) for Gorakhpur compared with observed rainfall (1961–2000). Projections sourced from CSAG (2010).



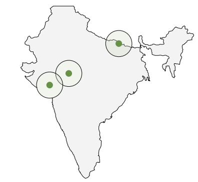
via statistical downscaling and instead, sought projections from other climate research centers. ISET was aware that Stockholm Environment Institute (SEI) and the Climate Systems Analysis Group (CSAG) at the University of Cape Town had been collaborating to develop a software tool — the Climate Change Explorer Tool (CCE) — to provide statistically downscaled projections from a variety of GCMs for Asia and Africa. While CCE was still in the development and testing phases, projections downscaled from eight GCMs (each utilized in the most recent IPCC assessment) were available for many of the ACCCRN cities. ISET procured the projections and analyzed the data for GEAG. In the process, ISET discovered that CSAG had made public the wrong datasets and informed CSAG in February 2010; CSAG re-ran their models and released new projections in March 2010. ISET then produced a report for GEAG in May 2010, *Simple Climate Scenarios for Gorakhpur* (Opitz-Stapleton 2010b), which detailed the analysis steps and explained the data limitations before ISET released both historical and climate projection data. Additionally, TARU was able to procure climate projections (generated using the RCM PRECIS for the SRES A2, B2, and A1B scenarios) from IITM-Pune for Gorakhpur in late May 2010 that they shared with ISET. These have not yet been analyzed, nor has ISET completed an extreme events analysis for GEAG using either the CSAG or PRECIS projection data.

INDORE AND SURAT

TARU, with technical assistance from ISET, began seeking climate information in April 2009 for Indore and Surat. TARU's expertise lies in GIS-enabled vulnerability mapping, which was employed during the vulnerability assessment and stakeholder consultation process in each city. TARU collected historical daily precipitation and temperature data from the IMD and Anand Agricultural University in Gujarat with the intention of examining historical variability, trends, and recent changes in annual and monthly statistics. The analysis of the historical station data was designed to support analysis related to flood hazards and waterlogging mapping in both cities, as these are currently the phenomena of greatest concern to city partners. Additionally, Indore faces issues of local water scarcity and energy fluctuations due to the necessity of pumping water nearly 70 kilometers from the Narmada River. TARU acquired data through various formal protocols, including telephone calls to confirm data existence, individual meetings, and filling forms and sending official letters to the agencies. Metadata files explaining how to read the datasets accompanied all of the datasets, but there were no explanations of data limitations or recommendations for data usage.

Indore faces issues of local water scarcity and energy fluctuations due to the necessity of pumping water nearly 70 kilometers from the Narmada River.

TARU's strength in GIS-enabled vulnerability assessments led them to seek climate projection data available in raster data format (for GIS applications) to develop future climate vulnerability maps. Initially they used projection data from WorldClim, a database of interpolated, high resolution spatial data layers of bioclimatic data for use in ecologic modeling. WorldClim has collated observed climate data from a number of sources and generated global-extent GIS layers of 1km x 1km resolution for 1950 to 2000. However, some of



the data, notably precipitation, have some errors and should be avoided. Furthermore, the climate projection map layers available from WorldClim are from the IPCC Third Assessment (2001) and are outdated for many parts of Asia. TARU presented projections from a single GCM, as downloaded from WorldClim, to ACCCRN partners at the Second Regional Partners Meeting in September 2009. Partners expressed concerns over the projections and data sources, noting that the maps displayed did not contain any information about potential ranges of change in precipitation or temperature or provide the historical data context against which to reference the projections. Due to these concerns, TARU sought assistance from ISET in finding alternative sources for climate projections, in analyzing the data, and in displaying it in a manner that could convey uncertainty and ranges to city stakeholders.

ISET directed TARU to the CSAG datasets and assisted in selecting downscaled projections from those models that were best able to replicate the timing of key seasonal climate features, such as the monsoon season, for Indore and Surat. Additionally, TARU requested RCM projections from IITM-Pune, which took approximately six months to deliver the data, because IITM-Pune had not completed all of the model runs at the time of TARU's data request.

To sum up the ACCCRN process in India, even though all three cities engaged early on, national partners found it difficult to access climate information — especially projections from reliable sources — in time to contribute to the vulnerability assessment, stakeholder consultation, SLD, and city resilience planning processes. Hindering the data collection and analysis process were the multiple agencies with overlapping data collection mandates and with differing copies of what should have been identical datasets. These same agencies were overburdened with work and are scrambling to produce high quality, high resolution datasets in a timely fashion. These delays and bureaucratic hurdles adversely affected the ACCCRN process in India.

INDONESIA

BMKG Indonesian Meteorological, Climatological, and Geophysical Agency

Tropical Cyclone Warning Center of Jakarta

INDONESIA

PERCEPTIONS AND PROCESS

The Indonesian Meteorological, Climatological, and Geophysical Agency (BMKG), a governmental agency, is in charge of administering and maintaining a network of weather stations throughout the country. Local-level BMKG offices collect and store the station data. BMKG also houses the Tropical Cyclone Warning Center of Jakarta, which shares responsibility with Australian meteorological agencies for monitoring tropical cyclone formation in a portion of the Indo-Australian ocean region. The agency has conducted some regional climate downscaling work and has recently announced that it will begin monitoring GHG emission levels at various sites throughout the country. ■

PERCEPTIONS

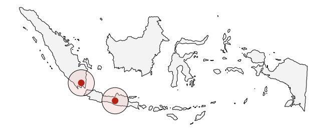
Indonesian national partners faced challenges similar to those in other ACCCRN countries in acquiring, interpreting, and translating climate information in a meaningful manner for city partners. ACCCRN partners shared the following perceptions about using climate information in the two ACCCRN cities in Indonesia:

1. Information related to current climate hazards, as presented by climate scientists in the vulnerability assessments, does not match city partner's observations and needs to be verified. Indonesian partners are attempting to reconcile datasets provided by the BMKG and by city meteorological agencies with city partners' knowledge on current hazard exposure.

2. Historical climate datasets are often short and incomplete, making analysis of historical variability and extreme events difficult.

3. Local partners also expressed concerns that the information is "too scientific," difficult to understand, and difficult to translate into understandable impacts/implications that can be then used in the city resilience strategies. Partners are not sure how to use the available information in its current format in development and long-term planning.

4. Local partners are under the impression that climate change can only happen as a gradual process. They do not understand how impact risk — deduced from climate projections — can increase as rapidly between 2025 and 2050 as presented in projections prepared for the cities. Additionally, city partners have had just enough exposure to the IPCC assessment reports to be confused about emissions scenarios and how climate risk can be high even though a GCM has been run with a low emission scenario. Both



of these city stakeholder impressions indicate the need for greater education and capacity building in order to understand how climate projections and climate impacts are generated.

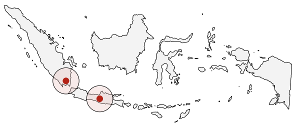
5. Local-level projection data, especially those related to sea level rise and temperature change, do not exist for the Indonesia cities. National partners had to downscale coarse resolution projections from GCMs to the city level for the CRS.

PROCESS

Indonesia joined ACCCRN roughly six months later than India and Vietnam. As a result, the vulnerability assessment and SLD work did not begin until late 2009. Indonesian partners (CCROM, Mercy Corps, and URDI) conducted three levels of assessment: a citywide vulnerability analysis (CCROM), a community-based assessment in vulnerable sub-districts identified through SLDs (Mercy Corps), and an assessment of governance in relation to climate adaptation (URDI). Results of these three reports were combined approximately five months later into synthesis assessment documents for each city. The synthesis documents begin with assessments of current vulnerability and capacity at the city level, in Semarang and Bandar Lampung, down to the Kelurahan or sub-district administrative level. Scenarios of future vulnerability, capacity, and climate variability were extrapolated from a variety of information sources and from the current vulnerability and capacity profiles.

CCROM, who mostly conducted the climate assessment work, first began requesting historical climate data — rainfall, temperature, and sea level — for the cities in October 2009. CCROM intended to use the data for assessing historical climate variability and extreme events and in the vulnerability assessments. They first enlisted the aid of city level partners (a university in Bandar Lampung and a local NGO in Semarang) in acquiring weather station data from local BMKG offices. Unfortunately, only rainfall data were available, and these datasets were not as complete or as long as national partners hoped. CCROM supplemented the station data with interpolated rainfall datasets available through the CRU database in order to spatially and temporally disaggregate rainfall trends for the cities from 1901 to 2002. Weather station temperature data were not accessible. Therefore, CCROM used CRU temperature datasets to examine temperature trends through the late twentieth century. Due to the patchiness of the historical rainfall data, and the mismatch in scale resolution between the CRU datasets and station data, CCROM used RegCM3 to generate high-resolution rainfall data from 1958 to 2001. This simulated historic rainfall dataset was corrected for bias against the actual station data/CRU rainfall datasets in order to find a scaling factor to generate climate projections from GCMs.

Climate projection data was not available through the local BMKG offices. Instead, CCROM relied on projections provided by the National Institute for Environmental Studies in Japan (NIES, Masutomi 2009). NIES extracted projections derived from 14

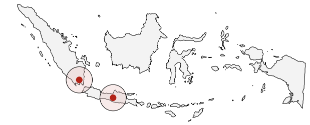


Local-level projection data, especially those related to sea level rise and temperature change, do not exist for the Indonesia cities. National partners had to downscale coarse resolution projections from GCMs to the city level for the CRS.


© Thatcher Cook, Mercy Corps

GCMs under the SRES emissions scenarios A2 and B2. CCROM rescaled the GCM projections to the city level using the scaling factor described above, which is a fairly common technique. In this manner, CCROM generated projections for two future time-slices for the cities: 2021 to 2030 and 2051 to 2060. The near-term time-slices were selected because they were deemed more relevant to city planning processes than end-of-twenty-first-century projections. These projections were then used to evaluate how climate change might alter the frequency of extreme events and to generate maps displaying changes in general temperature and rainfall trends and variability.

Climate information was presented to city partners through the SLDs, which were also used to discuss and verify the results of the vulnerability assessments. During SLD 1 in August 2009, participants divided into three groups to discuss the issues related to climate change that they thought might impact the cities. Climate scientists from the National Council of Climate Change and CCROM attended the first SLD.



Organizers used participants' impressions and experiences with current hazards to focus the scope of the upcoming vulnerability assessments. Between SLD 1 and SLD 2, in February 2010, CCROM, Mercy Corps, and URDI conducted the vulnerability assessments in each city. As part of this analysis, a coping capacity index based on vulnerability and adaptive capacities, and a composite index of climate hazards, were overlaid onto maps to display the cities' sub-districts' vulnerability. The vulnerability maps, indices, and climate change projections were presented to participants at SLD 2. Semarang expressed some scepticism of the vulnerability maps, noting that some sub-districts marked as currently vulnerable to a type of climate hazard did not actually experience those hazards. Additionally, in one SLD in Bandar Lampung, a participant from the local BMKG office questioned the historic rainfall datasets that CCROM used, yet CCROM noted that the datasets in question were provided by the local BMKG office and that they had no way of checking for discrepancies in datasets. City partners found it difficult to understand the climate projections and how climate risk could increase so rapidly between the earlier projection period and the later projection period.

Chapters 5 and 6 describe in greater detail the vulnerability assessments and resilience strategy preparation process in Indonesia.

Overall, the main obstacle in Indonesia to incorporating climate analysis into the ACCCRN work was the disagreement over the datasets' validity. In contrast, in India, winnowing the broad field of available data to obtain the most reliable datasets was the primary limitation. However, partner (both city and national) interpretations of the available data created challenges in both countries, though with different results. In Indonesia, the inability to understand data in the format presented was an obstacle, while in India, city partners' misinterpretation of implications (i.e., Indore's focus on increased average annual rainfall rather than on changes in variability or extremes) challenged national partners' ability to communicate data.

GCMs Downscalead
(Bandar Lampung and Semerang)

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cnrm_cm3	miub_echo_g
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THAILAND

THAILAND

PERCEPTIONS AND PROCESS

TMD Thai Meteorological Department, under the Ministry of Information and Communication Technology

START Global Change SysTem for Analysis, Research and Training

SEA START Southeast Asia START Regional Center

The Thai Meteorological Department (TMD) under the Ministry of Information and Communication Technology has had responsibility for the collection and dissemination of historical climate data in Thailand since 1923 (TMD 2005–6). In addition to this role, TMD provides a number of other functions, including: short-term and seasonal forecasts for a variety of users (e.g., industry, agriculture, and tourism), monsoon forecasts, and monitoring of tropical cyclones. TMD's mandate extends to disaster monitoring (climate hazards as well as earthquake and tsunami) and early warning for the country.

The Southeast Asia START Regional Center (SEA START) is the research node of the Global Change System for Analysis, Research and Training (START) network in charge of conducting climate change research for Southeast Asia. SEA START's primary research focus is on statistical and numerical climate projections for the region, accomplished via operation of a pair of RCMs — PRECIS and CCMA. The center collaborates with meteorological agencies and academic research institutions in multiple countries and provides services to the Mekong River Commission. ■

PERCEPTIONS

Thailand joined ACCCRN much later than India and Vietnam, in November 2009. Perceptions about the role of climate information in the Thai research processes reflect the difficulties and experiences participants encountered, but do not yet reflect attempts to incorporate information into the city resilience strategies. These strategies were being developed as this chapter was written. Common observations include:

1. It is difficult to identify the types of climate information — e.g., which timescales and for which variables — are necessary for vulnerability and impacts assessment, and urban resilience planning. Because partners were initially unaware of what types of climate products existed, they did not know what data to request.

2. Partners are somewhat confused about emission scenarios, such as A2 or B2, and climate models and often conflate the two. City partners also do not understand uncertainty, projection ranges, and the necessity of utilizing projections from multiple models (if available) or being extremely cautious if results are available only from a single model.

3. City partners find it difficult to differentiate between the long-term impacts of climate change and the impacts of current climate variability, and thus they do not necessarily understand the implications both have for economic development and urbanization.

THAILAND

4. At the same time, city partners are willing to attribute existing environmental and ecosystem services problems, such as water supply shortages or flooding, to climate change rather current city planning processes and land use policies.

5. Thailand has had ongoing environmental awareness and climate mitigation campaigns, particularly at the city level, which have focused on saving energy, reducing use of plastics, reforestation, and recycling. However, additional climate vulnerabilities and the need to build resilience are not yet familiar issues for city partners.

6. Acquiring climate information can take considerable time, even when data requests and bureaucratic processes are minimal, as the TMD is chronically overwhelmed. Due to this delay, climate projections were not available to national and city partners before beginning the vulnerability assessment and SLD processes, so it was difficult for partners to characterize possible local climate impacts.

7. Data interpretation and verification can be difficult and time consuming, as datasets are often provided without explanation or context and in an unfamiliar file format. Partners found that some of the historical data were inconsistent,

requiring further time-consuming investigation to clarify data discrepancies.

PROCESS

Because Thailand joined ACCCRN after India and Vietnam, TEI could communicate with other national partners and learn from their experiences in accessing and communicating climate information to city partners. Prior to the start of the SLD process in Hat Yai and Chiang Rai, TEI hosted climate workshops (early 2010) in each of the cities to ascertain the level of city partners' climate literacy. Although Thailand has held multiple climate mitigation and environmental awareness campaigns for several years, the concept of climate adaptation is quite new to local government officials. Through group discussions, TEI gauged partners' familiarity with: 1) the term "climate change;" 2) how climate change might affect their livelihoods and communities; and 3) who is vulnerable to climate impacts and why. Responses indicated that city partners have a low level of comprehension about climate change complexities and little scientific-language capacity. In part, the Thai language hinders the capacity to understand internationally promulgated climate science terminology and concepts, because it does not distinguish between weather and climate. Additionally, partners indicated that they have had little access to climate information and that their limited science background in this topic made the concepts confusing. The climate workshops provided TEI with a critical initial knowledge and capacity assessment of city partners before beginning the SLD and vulnerability assessment processes.

Thailand has had ongoing environmental awareness and climate mitigation campaigns, particularly at the city level, which have focused on saving energy, reducing use of plastics, reforestation, and recycling. However, additional climate vulnerabilities and the need to build resilience are not yet familiar issues for city partners.

TEI introduced climate information to the city partners through the SLD processes. Based on the observations of the low climate science capacity of the city partners, TEI sought to use the first SLD to educate partners. Dr. Anond Snidvongs of SEA START attended the first SLDs in Hat Yai and Chiang Rai in February 2010 as a key speaker, presenting information on climate change and its significance to livelihoods and urban development at local, provincial, and national scales. However, detailed city level scenarios of future climate were not heavily addressed until the third SLD in each city in late 2010, with earlier discussions of vulnerability focused primarily on current issues facing the cities. Furthermore, TEI could not access relevant historical climate data and future projections until SLD 3. Only then, in September–October 2010, did TEI introduce climate projections to city partners and discuss them in terms of implications to vulnerable community groups and larger urban development processes.

TEI first requested precipitation and temperature data — both historical and projections — for Chiang Rai, the Kok River Basin, Kluong U-Tapao Basin, and Hat Yai in December 2009 from SEA START via email and a series of meetings between December 2009 and January 2010. Because of miscommunication, instead of daily information, SEA START initially provided yearly, simulated data — from the RCM PRECIS initialized with data from the GCM ECHAM4 — of average precipitation, T_{max} and $T_{min,}$ from 1980 to 2099


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for two emissions scenarios (A2 and B2) for Chiang Rai and Songkhla provinces. The yearly timestep of the modeled data allowed TEI to describe broad potential changes in rainfall and temperature trends, but not to explore possible changes in seasonal variation or extreme events. Furthermore, because the data came from only one model run with two emissions scenarios, TEI had very little information on potential ranges of change magnitudes or variability.

Thus, as first provided, the information was not very useful for TEI's research and lacked the necessary level of detail for resilience planning. TEI then requested daily data, including sea level rise projections for Hat Yai, from SEA START. A further complication with the data was that it was provided in a file format with which TEI had little experience and could not open. When the partners were finally able to read the data files, SEA START warned TEI that the data alone would not provide useful information without also considering the local context, such as hydrology, but that they did not have enough location-specific data to provide context or for verifying model bias. As TEI began to examine the data, they encountered discrepancies, such as in the precipitation data for Hat Yai that indicated the dry season receives more rain than the wet season in both the historic data and the model reconstruction of the historical period. All data is now under review by project partners, and they are working to rectify the data problems.

The issues encountered in the ACCCRN program are not unique. Other adaptation initiatives, both large and small, in developing and developed countries, face similar constraints. Despite these challenges, or perhaps because of them, individuals in the climate science and adaptation/development communities are beginning to recognize the need to change directions.

Each of the following examples highlight some of the challenges that arise when trying to effectively incorporate climate information into adaptation and resilience planning initiatives.

Risk To Resilience Program

http://climatetransitions.org

The Risk To Resilience Program (funded by DfID, NOAA, ProVention Consortium, and IDRC) was an initiative to explore the opportunities, constraints, and policies guiding community disaster risk reduction and climate adaptation strategies in select field sites in Nepal, India, and Pakistan. In particular, the program sought to identify and evaluate (in terms of their costs and benefits) pro-active disaster risk management strategies, including risk reduction and risk transfer. In addition to the language and conceptual differences about weather and climate between South Asian cultures and Western climate science, the program encountered difficulties in accessing quality data in a timely manner. Because some of the field sites were close to national borders, some of the national agencies refused to share climate and hydrological data, citing national security interests. In other field contexts, datasets were incomplete and inaccurate — some contained physically impossible numbers, such as negative streamflow. Some stream "gauge" data were collected via observation of where water levels reached marks painted on bridge pilings; however, during floods when the bridges had been destroyed or were underwater, the hydrologist just estimated flood levels and these became the official record. In another instance, government officials provided over two years' worth of daily temperature and rainfall data for five weather stations from memory. These data issues, among others, challenged the ability of the researchers to conduct traditional, quantitative, cost-benefit analysis and highlighted the importance of shared learning processes for overcoming information difficulties.

Adapting to Climate Change in China (ACCC)

http://www.ccadaptation.org.cn/en/index.aspx

The Adapting to Climate Change in China (ACCC) program, a collaborative effort between the Swiss, UK, and Chinese governments, seeks to improve understanding of potential climate change impacts in three Chinese provinces: Guangdong, Ningxia, and Inner Mongolia. The China Meteorological Administration, Chinese

Academy of Agricultural Sciences, Institute of Atmospheric Physics, and the UK Met Office Hadley Centre are all providing climate information, including high resolution projections, to the project partners. The four organizations began modeling efforts almost a year and a half before other partners began work on physical and social impact assessments and adaptation planning. Despite the advanced lead-time allotted for generating climate change scenarios and the heroic efforts of the climate organizations, the models are not yet complete. Other partners have had to begin their assessments without this information. Furthermore, while various project partners discussed how to meet impact assessment and adaptation planning information needs and how to make the information useful, it is unclear if project partners will be able to use the information when it becomes available. Each of the three (physical, social, and climate science) research groups has minimal interaction with each other and relatively few opportunities to coordinate research efforts.

New York City Panel on Climate Change (NPCC)
http://www.nyc.gov/html/om/pdf/2009/NPCC_CRI.pdf

The NPCC was established with support from the Rockefeller Foundation as part of an initiative by the city to develop climate change and impact scenarios, conduct risk assessments, develop and evaluate adaptation strategies and monitoring criteria that can help the city respond to climate change. When the city initiated the process and began engaging with a variety of stakeholders, the work plan was structured around the assumption that scientists would develop climate projections and impacts for the city, which would then be given to other stakeholders who would use the reports to develop adaptation recommendations and prioritize actions. Even though the U.S. is rich in climate data in comparison with many developing countries, it took the climate scientists approximately one year longer than planned to produce the requested information. The delay in developing projections and impact scenarios had both benefits and drawbacks to the project: it allowed time for more dialogue between the scientists and other stakeholders, and the scientists themselves became stakeholders in the process. The non-scientists gained an appreciation of how climate models operate, their limitations, and the necessity of considering uncertainty in urban resilience planning through the enhanced dialogue. Likewise, the scientists began to understand that different stakeholders had different information needs due to varying thresholds of concern — for example, energy utilities were concerned with different temperature thresholds than were public health officials. The downsides to the information delays were that project costs increased significantly, as did the time requirements for most of the stakeholders, who largely volunteered their time.

NEW DIRECTIONS FOR EFFECTIVELY COMMUNICATING AND USING CLIMATE INFORMATION

Relationships between the adaptation/development and climate science communities are still quite new and in exploratory phases. A shared understanding of each other's research methods, priorities, and goals does not yet exist, for many of the reasons discussed earlier in this chapter. Yet, a number of new directions are emerging, signifying the beginning of efforts to bridge climate science and adaptation science. Some of these directions are listed below:

New Directions

PROCESS-BASED

- Increasing calls for dialogue between climate scientists and the adaptation community, particularly through the IPCC process.
- Greater focus on shared learning through programs such as ACCCRN.
- The inclusion of climate scientists as stakeholders (but not dominant stakeholders) who are engaged early on, leading to greater capacity building for all stakeholders, such as in the New York City Panel on Climate Change.
- Groups actively investigating better ways of communicating climate information, such as the Center for Research on Environmental Decisions (CRED) at Columbia University.

INSTITUTIONAL

- Growing recognition of the need for individuals and organizations that can serve as information brokers. People who understand the science behind climate information production and are engaged in adaptation research could bridge disciplines, foster dialogue, and serve as information translators.
- Development of multidisciplinary advanced degree programs that require training in physical and social science, some in the context of climate adaptation or climate information communication.
- Groups calling for better communication efforts emerging in the climate science community; they are simultaneously attempting to educate themselves and engage in social science research methods, adaptation, and disaster risk reduction. Such groups include the Weather and Society*Integrated Studies (WAS*IS) or the UK Climate Impacts Program (UKCIP).

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SCIENCE

- A tacit acknowledgement by the Conference of Parties that climate projection data included in the next IPCC assessment needs to be more user friendly (although this is not defined) and respond to near-term policy perspectives, while continuing to investigate the potential longer-term climate change patterns and impacts.
- Dialogue about the need for the extreme threshold analysis conducted by climate scientists to support the critical thresholds pertinent to health care providers, agriculture extensions, energy analysts, etc.
- Climate modeling initiatives to produce higher resolution projections for all parts of the world such as the Co-Ordinated Regional climate Downscaling Experiment (CORDEX) initiative or efforts to make RCMs available to scientists in developing countries along with assistance to run the models.

TECHNOLOGICAL

- Calls for an international data repository of historical and climate projection data that are available online for free or minimal charge through the World Meteorological Organization.
- An increase in the number of climate science articles that are now being published as open source, allowing for free access.
- Joint initiatives between scientists, artists, and adaptation experts to depict regional- and local-scale climate projections or impact scenarios in multiple formats — from GIS layers and maps to audio documentaries and videos. Such initiatives, which include the new Google Earth climate layers, are still struggling to figure out ways to present uncertainty and projection ranges.

RESOURCES AND ACTION STEPS

Finally, this chapter ends with a short criteria list for evaluating the growing number of websites offering climate information products, as well as links to a few select sites that meet most of the criteria. Web-based data portals now offer individuals around the globe, including those in developing countries, unprecedented access to information and climate data. However, as with anything on the Internet, some sources are unreliable or poorly inform potential users about data limitations. Adaptation and mitigation decisions that are based on poor or incomplete information are likely to be maladaptive and attempts to rectify them are likely to be costly.

Criteria for Selecting Web-Based Climate Information

- Scientific concepts are presented clearly and in non-technical terms.
- Climate impacts, if discussed, are meaningfully related to experiences or situations that are relevant to particular user groups. For example, this can include discussions about how projections indicate that the number of heat wave days (say temperature above 40°C) might increase between 10 percent and 50 percent when compared with the last decade and that companies should consider relaxing their dress code on these days.

Websites containing datasets should:

- Educate potential users about uncertainty and the necessity of using multiple projections from multiple models.
- Clearly describe the methods by which historical data were gathered and quality controlled or the method used to downscale the climate projection data.
- Provide a cautionary note describing data limitations and what is NOT appropriate to do with the data.
- Provide clear directions on how to download the data and read it.
- Provide the data in a common format that can be easily imported into Excel or as GIS-layers.
- Allow projection data that can be easily compared to a clearly defined historical reference period in order to demonstrate what the changes mean.
- If possible, allow users to “play” with projections from multiple models, multiple emissions scenarios, and for multiple time periods, so that they can observe uncertainty and how the climate responds differently depending on the scenario.

Criteria for Selecting Web-Based Climate Information

Climate Data Products:

- Climate change in Australia
  http://www.climatechangeinaustralia.gov.au/index.php

- Climate Systems Analysis Group (CSAG)
  at the University of Cape Town
  http://data.csag.uct.ac.za/

- India Water Portal
  http://indiawaterportal.org/metdata

- Canadian Centre for Climate Modelling and Analysis
  http://www.ec.gc.ca/ccmac-cccma

Communicating Climate Information:

- Center for Research on Environmental Decisions (CRED)
  at Columbia University of New York City
  http://www.cred.columbia.edu/guide/guide/sec1.html

- George Mason University:
  Center for Climate Change Communication
  http://www.climatechangecommunication.org/

Climate Concepts

- UK Climate Impacts Program (main website)
  http://www.ukcip.org.uk/

- Understanding climate change (thematic link under main site)
  http://www.ukcip.org.uk/index.php?option=com_conten
  t&task=view&id=73&Itemid=186

- Tools to help in adaptation and resilience planning (thematic link)
  http://www.ukcip.org.uk/index.php?option=com_conten
  t&task=view&id=74&Itemid=187

- From Risk to Resilience: Responding to Climate Change
  and other Natural Hazards through Adaptive Risk Reduction
  (project website with detailed information and methods)
  http://climatetransitions.org

- The Resilience Alliance
  http://www.resalliance.org/1.php

- weADAPT
  http://www.weadapt.org/

COMMON OBSERVATIONS

- There is no consensus and little common understanding, on the part of climate scientists and those engaged in adaptation work, about the appropriate role for climate information. What information is needed to support adaptation? How should it be presented? When can and should it be used in adaptation processes?

- Quality information at a scale useful to adaptation planners is difficult to access, even with many resources now available on the Internet.

- Non-climate scientists have limited capacity to assess climate information and determine its source, quality, associated assumptions and uncertainty, and the appropriate contexts for its use.

- Non-climate scientists are sometimes made to feel "technically inadequate" by some scientists when they cannot use scientific information. This makes important stakeholders reluctant to voice concerns or request assistance in accessing, interpreting, and using information.

- Some climate scientists are reluctant to explain the assumptions used to generate projections or the uncertainty inherent in the data. This reluctance reflects fears that non-scientists will dismiss data if assumptions and uncertainty are disclosed, and that uncertainty will be used as an excuse for inaction. This reaction is also a result of attacks on climate scientists and their integrity by groups convinced that climate change is a hoax.

- Climate information is typically presented in a form that is of limited value to planning processes and timeframes because the climate science community does not understand important thresholds and impact areas of concern to users in different sectors and backgrounds.

- Similarly, users are typically unable to frame requests to climate scientists in a way that would help them to see how existing data could be usefully presented.

- While there is a surplus of global-scale information, many developing countries lack local-scale historical information and have limited ability to validate climate model performance. In addition, there are few high resolution projections for developing countries, and the uncertainties in projections that do exist are difficult to quantify and interpret.

- Climate science is evolving. With a growing investment in both observation and modeling, as well in paleo-climatology, our knowledge of climate systems is likely to develop rapidly over the coming decades. As a result, scientists will revise projections and reduce uncertainty, though never eliminate it, in those projections.

PRACTICAL SUGGESTIONS TO MAKE CLIMATE INFORMATION MORE USEFUL IN ADAPTATION

- Climate scientists need to recognize the diverse array of users in adaptation projects. Such users may include, for example, community-based organizations, international NGOs, utilities managers, city governments, or private corporations. Each type of user has different capacities to both articulate their needs and understand information.

- There is a crucial need for "climate extension services" — specialized groups who can serve as intermediaries by helping translate climate science into information useful for various groups and by helping user groups articulate information requests in technical terms. Such brokers would need to have cross-disciplinary expertise in climate science, statistics, data management, and presentation, as well as strong communication skills and broad familiarity with the specialized needs of different users.

- Effective adaptation decisions should rely on evidence from climate science, which is itself value-laden, but they also inevitably reflect the values and priorities of local social, economic, environmental, and political interests. Climate scientists and other expert information providers play important roles in adaptation decision making, but they should not drive the process.

- Adaptation programs should be premised on shared learning and early engagement between knowledge holders and other stakeholders, including donors and managers. Shared learning is essential to setting adaptation goals, discovering concerns, and starting a dialogue among groups that will reveal information gaps and the needs and assumptions of users. Making climate products useful to people, or recommending what information (not just related to climate) is needed and when and how it can be used in the program or intervention, is difficult without knowing what people understand about climate change and what they find confusing.

- Shared learning requires a significant time commitment and is unlikely to be effective through one-off interactions.

CHAPTER 4

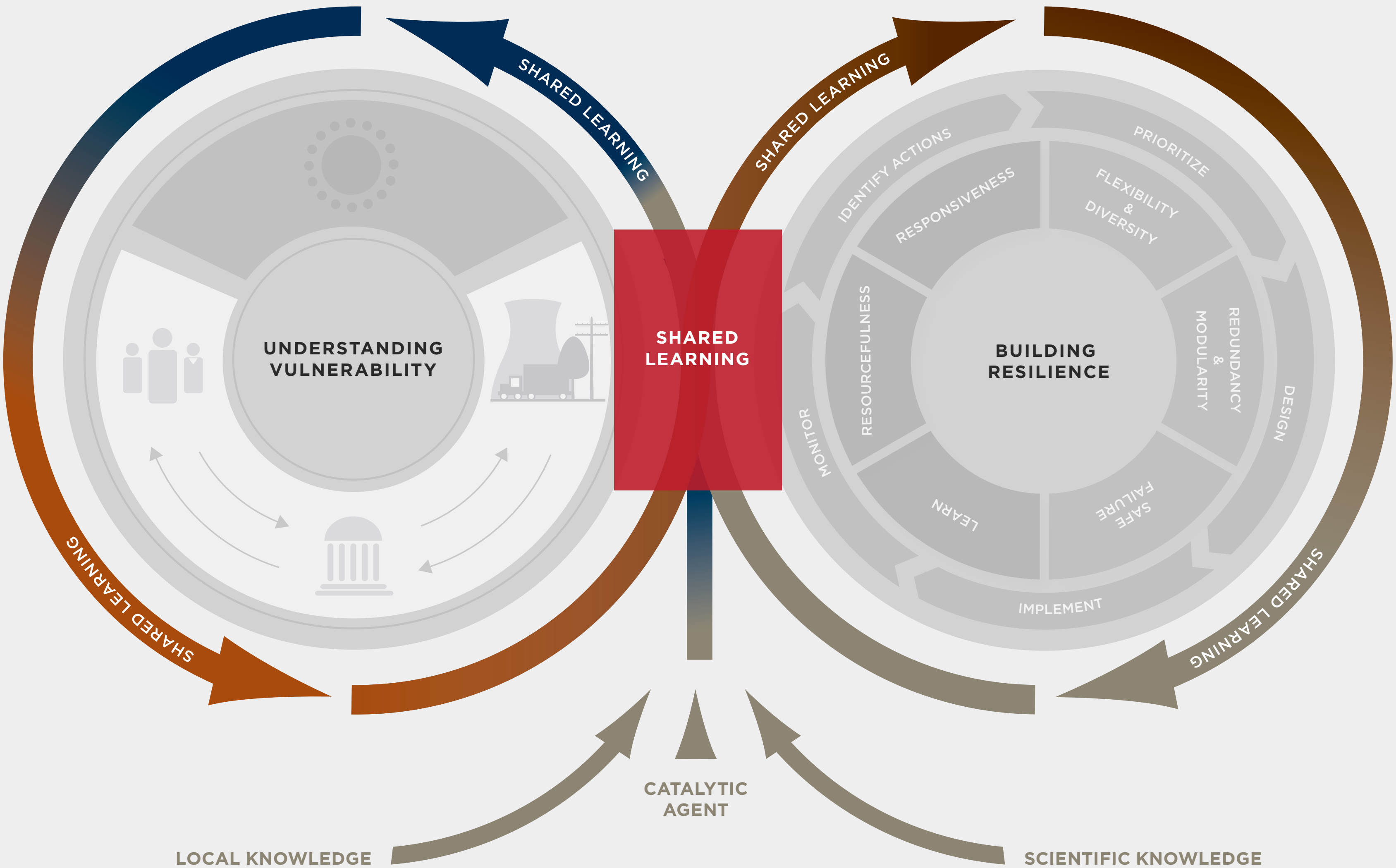
THE SHARED LEARNING DIALOGUE

BUILDING STAKEHOLDER CAPACITY AND ENGAGEMENT FOR CLIMATE RESILIENCE ACTION

Sarah Orleans Reed, Greg Guibert, and Stephen Tyler
with Marcus Moench

FIGURE 4.1 | The Urban Climate Resilience Planning Framework: Shared Learning

This chapter will focus on the shaded area that links the two loops of the resilience planning framework: the shared learning dialogue process (SLDs). Shared learning is a fundamental part of resilience planning. SLDs help to cross barriers and initiate collaboration across sectors and scales, introduce scientific knowledge into local contexts, and drive action over an extended period of time.



INTRODUCTION

As a global phenomenon with profoundly local consequences, climate change represents a unique challenge. Generating effective responses to climate change requires understanding both emerging global scientific knowledge as well as the range of local factors that shape climate change's effects on individuals, communities, and local ecosystems. It also requires overcoming the significant divisions that typically exist between sectors and disciplines within a locality. To that end, ISET, along with local partners, has developed and piloted the shared learning dialogue (SLD), a stakeholder engagement process born from strong roots in participatory action research.

This chapter outlines the underpinnings and key characteristics of the SLD process. ISET has successfully applied SLDs in a number of Asian contexts to facilitate learning and generate options for responding to current and future climate conditions. We offer a number of examples and key lessons from the ACCCRN project, as well as more rural examples from Pakistan and Nepal, to illustrate the utility and challenges of using a shared learning approach to understanding climate change risks, impacts, and resilience.

THE CHALLENGE

Whereas academic findings and national or international policy largely shape understandings of climate change, its impacts occur at the local level, where governments, organizations, and individuals must ultimately take action on adaptation. The ways in which people change, adapt, and respond to climate challenges will vary greatly depending on a variety of local factors, including geography, economic opportunities, culture, and political and social constraints; these variables may, in many instances, be poorly anticipated or understood in national or regional planning efforts. Effective adaptation requires processes that integrate global and local sources of information, assembles key actors from diverse backgrounds and arenas, and generates common understanding to address the complex direct and indirect impacts of changing climate regimes. Only through such crosscutting engagement can relevant actors identify and develop ownership over effective, practical climate adaptation actions.

Generating effective responses to the consequences of climate change requires understanding both the emerging global scientific knowledge as well as the range of local factors that influence the effects climate change has on individuals, communities, and urban systems, including ecosystems. For many local actors and institutions, however, the results of scientific research and modeling are often inaccessible both logistically and conceptually; and, conversely, localized information is regularly unavailable to scientific entities at national or international levels. ISET developed the shared learning dialogue process as a mechanism that can effectively parlay information into understanding and action at meaningful scales. The purpose of the SLD process is to bridge this information divide and create understanding of complex climate and natural resource scarcity issues among diverse actors and institutions in order to better enable effective local responses.

The need for integrated, interdisciplinary processes to build climate change resilience is well established (Tompkins and Adger 2004) and integrating local and scientific expertise increasingly is seen as a key aspect of participatory processes for environmental management (Reed 2008). ISET views this hybrid scientific-local knowledge interaction as essential for climate change adaptation. As described in chapter 2 of this publication, understanding urban climate vulnerability and building resilience requires an appreciation of the capacities of individuals, households, and many different organizations, as well as an appreciation of the constraints of systems and institutions.

In order to understand climate vulnerabilities, planners must seek information from private sector actors, local communities, and local stakeholders like water and energy sector managers. Shared learning

dialogues aim to bridge not only the gaps between local and global scale processes, but also different kinds of knowledge and the significant divisions that typically exist between sectors and disciplines. They can, for instance, help stimulate interaction and innovation between sectors such as water and energy, health services, industry, and transportation — the benefits of which may reach beyond the initial climate issue to other development goals. In addition, the history of planning and development demonstrates that however well external "experts" understand issues, those who will be responsible for taking local action must have ownership over the responses in order for them to be effective (Stiglitz 1998).

The following section outlines the key characteristics of the shared learning dialogue process.

Shared learning is an approach to participatory planning and problem solving in complex situations, characterized by non-extractive, mutual learning. The concept of shared learning is straightforward: fostering iterative deliberation and sharing sector- or group-specific knowledge and experience, as well as knowledge from both local practitioners and from external experts, will improve the quality and effectiveness of decision making.

The shared learning process helps both decision makers and those with a stake in outcomes to understand a fuller spectrum of factual conditions and operational constraints and to better recognize the available sources of information and their quality. When iteratively and carefully enacted, shared learning can also help to break down established disciplinary and cultural divides that cause groups to reject or discount sources of information, insights, and perspectives that challenge their world views (see Kahan 2010 for examples in the climate change debate). This evolving understanding can assist decision makers in public and private sectors, civil society, communities, and households to jointly and separately identify possible interventions, target potential constraints, and set priorities for collective and independent actions.

Shared learning processes focus particularly on social learning, and in doing so, contrast with more conventional development or research processes. It is often the case that external actors base plans or recommendations on information extracted from local sources, or that external facilitators seek to implement existing development priorities of local partners without introducing new information that would materially affect those priorities. External experts like social and natural scientists are important players in social learning, but they should not drive the process. Their task is to validate and share various kinds of knowledge; to expose assumptions; to help structure experiments capable of generating useful new information; and to apply data collection, management, and analysis tools in support of questions that arise from various players

Deliberative processes are particularly useful in building resilience because they not only assure broader interpretation of knowledge from diverse perspectives, but they also build shared understanding of the values that underlie positions and interests.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in the process (see chapter 3 for a discussion of how climate information has been applied to planning in ACCCRN). The unique aspects of social learning foster innovation through deliberation, collaborative investigation, and shared power, as well as relationship building, better communications, recognition of mutual interest, and greater empathy (Delli Carpini, Cook et al. 2004; Forester 1999).

Deliberative processes are particularly useful in building resilience because they not only assure broader interpretation of knowledge from diverse perspectives, but they also build shared understanding of the values that underlie positions and interests; in doing so, deliberative processes help generate consensus and capacity for collective action (Forester 1999). These attributes develop decision makers' capacity to understand context and alternatives as conditions change and decisions need to be revisited (Tyler 2009).

ISET uses the term "shared learning dialogues" in part to distinguish this approach from other types of stakeholder meetings in which mutual learning is not the main purpose and participants may be more homogenous. For example, many "workshop" events are intended either primarily to transmit information from a trainer to participants, or conversely to enable a researcher to collect information from participants; while other meetings of peer groups are intended to make decisions. Shared learning dialogues build on lessons in social science theory and in professional practice. ISET has used SLDs in South Asia to explore climate adaptation and resilience practices at a micro level in a wide range of diverse field contexts (Risk to Resilience Study Team 2009). The approach has proven highly relevant at many scales, in urban, rural, and peri-urban or *desakota* contexts, and with stakeholders from the village to the national level (Desakota Study Team 2008).

Genuine dialogue and deliberation among stakeholder participants is a defining characteristic of SLD engagement. SLDs can vary in size, composition, format, and structure depending on the context, objectives, and strategic decisions of the facilitator. An SLD, as practiced by ISET, has the following key attributes (see Figure 4.2):

- Information sharing is multi-directional: Local stakeholders representing disparate sectors, scales, or perspectives should learn from each other; they should also learn from international knowledge presented by external experts, and external experts should learn from local stakeholders. The development of understanding, therefore, is mutual.

- The process involves stakeholders in an open manner: Participants from diverse groups, interests, and official responsibilities can contribute their views and experiences. They have time to absorb and think about the information and perspectives of different groups before they interact again and work towards the development of specific mechanisms for responding to climate change risks.

- The process crosses scale, community, organizational, and disciplinary boundaries: Shared learning dialogues bring together local, regional, national, and global scientific perspectives and seek to overcome knowledge systems divides typical of sectors. The dialogues will occur at multiple levels where engagement is necessary to catalyze effective action.

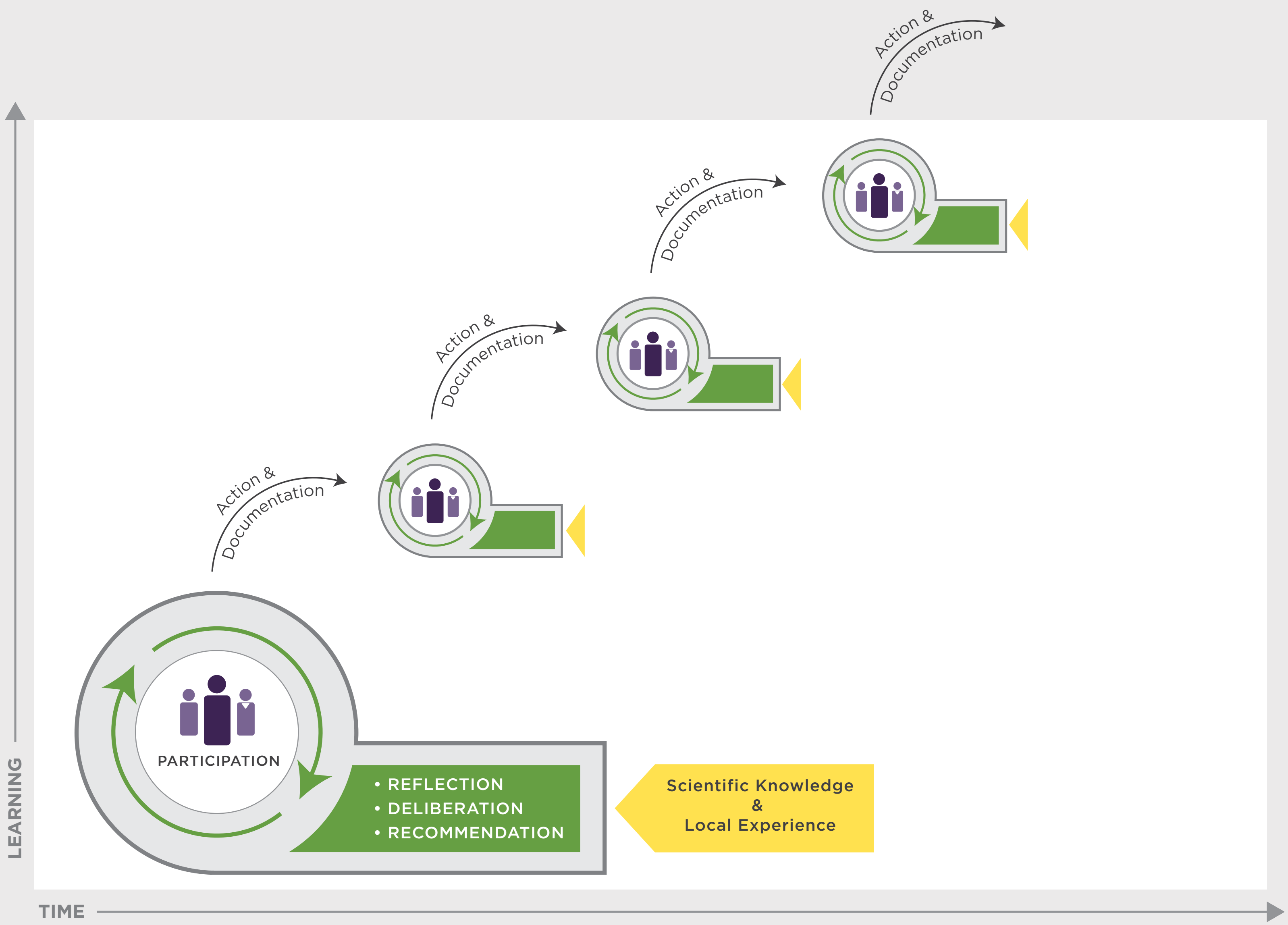
- The process is iterative: Participants have multiple opportunities to share, generate, and understand new knowledge.

These characteristics may be achieved through a variety of formats, methods, and sequencing. For this reason, a critical aspect is that the shared learning process should be planned strategically to contribute to project objectives by facilitators with strong understanding of the local context. In the case of ACCCRN, for example, the project objectives in Phase 2 were to engage local stakeholders and to generate a city-based resilience strategy that would prioritize specific proposals for action to strengthen resilience of the most vulnerable groups in the city. The shared learning process was designed to iteratively build understanding of city vulnerabilities and then to plan for measures to increase resilience.

In addition to strategic preparation and planning, ISET's experience suggests that successful shared learning processes require a substantial time commitment — a minimum of several months to several years, depending on the project scale and the degree to which stakeholders differ initially in their level of understanding and openness to new knowledge. The wider the initial divides, the more time that will probably be required. Substantial time allocations are also essential to ensure that process leaders and facilitators are able to reach the full spectrum of stakeholders, absorb and contextualize new concepts, conduct sufficiently rigorous research, and incorporate new knowledge into planning processes. ISET has learned that the components of the planning process must also be iterative, consistently reassembling stakeholders, revising understandings of vulnerabilities, and testing and evaluating possible actions. Finally, skilled meeting facilitation, as well as the presence of a core group of stakeholders whose engagement is crucial to action, are critical to the overall effectiveness of the process.

The SLD process is not simply a series of meetings but rather a semi-structured and strategically facilitated succession of interactions that should include significant opportunity for all stakeholders to participate and dynamically interact. This can prove challenging and, in some contexts, frustrating for organizers and participants alike. Depending on

FIGURE 4.2 | **Shared Learning Process: Iterative Approach**



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the ways in which they are designed, SLDs can challenge conventional power dynamics, confound existing and seemingly well-established doctrine and understanding, and induce interaction between institutions and actors in ways that can feel foreign and uncomfortable to their cultural expectations. Because the structure and composition of an SLD process can be highly adaptable and malleable, to meet the needs of the organizers as well as the social context, the facilitator may choose to use any number of tools and techniques to generate discussion and interaction. However, the organization convening the SLD process can enhance its success before beginning the process by clearly understanding how the integration of global and local knowledge can further the project objectives and by engaging a skilled facilitator familiar with local issues, power structures, and sensitivities.

Multiple iterative sessions allow for sequential growth in understanding and typically lead to increased levels of comfort and more meaningful dialogue among participants. Early meetings can be intensive discussions used to develop baseline appreciation for the need of the dialogue process, some measure of trust and respect among diverse actors, and a common understanding of the issue being addressed. Later iterations may focus on incorporating cooperatively generated information, such as assessments of local vulnerability and risk, into the pool of common knowledge; or they may aim to create further opportunities to understand the complexities and nuances of how global trends such as climate change and urbanization will interact in nonlinear ways to affect local response opportunities and priorities. The spacing of the SLD gatherings is also flexible; the need to balance process momentum together with the time needed to absorb new information, appreciate new relationships among actors and institutions, and generate meaningful new knowledge inputs into the dialogue all influence the spacing of the meetings. Finally, because iteration in the SLD process is central to the sequential development of understanding, a core group of regular participants is required, although not all participants need attend every gathering, and new participants should be welcomed for their fresh perspectives and contributions.

As introduced in chapter 2, shared learning processes are central to building urban climate resilience. On one hand, the diagnostic processes of vulnerability assessment require interaction between climate scientists, local experts knowledgeable in the function of urban systems, decision-making actors, and marginalized agents whose vulnerability might not be recognized by others. The iterative interaction among these groups and their different knowledge domains is crucial to building a clear analysis and common understanding of potential urban vulnerabilities to climate change. On the other hand, design of resilience-building actions also requires iterative engagement between technical experts, system users, and marginalized groups who need access to those systems in order to actualize their resilience capacities (see chapter 2).

Monitoring the results of resilience-building actions similarly requires the scientific experts, local system operators or managers, users and intended beneficiaries to reach a shared interpretation of outcomes. We describe below how the SLD process was applied in different city contexts throughout Phase 2 of the ACCCRN program.

SLDs IN PRACTICE: DESCRIBING THE ACCCRN EXPERIENCE

In all ten cities involved in the ACCCRN program, the SLD process was employed as the key tool for early stakeholder engagement and for guiding and interpreting other inputs to resilience planning. ISET chose the SLD process over other methods of engagement because of previous successes in Pakistan and Nepal (described briefly below) in bridging the global science and local knowledge divide on related issues and because of its structural and contextual flexibility given the diverse contexts of ACCCRN cities. The flexibility of the SLD process, which can be designed by local organizations to meet the specific needs and goals within their own social, cultural, and political boundaries, meant that the SLDs in practice were conducted in a variety of formats, employed a range of methods, and had different sequencing.

ISET, in its role as regional advisor to ACCCRN partners, designed a structured sequence of inputs and outputs into the SLD process, as a guideline. The general model included vulnerability assessments (encompassing hazards and social vulnerability), sector studies focusing on particular issues of concern, and pilot projects to test early interventions on a small scale. A City Resilience Strategy was designed as the key milestone at the end of an initial engagement process (see also chapters 6 and 7 of this report, about the process and results of resilience planning).

The objectives of shared learning in ACCCRN, as originally outlined to partners, were to:

- Engage key actors and identify critical climate risks and potential responses that build resilience;
- Build ownership among stakeholders necessary for successful implementation;
- Overcome knowledge divides and coordinate across scales and sectors;
- Engage vulnerable groups;
- Build understanding of divergent interests of stakeholders;
- Compile and make accessible relevant local information sources.

In practice, however, objectives and emphases for the shared learning process varied between cities and partners. While ISET suggested the sequence, the nature and content of the inputs was ultimately driven by the engagement of stakeholders through SLDs. The inputs were intended

Shared Learning Dialogue Process in Nepal and Pakistan

Examples from previous ISET work demonstrate the way in which SLD processes can be tailored to the specific needs and objectives of a project. ISET and its partner organizations applied SLD processes extensively in the "From Risk to Resilience" project, a cost-benefit analysis of disaster risk reduction and climate change adaptation measures in specific rural, peri-urban, and urban sites in India, Nepal, and Pakistan. As in ACCCRN, Risk to Resilience was an action research program designed to catalyze new relationships and action on a local level and test research methods (vulnerability assessments, climate downscaling techniques, climate and hydrological modeling, and cost benefit analysis). Qualitative and quantitative results were used as input for in-depth evaluations of flood, storm, and drought risk reduction measures. Beyond this, the team evaluated the robustness of cost-benefit itself as a tool for decision-making (Risk to Resilience Study Team 2008).

The process applied in Nepal and Pakistan resembled more closely the ACCCRN style of engagement in India than in Vietnam, Thailand, or Indonesia; facilitators from the Risk to Resilience study teams conducted a combination of individual meetings, multi-stakeholder meetings, homogenous group meetings, and focus groups rather than holding several large multi-stakeholder meetings. In general, iterations with each group or individual occurred three to four times. The Risk to Resilience research team functioned as the core group for retaining and transmitting knowledge generated throughout the process. Though the project spanned a similar timeframe as ACCCRN, the teams held many more SLDs in comparison.

The Risk to Resilience research teams conducted SLDs on national, regional, and local levels. They sought involvement from institutions, agencies, and organizations involved with disaster response, management, and development, as well as from communities identified as vulnerable. Meetings were deliberately designed and structured with specific inputs and outputs. Individual meetings were generally preferred when meeting with national level actors or experts to create a comfortable environment for representatives to share policy details and insights about institutional operations, and/or to prepare individuals for larger multi-stakeholder gatherings. Through sharing knowledge between research team representatives and stakeholders, these meetings sought to promote cross-fertilization, build awareness and capacity within those institutions, and create opportunities for relationship building and coordination.

In contrast, small, homogenous, group meetings were utilized in community contexts, similar to their application in ACCCRN vulnerability assessments. These group meetings employed a variety of participatory rural appraisal tools to generate discussion of hazards and responses. In Pakistan, for instance, facilitators applied hazard matrixes and maps, problem trees, preference ranking, problem/solution preference ranking, cost benefit matrices, funding matrices (to assess financial needs and burdens during and after disasters), and climate and weather matrices. In Nepal, community focus groups lasted as long as two and a half days.

The analyses conducted as part of the SLD process produced a systematic inventory of hazards, response strategies, cost and benefit areas associated with each strategy, and a relative weighting of those costs and benefits. In addition, unlike conventional cost-benefit analysis, the methodology incorporated less quantifiable measurements such as livelihood resilience, social equity, and environmental quality.

Five Main Steps of the Nepal Shared Learning Process

1. Scoping, initial engagement, and secondary review to identify areas affected by and vulnerable to floods, along with local perceptions regarding existing governmental and community or individual strategies for responding to them.

2. Intensive shared learning dialogues with local communities and key actors to identify key risks and the array of potential response strategies. These included 1) discussions on the nature, condition, and location of flood mitigation measures that had been implemented by the government (e.g., embankments); 2) identification of autonomous responses; and 3) introduction and evaluation of the ways in which climate projections affected perceptions of risk and major challenges.

3. Intervention-specific evaluations and technical studies to identify key risk management measures, both the more centralized structural intervention of embankments and softer, dispersed responses. Benefits and negative outcomes of both were evaluated with communities through group SLDs.

4. Ranking and related techniques to allocate relative magnitudes or “weights” to perceived benefits and cost elements. Facilitators used ranking tools to access perspectives and insights from local communities, and additionally to present external information previously unavailable to the communities.

5. Identification of changes in perceived benefits and costs to determine the robustness of disaster management strategies under projected climate change scenarios and the direct and indirect costs associated with the types of strategies.

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to proceed in a roughly chronological sequence prior to formulating resilience strategies or intervention proposals, but in reality, logistical delays and ambitious funder timelines often required that these stages overlap. Indonesian and Thai cities began their resilience planning processes later than those in Vietnam and India, and thus had even less time to complete the process.

In general, the citywide scope of ACCCRN shared learning meant engaging a very broad group of stakeholders. Participants included government departments and officials, social and environmental NGOs, university faculty and researchers, vulnerable communities (reached through focus groups or community representatives), members of the private sector, and external climate resource people. These participant groups involved governmental and agency decision makers to increase the possibility that tangible action would be taken as a result of the ACCCRN interactions.

Shared learning processes in Vietnam, Indonesia, and Thailand were structured around three to five large, multi-stakeholder SLDs held over a period of ten months to one and a half years (the timeline varied between countries). These assembled 40 to 60 attendees and used a combination of plenary presentations, question/answer sessions, and small-group breakout discussions. They were fairly formal gatherings held in government buildings or professional conference venues and were generally kicked off with opening remarks by a government official. In many of the engagements, high-ranking government officials such as the mayor attended the first SLD and welcomed participants. The meetings were highly structured and facilitated, normally lasting an entire workday, and convened both local stakeholders and national technical resource people such as climate scientists. Each of the cities formed a "working group" composed of core stakeholders who met regularly to collate information generated from the process and conduct analysis for resilience planning (see chapter 6 for a description of the entire resilience planning process in each country).

In India, in contrast, country partners (GEAG and TARU) conducted a series of one-on-one and small-group meetings to share knowledge among a large and diverse set of stakeholders, rather than holding large multi-stakeholder gatherings. When larger multi-stakeholder gatherings were employed, they were not always structured as an SLD as defined above. In India too, a core group was formed in each city that was known as the city advisory committee (CAC — Indore and Surat) or city steering committee (Gorakhpur). ACCCRN country partners — TARU and GEAG — played a strong role in driving the process with these groups, although the degree of ownership and participation from the city stakeholders varied among cities.

In meetings, facilitators employed a variety of tools to stimulate discussion and knowledge exchange. These included:

- Breakout discussion groups: Facilitators usually provided a prescribed set of questions depending on the specific context — for instance, "What are the most vulnerable groups or districts in the city?" or "Do you agree or disagree with the conclusions of studies presented?"

- Matrices: Participants used matrices in breakout sessions to help identify vulnerable populations, areas, and sectors.

- Ranking exercises: During some breakout sessions, groups ranked vulnerabilities, projects, or proposed activities based on criteria provided by facilitators. This was how participants provided input for the selection of pilot projects and sector studies, as well.

- Note cards: Participants in some cases were encouraged to write comments and questions on note cards as a means of providing feedback when time was limited or for ensuring participation of those less comfortable presenting their views publicly.

- Scenario development: At various stages of the process, facilitators used scenario development as a visioning exercise or to inform resilience planning. In Thailand, in the first SLD workshop facilitators presented and requested participant input for envisioning three future climate and development scenarios. Group SLDs in India conducted a similar exercise at the beginning of the resilience planning stage.

SLDs in Indonesia, Thailand, and Vietnam followed a similarly structured sequence of meetings and inputs. In between official SLD interactions, stakeholders participated in vulnerability assessments, sector studies, pilot projects, and resilience planning activities, which kept them engaged in the process and also generated new information and engaged specific "vulnerable" populations. In particular, partners conducted focus group sessions or community surveys for the vulnerability assessments to inform the shared learning process.

Specific features of the processes in the four countries are described in detail in the next section of this chapter.

SLDS IN ACCCRN PHASE 2: LESSONS AND CHALLENGES

At the conclusion of Phase 2, ISET staff interviewed ACCCRN country level partners about their experience with the SLD process. Overall, ACCCRN partners expressed positive experiences with SLDs. In Vietnam and Indonesia in particular, the types of interactions held through SLDs were ground breaking, as the types of stakeholders that participated in SLDs do not frequently meet or share ideas under normal circumstances. Partners generally cited the importance of active and knowledgeable facilitators and deliberate meeting structure with planned inputs and outputs. Meeting ACCCRN-mandated timelines proved challenging across all cities, especially in Indonesia, where shared learning processes began several months after India and Vietnam, but the timeline for outputs into the larger resilience planning process was similar. The capacities, leadership skills, availability, and enthusiasm of working group and CAC members have demonstrably influenced the nature of SLDs and resilience planning in each city. A number of key lessons are cited below:

Structure

Most partners felt positive about the process of sequencing new knowledge inputs for SLD discussions. They agreed strongly that planners should inject new information into each interaction so that the process evolves at each stage and holds the attention of participants. All partners confirmed the need for considerable planning and preparation in advance of SLDs and for clearly defined inputs and outputs.

In the ACCCRN experience, the multi-stakeholder meeting format demonstrated a number of advantages in promoting transparency, formation of partnerships, and multi-directional learning. They also provided useful project milestones both for planners and stakeholders, but this was a double-edged sword as the "must accomplish" timing often disrupted the organic evolution of the city learning and capacity building process.

Timeframe

Partners were aware from initial stages of ACCCRN that the program was quite ambitious in scope and demands, given the relatively limited engagement period. The timeframe proved even more challenging than initially expected, because partners consistently postponed SLDs or extended information collection and analysis tasks between SLDs.

Communicating Uncertainty and Climate Concepts

The compressed timeframe also created communication difficulties for the meetings. Partners responded that introducing climate change concepts and ideas about planning for uncertainty was challenging and time consuming (see chapter 3). They feared that without establishing shared understanding, participants with a higher level of understanding would move forward without other stakeholders, who would then continue to focus on existing rather than future problems. In addition, Vietnamese and Thai partners both expressed the need to "check" participants' understanding of key concepts through side discussions in breakout sessions. Thai partners accomplished this through holding a climate workshop before the SLDs, as well as several workshops during the SLD process. Indian partners found that diagrams showing causal loops provided a useful tool both for explaining vulnerabilities and eliciting inputs.

Engagement and Crossing Barriers

The shared learning dialogue process has been effective for engaging groups that would otherwise not interact, building partnerships, and promoting joint implementation. In Vietnam, partners noted that the participation of local community-level leaders in discussion with senior city and national officials was unusual; similarly, in Indonesia, NGOs do not usually work directly with government officials. In this way, partners felt that the multi-stakeholder SLDs created an unprecedented space for learning and interaction.

As described above, the composition of the groups represented in the SLDs varied between cities for a number of reasons. With the exception of the Indian cities, involvement with formal private sector actors and industry representatives was minimal and was identified as a weakness in the resilience planning process. Vietnamese and Thai partners also highlighted the need to involve youth and students in order to build new attitudes and awareness among the next generation of professionals.

The involvement of high-ranking officials such as city mayors (India, Thailand, and Indonesia), municipal commissioners (India), and vice chairmen of city People's Committees (Vietnam) helped attract participation from government departments and other organizations by demonstrating political commitment to the issues.

Engaging Vulnerable Groups

One intended outcome of ACCCRN is to build the resilience of vulnerable groups to urban climate change impacts. The ACCCRN experience suggests that reaching vulnerable groups and engaging them in the shared learning process requires a multi-layered approach, in which SLDs, vulnerability assessments, and pilot projects each play a role. In Vietnam, Thailand, and Indonesia, representatives of vulnerable communities participated in large multi-stakeholder SLDs. This helped ensure that the experiences of these communities were included in the growing body of knowledge and understanding; that design of vulnerability assessments, sector studies, and pilot projects reflected their priorities; and that the community representatives themselves developed a greater understanding of their vulnerabilities to take back to their community constituencies.

Large meetings promote multi-directional knowledge sharing by gathering all parties in one place — yet they may also constrain knowledge sharing of certain partners who cannot attend these meetings or feel uncomfortable in that setting (i.e., many women, marginalized groups, and representatives of poor communities). However, many partners were conscious of the limitations of multi-stakeholder meetings for engaging populations that are poor and/or marginalized. Partners identified the significance of unequal power dynamics during the interactions that can lead to dominance of certain perspectives and marginalization of others. Unequal power dynamics can be mitigated to some extent by skilled facilitation and alternative communication tools (mapping exercises, note cards, small breakout sessions, etc.).

The ACCCRN experience and the history of participatory processes in development work in general demonstrate the need for multiple methods of engaging poor populations in shared learning processes. In all cities, community-based surveys and focus groups conducted through vulnerability assessments allowed for much greater insight

Large meetings promote multi-directional knowledge sharing by gathering all parties in one place — yet they may also constrain knowledge sharing of certain partners who cannot attend these meetings or feel uncomfortable in that setting.

and participation for these groups. As noted above, Indian partners ISET, TARU, and GEAG led SLDs with slum communities identified as vulnerable, which generated interest in climate change within the communities and provided input for the CAC. Such interactions were especially extensive in Gorakhpur, where GEAG has a long-term presence and connections in those communities. Partners commented that the interactions were helpful not only for the analysis of climate vulnerabilities in the city, but also for stimulating long-term community engagement (evinced by the appearance of participants months later at GEAG offices for follow up conversations) and assisting community members to approach elected officials as informed citizens.

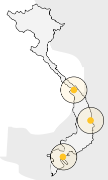
Facilitation

The ACCCRN experience also suggests that multi-stakeholder SLDs benefit from skilled and active facilitation of meetings, workshops, and processes. Partners have indicated the advantages of engaging facilitators with an adequate working knowledge of climate change so that they feel comfortable engaging on this topic and do not risk misdirecting or confusing the participants. Thai partners described that their facilitator's lack of familiarity with climate change presented an obstacle at the first SLD, while the initial round of Indonesian SLDs suffered from overly passive facilitation.

COUNTRY BY COUNTRY: SLDs IN PRACTICE

In this section, we provide a more detailed narrative of the SLD process in the four counties in the ACCCRN project. These descriptions provide further insight as to how various partners have received and executed the SLD concept, how the SLD process is planned, and the constraints and challenges SLDs often face (although many of these are unique to the city and context in which they are enacted).

VIETNAM



VIETNAM

SLDs IN PRACTICE

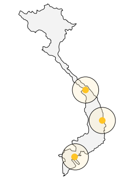
The Vietnamese cities each held three SLDs between February 2009 and August 2010 with 50 to 60 attendees, including the city steering committees, technical partners, national level experts, representatives of city departments, local people's committees, mass organizations (i.e., Women's Union, Youth Union, Farmer's Association), and representatives from NISTPASS, CtC, and ISET. The lowest level of government structure (commune or ward) and the local women's groups and fishermen associations represented local communities in vulnerable areas. Initially, the meetings attracted few government officials, especially senior staff whose time is extremely limited, but by SLD 2 and 3, most key city government departments were represented, though usually low or mid-level officials rather than senior decision makers. The composition and consistency of government leadership and participation varied among the three cities.

Meetings were initially planned by ISET and NISTPASS, with ISET becoming less involved over time. In each city, the local government organized SLD 3 itself. CtC staff with facilitation expertise led the meetings in Vietnamese and assisted in coordinating the SLDs. Throughout the process, a project steering committee led by the vice-chair of the People's Committee (deputy mayor) has approved decisions and provided specific executive direction for government agencies in relation to the work plan, including technical staff participation in SLDs.

The steering committees in each city also directed the working groups, which were formed following SLD 2 and are responsible for technical coordination, such as interpreting analytical inputs and drafting the resilience plans. The working groups included representatives of multiple local government agencies and local disaster response organizations.

In Vietnam, the SLD process and associated consultations challenged the conventional top-down Vietnamese planning processes. Partners responded positively to the innovative practice of convening diverse departments and stakeholders and encouraging them to share on an equal basis. Participants assessed the process as largely successful in sharing knowledge, building collaboration, reaching consensus, and engaging multiple local government departments. Through the SLD process in Vietnam, local governments and technical experts also developed new relationships with universities and technical agencies.

The unconventional approach of the SLD process in the Vietnamese social-political context and the lack of bureaucratic control also caused discomfort and instances of tension (see chapter 6 for more on this). Securing the continued involvement of vulnerable groups emerged as an additional key challenge. Officials from vulnerable communities and members of mass organizations were



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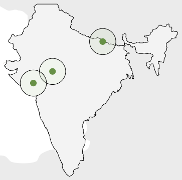
strongly reflected in the composition of SLDs 1 and 2, but their participation declined as the process shifted into the resilience planning stage. Local engagement of vulnerable groups was maintained principally through pilot projects, community-based disaster risk management trainings, and other community engagement work supported by CtC in parallel to the SLD processs.

INDIA



INDIA

SLDs IN PRACTICE

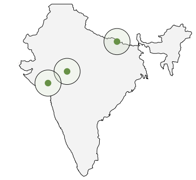
In India, the initial period of Phase 2 was used for discussions with a cross section of stakeholders in each city, including the city government, NGOs, institutions, private sector representatives, and others. Subsequently, TARU and GEAG conducted stakeholder mapping to better understand the characteristics of organizations and institutions in the city, their mandates, constraints, and opportunities for the project processes. This kind of institutional analysis led to the formation of a city advisory committee (CAC — Indore and Surat) and city steering committee (CSC — Gorakhpur) comprising representatives from the local government agencies, NGOs, academic institutions, and the private sector in each city.

GORAKHPUR

In Gorakhpur, the shared learning process facilitated secondary data collection with key stakeholders such as Gorakhpur Municipal Corporation, Jal Nigam (water works), the electricity department, Gorakhpur Development Authority (GDA), Gorakhpur University, and the Gorakhpur Medical College. Individual, bilateral consultations were conducted during February and March 2009 with the city mayor, city members of legislative assemblies, the municipal commissioner, and former engineers from water and electricity departments. Group consultations were subsequently held between March and April with key stakeholders including academics, engineers, NGOs, journalists, and informed citizens. In March 2009, the CSC was formed with 12 members from government departments, research institutions, and the medical college, along with other key stakeholders.

Following CSC formation, an SLD was conducted with a larger group (including CSC members, elected representatives from many municipal wards, private sector, among others). The objectives were to identify and prioritize the vulnerabilities in Gorakhpur and to identify the most vulnerable areas/communities in the city. An external consultant facilitated this SLD, which involved small breakout group exercises (similar to SLDs in the other countries). As part of the vulnerability assessment from March to April 2009, GEAG engaged with communities in 20 percent of the city's wards through participatory learning and action (PLA) techniques like social and resource mapping, as well visual tools like maps and aerial photographs. At the second SLD, in July 2009, with the CSC and other key citizens from Gorakhpur city, the results of the vulnerability assessment were shared along with climate projections and their implications for Gorakhpur. During this SLD, sector studies and pilot projects were shortlisted by stakeholders. These were later validated and approved in a CSC meeting.

The CSC continued to meet regularly, and in October 2009, GEAG organized a large consultation during which other stakeholders from the city administrative authorities, citizens, institutions, and media were



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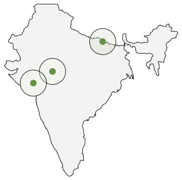
invited to discuss and share information on city vulnerabilities and project progress, including preliminary results from the sector studies and pilot project.

GEAG held a series of SLDs to support the development of their resilience planning. Specific stakeholders from the city — for example a representative from the meteorological department and one from Gorakhpur Development Agency — attended the first two SLDs on future climate scenarios and urban development trends. The third SLD was larger, and participants from the CSC and from the earlier two consultations reconvened to identify and prioritize present and future vulnerabilities for the two most plausible development scenarios given the likely climate change impacts in the city. Following this, the group identified specific resilience actions and/or projects.

SURAT AND INDORE

The process of engagement with stakeholders in the cities of Indore and Surat followed a similar pattern. Following the round of discussions among various city stakeholders in early parts of 2009, the respective CACs were formed in June/July 2009. The groups comprised the municipal corporations, the City Development Agency, NGOs, academic institutions, private sector representatives, TARU, and ISET. In Surat, the first round of SLDs was conducted as two consultations on June 22 and July 23, 2009. During these two meetings, TARU and ISET briefed the CAC on projected climate impacts, program objectives, timelines and activities, and initial results from the vulnerability assessment household survey. Participants in this SLD deliberated about the vulnerable areas and communities of Surat. The CAC further discussed the possible areas for a sector study that would provide a better understanding



of the inter-linkages and inter-dependencies between various sectors, with recommendations on how to conduct these studies and who would undertake them. In the second consultation held on July 23, 2009, the sector studies were finalized with specific guidelines for each study. Periodic consultations with the CAC — which met almost every other month in the initial period — continued to inform the detailed surveys (household and community) and the sector studies.

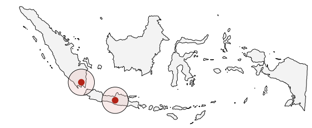
In addition to community surveys in both cities, consultations with communities from low income groups were organized in Indore, in which participants identified and prioritized problems and mapped the root causes of each: water scarcity, drainage/waterlogging, solid waste disposal, and sanitation. The findings were shared in a meeting with the Municipal Corporation, attended by community representatives. These sessions required strong facilitation to maintain focus as participants sought to use this relatively rare opportunity to air grievances to municipal officials.

In addition to community surveys in both cities, consultations with communities from low income groups were organized in Indore, in which participants identified and prioritized problems and mapped the root causes of each: water scarcity, drainage/waterlogging, solid waste disposal, and sanitation.

The second round of SLDs in Surat and Indore was undertaken in April and May 2010, as part of a series of consultations intended to develop a set of climate and urban development scenarios, construct the City Resilience Strategy, and prioritize a set of actions that would help in reducing the vulnerability of the city. These consultations were termed "Risk to Resilience" workshops; participants included members of the CAC and additional city persons with specific expertise or role in the resilience planning and/or pilot studies. During the initial consultation, participants developed future urban development scenarios. The subsequent meeting sought to identify a set of scenarios through an issue matrix (a combination of the urban development trends and future climate scenarios), and at the third meeting, TARU and ISET shared the draft resilience strategy for Surat and a short-list of intervention proposals.

The process of creating a core stakeholder group in each city and working with them for the program's duration had certain shortcomings. The level of involvement of stakeholders varied between the three cities: the Surat CAC was extremely involved in the process; Indore's CAC was involved to a much lesser extent; and the local government in Gorakhpur was the least interested of all. The change in Gorakhpur municipal commissioners in February 2010 also hampered the involvement and dialogue process in the city.

Another shortcoming was the lack of representation of the poor and marginalized groups in most of the consultations. This, to some extent, was addressed by having the elected representatives from the wards in the large SLDs in Gorakhpur — especially while mapping vulnerable areas and communities in the city; and in Indore, a separate consultation was held with low-income community groups.



INDONESIA

SLDs IN PRACTICE

The Indonesian SLDs assembled a diverse group of stakeholders, consisting of municipal departments, technical and research partners, heads of vulnerable sub-districts, local water supply companies, NGOs, representatives of the provincial planning board and other relevant organizations, and representatives from Mercy Corps and ISET. In Semarang, representatives from social responsibility departments of two local private businesses also attended the SLDs. Approximately 50 to 60 participants were present at each SLD.

Mercy Corps, with assistance from ISET and input from city stakeholders, planned and created the agendas for the SLDs, bringing external facilitators to lead the meetings. Two Mercy Corps staff members are based in each city, with senior staff visiting the cities and meeting with the working groups regularly to provide programmatic and technical support. City teams, consisting of a diverse range of local partners, were established during the second SLD and have been recognized officially by the city mayors. Smaller working groups were established within the city teams and are composed of members representing NGOs, academic institutions, and city government.

Bandar Lampung and Semarang each held five SLDs during the approximately one-year ACCCRN engagement phase, as compared to the three SLDs held in each Vietnamese and Thai city during this same period. Between SLDs, city working group members met to review materials (vulnerability assessments, sector studies, pilot projects), draft concept notes and proposals for donor funding, and produce inputs for the City Resilience Strategy. Indonesian partners have described the SLD as a useful tool, especially because of its flexible nature and ability to generate active participation. In particular, the style of engagement has led to collaboration between city government, NGOs, and academic institutions that are unusual in the Indonesian city context. The ACCCRN process in Indonesia also succeeded in getting the local planning boards to consider climate vulnerabilities for the city midterm development plans, which were finalized in October and November 2010.

THAILAND

THAILAND

SLDs IN PRACTICE

Partners have held three SLDs in the Thai cities. Unlike in the other cities, Thai partners held a climate workshop in each city prior to the first SLD. These large events convened a wider group of city stakeholders than the SLDs, as well as officials and community leaders from other areas and technical speakers presenting on climate change. Thailand Environment Institute (TEI) led breakout group discussions on concepts such as vulnerability and adaptation, aiming to assess participants' level of climate knowledge in order to provide targeted information for the subsequent SLD 1.

Participants varied among the three SLDs, however, core participants included members of the working groups, district and sub-district officials, and the TEI project team. Representatives of observer cities that are seeking to replicate the ACCCRN process also attended the SLDs, and key national and international experts were present at SLD 1.

During SLD 1, TEI facilitators employed scenarios to help participants envision future climate and development pathways: specifically, "Business as Usual," "No Holds Barred Development," and "Sustainable 'Green' Growth." These discussions helped to determine the scope of the vulnerability assessments, as well as the focus areas of thematic sub-groups within the larger working groups. In the second SLD, participants included local NGOs and researchers from local institutions, who carried out vulnerability assessments and sector studies, and from local communities, who took part in focus group meetings, interviews, and surveys as part of the vulnerability assessments. In these meetings, the researchers conveyed the findings of the vulnerability assessments and sector studies and provided recommendations on adaptation measures to the working groups and government officials. In addition, the local NGO representatives presented inputs and insights on community needs and priorities. The working groups discussed vulnerabilities and existing adaptive capacities, and determined options for adaptation and resilience plans. They also discussed potential pilot projects in each city.

The primary participants of SLD 3 were members of the working groups and key members of the executive groups (including the provincial governors; mayors of Hat Yai, Chiang Rai, and selected sub-district municipalities; and directors of selected government agencies). The discussions, facilitated by TEI, focused on development of urban climate resilience strategies, collaboration between municipalities across administrative boundaries, and involvement of key officials in implementing activities linked to strategies. This led to planning of possible intervention projects for ACCCRN Phase 3. Additional meetings were also arranged for further discussions on developing.

Whereas the Hat Yai SLDs included city stakeholders outside of the working group, the working group members were the main SLD participants in Chiang Rai. In contrast, the climate workshops assembled a larger stakeholder group in both cities. Between SLDs, TEI met regularly with the working groups to provide additional support. Although TEI initiated SLDs and meetings with the working groups, both working groups arranged additional meetings on their own without TEI's presence. This indicates that diverse members of the working groups have established good working relationships among themselves and with the municipalities and other government agencies. A central challenge that TEI described was the partners' ability to absorb, understand, and ultimately act on climate concepts and the associated ideas of future uncertainty that were presented in the SLDs. TEI felt the need to hold a follow-up to SLD 1 in Chiang Rai ("SLD 1.5"), as partners felt that key topics had not been adequately covered or understood during the initial SLD.

CONCLUSIONS

The ACCCRN experience in ten cities across four different countries has reinforced ISET's prior experience from rural South Asia that a shared learning dialogue approach provides a practical foundation for engaging local stakeholders in assessing climate vulnerability and building local climate resilience. This approach can successfully bring together diverse stakeholders, develop among them a common understanding of a complex and multifaceted issue, build local capacity, and bridge divides between "global" science and local knowledge. SLD processes are flexible and iterative, which allows organizers to modify engagement techniques, accommodate institutional or cultural boundaries, and space the sequencing of interaction to meet local timetables while building on cumulative experience and insights.

ISET's experience demonstrates the value of SLD processes for climate adaptation and resilience planning processes, unfamiliar challenges that can be addressed most effectively with appropriate technical ("global") knowledge, local experience, and the participation of those who will ultimately be responsible for devising, implementing, and (most importantly) sustaining resilience efforts and knowledge generation. Shared learning is particularly essential in circumstances where levels of uncertainty are high regarding future conditions and, as a result, the development of effective responses requires changing concepts, strategies, and techniques conventionally used for sectoral planning. ISET experiences, as outlined above, suggest a number of key elements — such as group composition, style of meetings, mechanisms for knowledge sharing and engaging vulnerable groups, and timeframe — that require strategic consideration to help the user achieve the desired outcomes.

The ACCCRN program demonstrates how such an approach has led to tangible outcomes (resilience strategies and implementation proposals), new partnerships, enhanced capacities among small groups and greater awareness among larger groups, and processes of institutionalizing climate change in city governments. ACCCRN partners have expressed that the innovative nature of this process can overcome functional boundaries, whether through NGOs working with city governments in Indonesia, local-level officials meeting with national experts and senior government officials in Vietnam, or disparate sectoral representatives communicating regularly in India.

ACCCRN has functioned as a laboratory for a number of methodologies for addressing the challenges associated with climate change in urban areas. Other key elements of the process used during ACCCRN — the use of climate information; vulnerability assessments, sector studies, and pilot projects; and the process of resilience planning — are described in other chapters of this report.

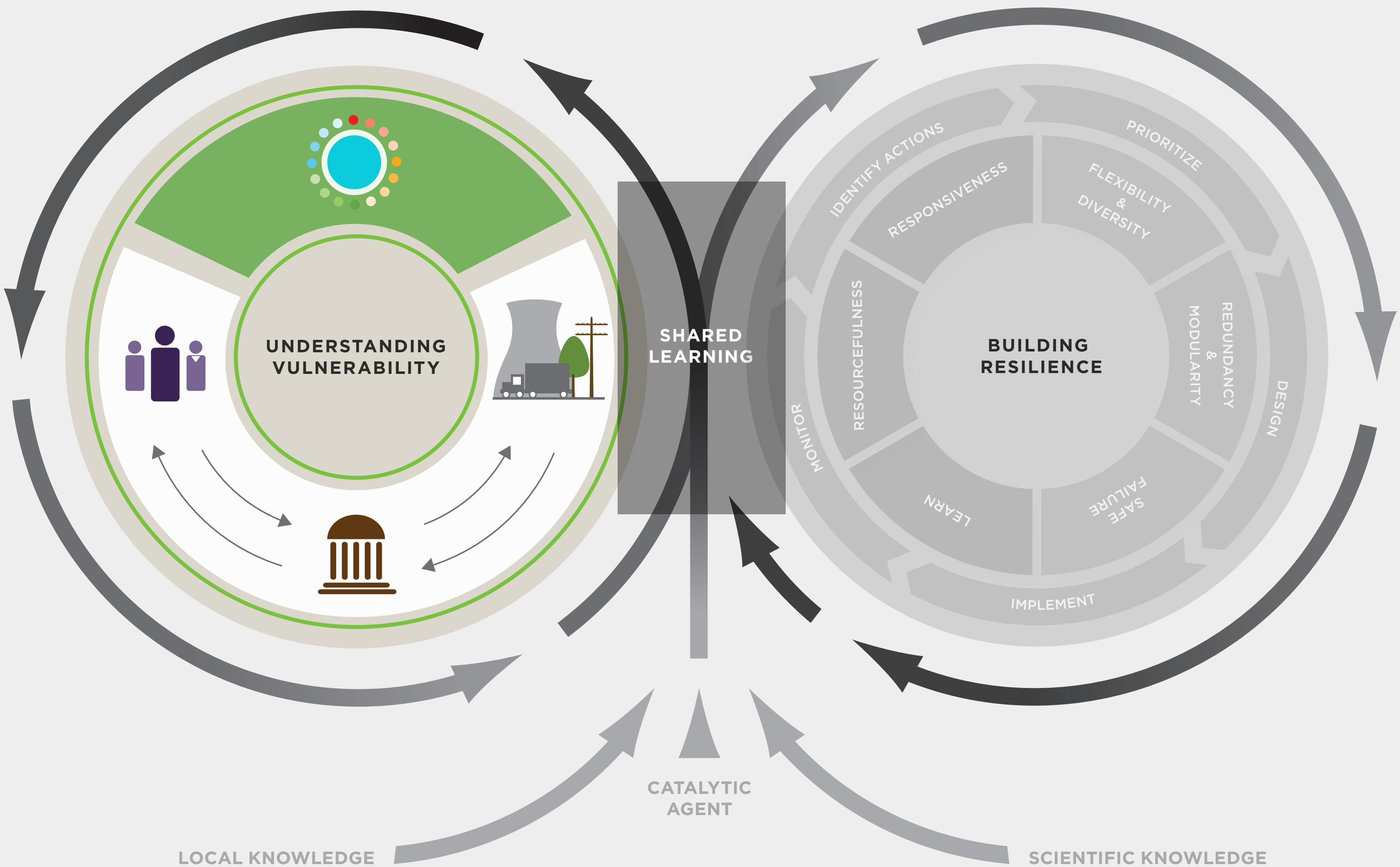
CHAPTER 5

VULNERABILITY ASSESSMENTS, SECTOR STUDIES, AND PILOT PROJECTS

Karen MacClune
with Elizabeth Fajber, Sarah Opitz-Stapleton, and Sarah Orleans Reed

FIGURE 5.1 | The Urban Climate Resilience Planning Framework: Understanding Vulnerability

This chapter focuses on the left loop of the diagram below. Vulnerability assessments are the first step in understanding vulnerability, including the potential impacts of climate change; what systems and communities might be affected and how; what resources or existing adaptation behaviors are available to begin addressing those impacts; and what gaps remain to be addressed. Vulnerability assessments identify areas where targeted sector studies can support further engagement or action; they also inform the development of pilot projects designed to reduce vulnerability and build resilience.



INTRODUCTION

Climate change vulnerability assessments are key inputs to climate change resilience planning. They assess the vulnerability of a city's ecosystems, infrastructure, agents (social groups), and institutions to existing climatic variability and future climatic changes, and assess the city's capacity to adapt to that variability and change. Specifically, vulnerability assessments help:

- Understand potential impacts of climate change;
- Identify what systems are exposed to the impacts of climate change and how effects on those systems may cascade through other systems;
- Identify who are the most vulnerable groups, areas, and sector and how they may be affected;
- Identify the different factors that make groups vulnerable, including both direct (e.g., exposure to hazards) and indirect (e.g., decreased agricultural production leading to increase in food prices and food insecurity);
- Assess how critical ecosystem services and functions might respond to continued human pressures in the face of climate change;
- Assess the capacities of key organizations and groups to adapt; and,
- Inform the development of resilience strategies (see chapters 6 and 7).

Vulnerability assessments are crucial elements of the resilience planning process and are closely tied to shared learning dialogues (SLDs). As discussed in chapter 4, in the ACCCRN process SLDs are the iterative platforms that enable joint dialogue, reflection, and understanding of climate challenges, vulnerabilities, and potential adaptation strategies within the cities. The process and outputs of these activities enable discussion, reflection, and collaborative planning on approaches and activities that can enhance a city's resilience to climate change impacts. Vulnerability assessments are a key part of this process, providing critical bottom-up community information, top-down expert analysis of local climate hazards and climate change projections, and synthesis of the two. This information is then fed back to the SLDs for discussion and decision regarding further action.

Sector studies and pilot projects were designed to allow further engagement around the vulnerability assessment findings. Sector studies explored key areas of vulnerability for which information was lacking; pilot projects provided a platform to develop — based on the vulnerability assessment findings — and test small-scale resilience building activities in the city. The results of all of these activities then fed into the development of city resilience strategies.

WHAT IS VULNERABILITY?

The concept of vulnerability varies depending on the discipline or sector (e.g., climate change, disaster risk reduction, food security, etc.) in which it is used. There is no single definition of vulnerability. The ACCCRN project is based on the definition in chapter 2 of this report: "vulnerability results from a combination of capacities at the household, organization, and city level, together with fragility in key systems and the ways in which these factors interact." Chapter 2 goes on to describe that "vulnerability is high where *systems are fragile*, *agents are marginalized, institutions confine rather than enable responses,* and *exposure to climate change is high*."

Cities are integrated functions of physical elements (infrastructure and ecosystems), agents (people and organizations), and institutions (the rules that guide behavior), as discussed in the Urban Climate Resilience Planning Framework (UCRPF; chapter 2). Our approach to vulnerability assessment considers each of these components separately as an input to a more integrated analysis. For analytical purposes, we use the term "system" narrowly, to refer to an ecosystem, a hydrologic, energy, water supply, transport, communications, or financial system, etc.

"Fragility" refers to the sensitivity of a system to disruption by climate-related events. Key system characteristics such as flexibility, diversity, redundancy, and safe failure heavily influence fragility, as does exposure.

"Exposure," in this case, is the nature and degree to which a system may be directly or indirectly exposed to climate conditions such as temperature changes, rainfall variability and change (including extremes), or changes in the frequency or intensity of tropical cyclones and storms. Sensitivity is the degree to which the system is affected, either adversely or beneficially, by climate-related stimuli.

"Agents" are individuals, households, and community, civil society, business, or government organizations. Their "capacities" that contribute to resilience include the baseline ability to function under current conditions as well as key capacities such as the ability to visualize and act, organize and reorganize, and learn. All of these capacities are constrained when agents are socially or economically marginalized and, as a result, unable to access or effectively utilize the services systems generate. The capacities are also constrained when institutions are rigid and limit the range of actions agents can take.

"Adaptive capacity" is the ability to shift strategies as conditions change in order to maintain the well being of populations and the ecosystems on which they depend. In the context of climate change, adaptive capacity requires **agents** to make choices and respond to opportunities in ways that manage both direct and indirect climate impacts. Agents' level of access to resilient **systems** influences their adaptive capacity, as does the

Marginalized Populations at Highest Risk

In many urban areas, the populations most vulnerable to climate hazards and climate change are those who are socially, politically, and financially marginalized. Such populations include:

SLUM DWELLERS Slums are often in highly exposed areas such as floodplains, and people who live in slums lack legal recourse in the event of a climate-related disaster.

RENTERS IN LOW-INCOME NEIGHBORHOODS Low-income neighborhoods are also often located in highly exposed areas. Since households or small businesses who rent in these areas do not have land titles or power of attorney for their property, they often find themselves homeless and not entitled to compensation after a hazard event or relocation scheme.

WOMEN AND WOMEN-HEADED HOUSEHOLDS For cultural reasons, women may lack skills such as swimming or climbing trees that can move them from harm's way, and experience significant barriers in accessing capital — from credit to land.

PEOPLE WHO DEPEND ON URBAN AGRICULTURE Individuals and households who rely on urban agriculture either as a significant portion of their incomes or as supplementary food sources are more vulnerable to climate hazards.

RECENT MIGRANTS Recent migrants (legal or illegal) to a city are not familiar with the most exposed areas of a city or the kinds of hazards likely to occur, and they do not have established social and political networks to depend on in the event of a climate-related disaster.

DAILY WAGE LABORERS Individuals or households who rely on daily wage labor in sectors such as construction or street cleaning are more vulnerable to climate hazards.

(Khan, Qutub et al. 2009; Mustafa, Ahmed et al. 2008; Enarson 2005; DAW 2001; Drechsel 2006)

manner in which **institutions** structure relationships among agents and between agents and systems.

In sum, climate change vulnerability is the degree to which climate-related hazards (both direct and indirect, and from sudden events such as storms to long-term changes such as sea level rise) affect agents or systems. This includes both people and the ecological systems in which they live. Vulnerability depends on a range of physical, social, human, economic, and environmental factors that increase susceptibility of individuals and communities to climate change impacts and that affect their adaptive capacity. Vulnerability to climate events is particularly high where marginalized populations depend on fragile systems that are exposed to climatic stresses and where institutions constrain rather than enable action. This accounts for the frequent correlation between vulnerability to climate change and poverty or other forms of social marginalization.

Institutions deserve specific attention in vulnerability assessments since they structure the *management* of other dimensions (physical infrastructure, services, ecosystems, etc.), thereby directly affecting the vulnerability and adaptive capacity of people, sectors, and the city. Similarly, it is critical to highlight that social factors such as gender directly affect social marginality and, as a result, vulnerability. Women and men may face differential exposure to hazards depending on their occupation and social norms; women may not have the same access to early warning systems and other services that often are directed toward men; and they often have less access to financial services or education opportunities that may support them to adapt.

VULNERABILITY ASSESSMENTS: NO STANDARD FRAMEWORK

With the above understanding of vulnerability in mind, how do we assess climate change vulnerability in an urban context?

There has historically been no standard approach to conducting a climate vulnerability assessment. Rather, a range of frameworks, tools, and methods that draw on work in climate change, disaster risk reduction, and food security can be adapted to different contexts. In particular, climate vulnerability assessments in urban areas are still relatively recent, especially in developing countries.

In the ACCCRN project, though there are common elements in all ten cities, each city implemented vulnerability assessments in a slightly different way. The most critical element of the assessments was that the findings and the process itself be linked to adaptation planning aimed at reducing vulnerability and enhancing resilience.

The SLDs, the sector studies, and the pilot projects expand on issues that arise in the assessment, facilitating the iterative process of planning for resilience. The vulnerability assessments, sector studies, and pilot projects were then used directly in developing city resilience strategies, as chapters 6 and 7 describe.

Facilitate, Learn, Guide

The primary goals in vulnerability assessment implementation in all of the cities were to:

FACILITATE Select methods for the vulnerability assessment with which the team was comfortable and that were feasible given the human, financial, and time resources available.

LEARN Create a process that was flexible and iterative in order to enable the cities to pursue priority issues that emerged.

GUIDE Help city officials, stakeholders, and residents get a preliminary understanding of climate change implications in their cities; to identify additional areas for more intensive analysis; and to provide some basis for considering how interventions could target vulnerable groups and areas in order to enhance resilience both of vulnerable groups and the overall city.

The following briefly outlines the conceptual four-step approach for the vulnerability assessments. The approach described here is relatively simple and provides an easy entry point for this type of work — beginning by looking at currently vulnerable people and current climate hazards — for stakeholders unfamiliar with climate change. However, it should be emphasized that the approach outlined below is not a blueprint; actual detailed methods for the assessment were developed at the national and city level by team members, drawing on this (and other) approaches. The ACCCRN vulnerability assessments in practice are described later in this chapter (see Vulnerability Assessments in the ACCCRN Cities).

1 CLARIFY VULNERABILITY FRAMEWORK	2 ASSESS CURRENT VULNERABILITY	3 IDENTIFY FUTURE STRESSORS	4 ASSESS FUTURE VULNERABILITY
To what: Vulnerable to what (climate hazards) **Of what:** Who/what is vulnerable (social group, neighborhood, sector) **Dimensions of vulnerability:** Physical (including exposure), environmental, social (including governance), economic, human	Current risk and event history, and response to existing climate hazards Current dimensions of vulnerability (physical, environmental, social, economic, human)	**Direct and Indirect impacts of:** climate changes, development trends, and growth scenarios	Identify most vulnerable groups and areas, and vulnerability of sectors and inter-linkages between them Review governance and institutional mechanisms associated with vulnerability and building resilience *(Dependent on 2 and 3)*

1 Clarify Vulnerability Framework

The first step in assessing vulnerability is to clarify the frameworks used, primarily vulnerability "to what" and "of what," and the five main dimensions that shape vulnerability and adaptive capacity. In thinking about vulnerability **"to what"** most people think about extreme climatic events, in particular those that cause individual high flood events. But apart from the extreme events familiar to disaster experts, we should also consider incremental, slow-onset, and widespread changes like droughts, salinization, and changes to flood regimes. Both fast and slow processes of change may be sources of vulnerability and may require different kinds of responses.

"Of what" refers to the system, or units of analysis that are "exposed." The units may be an individual, a household, a neighborhood (e.g., slum area), a government agency or program (e.g., water management, health), or an economic sector (e.g., tourism, fisheries). The assessment should consider different components of analysis depending on city.

Climate change and climate hazards do not take place in a vacuum. Hence, vulnerability is not only caused by exposure to or impact from climate hazards, but rather, it is shaped by and dependent on the interaction of systems (including ecosystems), agents, and institutions (including institutions of social marginalization). Each of these interactions has environmental, physical, social, economic, and human dimensions. The vulnerability assessment should provide an overview of all these dimensions before investigating specific categories and issues that emerge in the assessment in more detail. In doing this initial assessment, it is critical to consider both vulnerabilities and capacities.

2 Assess Current Vulnerability

Current vulnerability is explored by identifying existing and likely climate hazards and who is vulnerable (what, where, who). This includes an initial first cut at identifying what are the climate issues, and who and what sectors are vulnerable to those issues. Existing climate hazards can include:

- Increase in frequency and intensity of rainfall events (flash flooding);
- Increase in frequency or intensity of cyclones/severe storms;
- Increase in temperature (urban island and heat waves);
- Sea level rise (flooding, saline intrusion);
- Drought/longer dry spells.

An assessment of current vulnerability should also identify vulnerable groups and sectors, e.g., slum areas in low-lying coastal flood plains or water supply infrastructure vulnerable to salt water intrusion; vulnerability also should be spatially documented, i.e., where the most vulnerable areas and most vulnerable groups are located.

Finally, vulnerability assessments should evaluate historical climate trends and responses to historical events in order to explore the combination of existing climate hazards with vulnerable groups and sectors. This should include assessing impacts, responses, and coping strategies of vulnerable groups and sectors, and government and other key actors.

3 Identify Future Stressors

Armed with a firm understanding of current hazards and vulnerable groups and sectors, the next step is to explore potential future climatic changes and physical and social evolution in the city over a modest time frame. Available GCM and regionally or statistically downscaled data should be used to identify potential future climate trends and variability (the challenges inherent in this step are covered in depth in chapter 3). In parallel, city and regional socioeconomic and physical trends and plans should be compiled and reviewed, and the implications of development plans explored. Then, using these two sets of information, potential direct and indirect consequences of future stressors should be identified. These may include: change in resource availability, increasing demands on resources, stresses on physical infrastructure, increased flooding, inundation of coastal areas, and increasing salinization, etc.

4 Assess Future Vulnerability

Finally, armed with an understanding of current vulnerabilities and potential future stressors, potential future vulnerabilities can be explored. Questions to address in this stage could include:

- How will consequences of future stressors (climate, demographic shifts) affect future vulnerabilities?
- What are inter-linkages across sectors that may affect their vulnerability?
- Do the potential/projected changes and direct and indirect impacts render new vulnerabilities?
- Do the potential/projected changes and direct and indirect impacts affect different social groups or populations or neighborhoods? Do they affect other sectors?

The final vulnerability assessment should identify:

1. Current hazard and vulnerability issues;
2. Changes in future vulnerability;
3. Most vulnerable social groups and dimensions of vulnerability, including adaptive capacity;
4. Vulnerable sectors (sensitive infrastructure, service delivery, economic sectors) and crucial inter-linkages among them;
5. Governance and institutional issues;
6. Initial ideas to strengthen resilience of populations and sectors; and
7. Areas requiring more information.

COUNTRY BY COUNTRY: UNDERSTANDING VULNERABILITY

VULNERABILITY ASSESSMENTS

In practice, the conceptual outline for city vulnerability assessments presented in the above section served as a very loose guideline for the ACCCRN cities. Each country conducted vulnerability assessments differently, and in some cases, cities within the same country differed in their approach. How each country, and where relevant, each city, approached and conducted the vulnerability assessment is described below.

In general, none of the city vulnerability assessments provided particularly surprising or unexpected results. Their value lay in that they presented a set of information to the ACCCRN city stakeholders that, in many cases, had never been compiled in this particular way, or in some cases simply had never previously been available. Consequently, the vulnerability assessments provided a strong focal point for dialogue, educated many participants, and provided foundational information and framing for the entire resilience planning process.

SECTOR STUDIES

Within the ACCCRN program framework, sector studies are intended to provide a more detailed analysis of an area that the vulnerability assessments identify as problematic, but for which there is inadequate information to know how to begin addressing the issue. Each city had a different focus for their sector study or studies depending on their information gaps.

The secondary role of the sector studies is capacity building of local and national institutions. ACCCRN national and international partners worked with local and national institutions in each city to build their capacity for this type of analysis, so that in the future, more of the research and analysis skills needed by cities to replicate the ACCCRN process will exist within the ACCCRN countries. This first round of sector studies are somewhat rough documents, but for most of the ACCCRN cities, they provide the first comprehensive reports on their topics, assembling disparate data in one place for the first time.

The sector studies that have been undertaken to date by the ACCCRN cities are discussed country by country.

Cities were asked to select studies based on the following guidelines:

- Significantly influences the decision-making process of city development planning and also affects the livelihood of poor and vulnerable community;

- Addresses a knowledge gap needed to enhance city resilience to climate change;
- Addresses an issue that requires immediate action in order to prevent adverse and wider impacts;
- Can be completed within a relatively short time-frame (as demanded by the ACCCRN timeline specific to the country).

PILOT PROJECTS

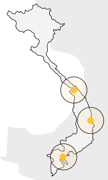
The ACCCRN pilot projects, modest-sized initial intervention activities, were conceptualized as:

- A means for the ACCCRN cities to gain experience with devising and implementing interventions to build adaptive capacity to climate change in ways that would particularly benefit vulnerable populations in the cities;
- A way to build experience and collaboration between partners and to introduce new organizational approaches;
- A way to test innovative and potentially replicable projects that could enhance climate resilience in the city; and,
- On-going activities to build and maintain engagement of city partners as resilience strategies were completed, and while waiting for implementation projects to be approved and funded.

As implemented, however, not every project met the initial objectives listed above. Each city chose their pilot projects based on their particular needs and priorities, and most projects reflect a clear link to the issues identified in the vulnerability assessments. Some cities used the pilot projects as an opportunity to test small-scale implementation of activities identified and developed in sector studies.

The pilot project timing varied from country to country. In some countries, the pilot projects were completed in time to allow pilot project results to be incorporated into the resilience strategies. In other countries, the pilot projects started late and were not completed until after the resilience strategies had been written; however, this timing did allow them to maintain project momentum in the transition from the engagement to the implementation phase of ACCCRN.

VIETNAM



VIETNAM

VULNERABILITY ASSESSMENTS, SECTOR STUDIES, AND PILOT PROJECTS

In Can Tho, the DRAGON Institute consulted with the Bo Bao community to determine whether they preferred to remain where they were, with upgraded housing, or to move to a new location. This is perhaps the first time in Vietnam that a community identified for resettlement was consulted on their preference, and as such provides significant new input to the resettlement process.

VULNERABILITY ASSESSMENTS

All three of the ACCCRN cities in Vietnam undertook two-part vulnerability studies composed of a climate change analysis and a household and community assessment. The Institute for Meteorology, Hydrology and the Environment (IMHEN), a technical division of the Ministry of Natural Resources and Environment in Hanoi responsible for generating national climate scenarios, assessed potential climate change impacts.

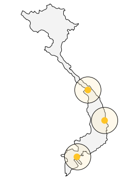
Parallel to the climate analysis, a hazard capacity and vulnerability assessment (HCVA) assessed the climate threats posed to groups, communities, and households. Both of these are described in more detail below.

SECTOR STUDIES

In Vietnam, ideas for sector studies and pilot projects were solicited and discussed during the second SLD in August 2009, following presentation and discussion of the vulnerability assessments. One sector study was completed in each ACCCRN city in Vietnam.

Like the vulnerability assessments, none of these sector studies were revolutionary, but they all took small steps into new territory. In Can Tho, the DRAGON Institute (the Delta Research and Global Observation Network, funded by the USGS and associated with Can Tho University) consulted with the Bo Bao community to determine whether they preferred to remain where they were, with upgraded housing, or to move to a new location. This is perhaps the first time in Vietnam that a community identified for resettlement was consulted in this way, and as such provides significant new input to the resettlement process. Similarly, although the hydrology studies in Da Nang and Quy Nhon were fairly brief modeling assessments and in both cases only addressed a small area within the city boundaries, because they were undertaken as part of the ACCCRN process and engaged a multi-sectoral stakeholder group, they catalyzed significantly new thinking and engaged diverse professional groups. For example, prior to these studies, the questions about development of low-lying floodplains in both cities generally focused on the depth of fill needed to elevate the entire development area above the 100-year flood elevation. However, by the time the sector study results were presented in November 2010, discussion focused on how development of these new areas would impact surrounding lands and highlighted the need for more in-depth models that could answer these more detailed questions.

All three of these studies were completed too late for results to feed directly into the resilience planning process. However, the sector studies are paving the



way for implementation projects in the three cities. In Da Nang and Quy Nhon, more in-depth hydrological studies have already been started. Can Tho continues to explore options for further analysis and implementation of innovative resettlement projects.

PILOT PROJECTS

Pilot projects for the three Vietnamese cities evolved directly from the HCVA. The projects were a way to fund local initiatives for the vulnerable communities selected for the HCVA analysis. Projects that the local government considered high priority were shortlisted, and ISET provided feedback on final project selection. The projects listed below are those that have been completed.

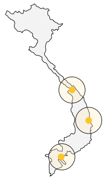
While the initial goal was for pilot project results to feed into the resilience strategies, because transferring the project funds and getting the projects going took significantly more time than anticipated, the pilot project results were not available in any of the three cities until after the resilience strategies were written. Nonetheless, the process of initiating the project proved valuable for all three cities, and several of the Phase 3 implementation proposals have built upon work initiated in the pilot projects. ■

VULNERABILITY ASSESSMENTS

IMHEN used MAGICC/SCENGEN 5.3 and statistical downscaling to provide monthly mean temperature and precipitation changes for the three cities as compared to 1980 to 1999 average conditions. IMHEN provided projections under the UNFCCC – SRES emissions scenarios A1F1, A2, and B2 for the years 2020, 2050, 2070, and 2100. Can Tho also obtained climate projections from SEA START. (See chapter 3 for details on the strengths and limitations of the IMHEN analysis.)

As part of their climate analysis, IMHEN also produced sea level rise (SLR) projections for each of the three cities. SLR projections were obtained from the MAGICC/SCENGEN model runs and were overlain on local Digital Elevation Models (DEMs) to illustrate potential future impacts from increasing sea levels. The resulting inundation maps were overlaid with current land use maps for agriculture, aquaculture, and infrastructure and compared generally with city plans for 2020. However, these projections used annual average sea-level increases only and did not take into account flood tides, waves, heavy rains, flash floods, and other hydrodynamic factors that could greatly exacerbate climate-change-induced flooding.

Challenge to Change (CtC), an international NGO, led the HCVAs, in close collaboration with the local government and community leaders. In Can Tho, the DRAGON Institute of Can Tho University assisted CtC. In each of the three cities, the HCVA was carried out in two highly vulnerable districts or wards: Son Tra and Lien Chieu districts in Da Nang; Vinh Thanh and Binh Thuy districts in Can Tho; and Nhon Binh and Nhon Ly wards in Quy Nhon.



The HCVAs ranked local hazards and mapped them by district, ward, and section, based on consultations and historical experience. The assessment also evaluated the effectiveness of city planning and disaster management, and how these interlinked with climate. Finally, researchers analyzed information collected on social issues crosscutting with climate change, such as gender, socioeconomic class (e.g., unregistered migrants), education, health, and livelihoods. In each case, the HCVA compiled data on existing coping methods and their limitations, and sought recommendations on improvements from local authorities and community members.

In Da Nang and Quy Nhon, the Institute for Water and Environment (IWE) integrated these two reports into a single city document, the "Climate Change Impacts and Vulnerability Assessment." Can Tho University prepared a similar report for that city. These synthesis documents used the climate and SLR results to evaluate potential effects of changing temperature, rainfall variation, and SLR on land use and future city development, including agriculture, aquaculture, and infrastructure. ISET provided support and guidance to IWE in its fieldwork for the climate impact and vulnerability assessment. Can Tho University, in contrast, relied on an extensive literature review focusing on agriculture, aquaculture, and infrastructure as a basis for the vulnerability assessment. In all three of these reports, future climate impacts were based on an assessment of current hazards and vulnerability, and by extension, the likely vulnerability to future conditions.

Local stakeholders reviewed the draft vulnerability studies through the SLD process and other small group consultations and meetings. The SLDs provided recommendations for in-depth studies to enable action on specific priority sectors or issues. While in each city a single technical department hosted and led the project, each recognized that multiple departments must be engaged in the planning work. So each city established an interagency technical working group to ensure that the climate change planning agenda moved forward. This group reviewed the results of studies and SLD recommendations.

Though the vulnerability assessments formed the basis for the city resilience strategies in all three cities, the cities also drew on existing studies and reports, particularly Can Tho, where the World Bank was developing a Local Resilience Action Plan for the city (World Bank and the People's Committee of Can Tho City 2009).

CAN THO

In Can Tho, the IMHEN climate analysis was supplemented by additional data and research. In part, this was due to data availability — significant research monies have been put into climate change and hydrological studies for the Mekong Delta, and as a result there is more information available for Can Tho than for most other parts of Vietnam. In particular, to understand the influence of SLR on extreme flood events researchers utilized an existing dynamic hydrological model developed and run by the Southern Institute for Water Resources Research (SIWRR). The

TABLE 5.1 | Da Nang Vulnerability Assessment Summary

This matrix is synthesized from data collected in the process of assessing vulnerability to natural disasters caused by climate change in Da Nang.

IMPACT OF CLIMATE CHANGE	CONSTRUCTION WORKS	LOSS OF LAND	FISHING BOATS	COASTAL AND RIVERBANK EROSION	DOMESTIC PLANTS AND ANIMALS	STREET TREES	LIVELIHOOD	INCOME	HEALTH	EPIDEMICS	WATER SUPPLY	POLLUTION
	LEVEL OF VULNERABILITY											
STORM	+++	•	++	++	++	++	++	++	+	+	+	++
FLOOD	+++	+	•	+++	++	++	++	++	++	++	+	++
INUNDATION	+	+	•	•	++	+	++	++	++	++	++	++
SALT INTRUSION	+	•	•	•	+	+	+	++	+	•	++	+
DROUGHT	•	•	•	•	+	+	+	++	•	+	++	+

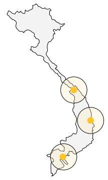
+++ high level of vulnerability ++ medium level of vulnerability + low level of vulnerability • invulnerable

model was calibrated to the (well-documented) one-in-50- year flood event of the year 2000, and scaled the model results for SLR of 30 cm, 50 cm, and 100 cm. The resulting inundation maps were overlain with current land use maps for agriculture, aquaculture, and infrastructure and with city plans for 2020.

DA NANG

In addition to temperature, precipitation, and sea level rise, the Da Nang vulnerability assessment specifically addressed drought, typhoons, heavy rains, and saline intrusion. These climate threats were characterized according to impacts on the most vulnerable groups, livelihoods, infrastructure and locations within the city, and impacts were assessed both for current conditions and projected conditions in 2020 (see Table 5.1).

The Da Nang assessment was coupled with an analysis of the city's capacity for disaster response and preparedness, which was evaluated based on the organizational structure of the City Committee of Flood and Storm Control Rescue; infrastructure and equipment for natural disaster prevention and response, capacity, and allocation of resources to respond to climate change; and monitoring and evaluation mechanisms.



QUY NHON

In Quy Nhon, current hazards include flooding from flash floods, river breaches, and/or storm surge; such flooding now affects most areas of the city and is felt most keenly in peninsular, coastal, and floodplain areas. Typhoons, drought, salinization, forest fire, and erosion were also addressed during presentations and in discussions.

In Can Tho, one focus of the vulnerability assessment was on agricultural loss due to sea-level-rise-exacerbated flooding. The information was new to the city stakeholders, and as a city highly dependent on agricultural product marketing and export, it was of key concern; the extent of potential agricultural production flood losses in the next 50 years could be a big problem for the city.

Observations on the Vietnam Vulnerability Assessments

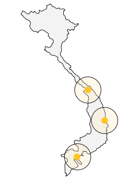
The Vietnamese HCVA reports demonstrate an understanding of the complexity of vulnerability and capacity. However, their quality varies from city to city, and, though they meticulously present primary data, they lack in-depth analysis of the implications of the findings. Perhaps as a result of this, the synthesis documents prepared by IWE and the DRAGON Institute do not reflect the complexities of vulnerability presented in the individual HCVA reports.

The HCVAs did not have much impact on the city teams, and they were underutilized in the later stages of the resilience planning work, particularly the development of the city resilience strategies. Nonetheless, the consultations with vulnerable groups done for the HCVA were a new approach for Vietnamese planning departments, and most of the key working group members found the information obtained from these interactions useful.

In contrast to the HCVAs, because a national government ministry prepared the IMHEN climate change scenarios, city teams accepted them at face value, without question. This proved somewhat problematic since the analysis was limited only to the government-approved climate model simulations and lacked the variability present in the full suite of IPCC results. (See chapter 3 for further discussion.)

None of vulnerability assessments for the Vietnamese cities addressed the challenges of weather variability or temperature issues; all three focused on climate disasters and large-scale hazards. They also focused primarily on current issues rather than future conditions, and the HCVAs only addressed a very limited geography. Nonetheless, the vulnerability assessments were an important input to the sector study and pilot project formulation and selection, and to the resilience strategy development. And, in spite of their limitations, the Vietnamese vulnerability assessments did impact the city stakeholder thinking and engagement in the ACCCRN project.

In Can Tho one focus of the vulnerability assessment was on agricultural loss due to sea-level-rise-exacerbated flooding. The information was new to the city stakeholders, and as a city highly dependent on agricultural product marketing and export, it was of key concern; the extent of potential agricultural production flood losses in the next 50 years could be a big problem for the city. Similarly, increasing river salinity has only just recently started to become an issue for Can Tho. The current increase in salinity during



low-flow periods, coupled with the model projections generated for the vulnerability study, indicated how quickly this could become a critical issue for drinking and irrigation water.

In Quy Nhon, as the vulnerability assessment report was being completed, major flooding occurred in Nhon Binh, one of the communities slated for urban development under the current city master plan. Though the cause of flooding in this case was more likely urban development than climate change, nonetheless, the combination of flooding and newly available climate change vulnerability information put climate change issues on the map and catalyzed new thinking on the part of the city government.

This also happened in Da Nang, where the flood inundation map prepared by SIWRR as part of the vulnerability assessment illustrated that the flood regime is changing. The Da Nang Department of Construction in the City Planning Department grasped the implications of a changing flood regime for a city accustomed to engineering solutions to flooding, and the city is undertaking further work via a Rockefeller Foundation-funded implementation project.

Finally, resettlement is an issue in all three Vietnamese cities. Decisions by the central government to resettle vulnerable communities, and the consequent concerns, are not new in Vietnam. However, the idea that the impacts of climate change will increase the need for resettlement was new for all three city governments. Can Tho began to actively grapple with this issue in their sector study and is considering further projects in this sector.

SECTOR STUDIES

CAN THO

Feasibility for the Deep Flood Regions Resettlement, Bo Bao Hamlet

Examines ways of improving resettlement practices, using the case of Bo Bao hamlet, the area of Can Tho most vulnerable to SLR, as a model of integrated flood adaptation resettlement planning and management for Can Tho. Proposes alternatives for Bo Bao and general strategies for the city, based on findings.

DA NANG

Climate Change and Sea Level Rise Impacts on Flooding in Hoa Xuan and Hoa Qui, Da Nang

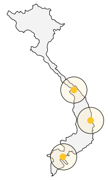
Reviews current hydrology and 2006 and 2009 floods as baseline for a model simulation of potential future flooding in rural, minimally developed communes slated for development. Key conclusions include need for future studies to examine impact of development. Available in Vietnamese only.

QUY NHON

Climate Change and Sea Level Rise Impacts on Flooding in Phuoc Son, Binh Dinh Province

Climate change and flood risk case study for the commune of Phuoc Son on the northwestern edge of Thi Nai Lagoon. Reviews current hydrology and recent flooding events to set the baseline for a model

The Vietnamese HCVA reports demonstrate an understanding of the complexity of vulnerability and capacity. However, though they meticulously present primary data, they lack in-depth analysis of the implications of the findings.



simulation of potential future flooding conditions under the influence of sea level rise and projected increased precipitation intensity. Simulations were run for a series of sea level rise scenarios spanning projections from 2020 to 2100. Key findings include that 50 percent of 2009 floodwater was due to dikes being overtopped. Available in Vietnamese only.

PILOT PROJECTS

CAN THO

Community Safe Water Supply and Solar Power Model

Provided 57 out of 83 households living in Con Son islet with safe water; solar power station installed to provide electricity for the operation of the water supply system and energy consumption of the community house; villagers trained on construction and maintenance of system.

DA NANG

Design and Construction of an Improved Boat Winch

Consulted with experienced local fishermen to carry out boat winch design; technical design was validated through several community meetings. Winch allows rapid relocation of boats from water onto shore in advance of typhoons, obviating need for dangerous trip around headland to safe harbor.

Coastal Tree Protection Planting, and Early Warning System for Fishermen

Trained 200 locals on planting and maintenance of Causuarina Equisetifolia for coastal storm protection and ecosystem restoration; Bought, tested, and delivered 454 SONY radios SW-988 to poor fishermen to receive typhoon warning and updated forecast information while at sea.

QUY NHON

Storm-Resistant Housing

Selected five households to pilot three models of flood and storm resistant housing construction; larger community trained in storm-resistant housing techniques.

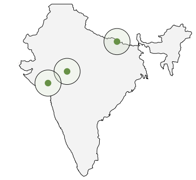
Improvement of Traditional Fish Sauce Processing

Worked with approximately 60 community members on modifying local fish sauce processing into a closed waste-treatment cycle, increasing process productivity, reducing waste otherwise released directly to the lagoon, and providing alternative revenue through waste collection, processing, and resale as animal feed.

Mangrove Planting

Trained local community in mangrove horticulture and preservation; established, using community labor and ongoing husbandry, ten hectares of new mangrove forest at lagoon edge to provide livelihoods benefits and storm protection.

INDIA



INDIA

VULNERABILITY ASSESSMENTS, SECTOR STUDIES, AND PILOT PROJECTS

VULNERABILITY ASSESSMENTS

In India vulnerability assessments were done differently in Gorakhpur than in Indore and Surat. The two different approaches are described below.

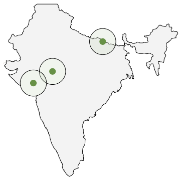
SECTOR STUDIES

In India, sector studies were selected by the city advisory committees (CAC; Indore and Surat) and the city steering committee (CSC; Gorakhpur) to address information gaps identified in the vulnerability assessments. Studies were completed in early 2010 so that results could feed into the city resilience strategies.

The objective of the studies was to capture the systemic vulnerabilities of the selected sectors in the three cities and to highlight cross-sectoral linkages. In general, the Surat and Indore sector studies are broader and focus more on compiling available information and using it to identify potential future actions than generating new information. The Gorakhpur studies are more targeted at specific issues and locations within the city, and in many cases generated new information through surveys, focus groups, and in some cases, technical research. As with the different foci in vulnerability assessments between Indore/Surat and Gorakhpur, the difference in sector studies is driven strongly by the different scale and needs of the cities, as well as by the different capacities and preferred methodologies of the ACCCRN national partners leading the work.

Most of the ACCCRN cities undertook one or two sector studies, due to time and budget constraints. The number of sector studies — and pilot studies — that the Indian cities completed, is striking in comparison. In Indore and Surat, the number of completed studies reflects the CACs' buy-in and engagement; the CACs were active participants in study selection and design and in selection of researchers to complete the work. In addition, in Surat, the Municipal Corporation donated city worker manpower to the research effort (both for sector and pilot studies), providing results at no or reduced cost to the program.

Surat's health sector study is the only detailed health work undertaken in the ACCCRN project to date. (Indore has conducted a study, but its is much less comprehensive than Surat's.) The Surat study addresses the full suite of areas that intersect with the health department's sphere of responsibility, including health systems, disaster response, epidemics, vector borne diseases, solid waste disposal, water, and wastewater. In Surat in particular, due to the health department's broad responsibilities, using the health sector as an entry point to climate change adaptation is very



effective, as the sector study clearly shows. Since the plague afflicted the city in 1992, the health department has been one of the most powerful departments in Surat and has the power to convene other departments and initiate joint activities.

PILOT PROJECTS

In India, the results of the vulnerability assessments and sector studies were used to identify pilot projects whose primary objective was encouraging buy-in and trust on the part of city stakeholders for the ACCCRN program. The pilots were also used to test approaches for building resilience.

The links between the pilot projects, the vulnerability assessments, and the sector studies vary between cities. In Gorakhpur, the linkages are readily apparent: cross-linked sector studies and pilot products picked up key areas of vulnerability identified in the vulnerability assessment and fed the information back and forth to strengthen both. The pilot projects themselves focus primarily on community education, capacity building at various levels, and founding new institutions (e.g., community solid waste management).

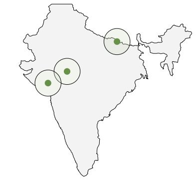
In Indore, because the city relies heavily on high-cost water supply sourced from long distances, the sector study explored key vulnerabilities regarding water supply, and partners implemented a pilot with urban user groups for conjunctive water management of local and distant water resources. The pilot also tested initial activities to build resilience, and as in Gorakhpur, its focus was primarily on education, capacity building, and laying the groundwork for new institutions (establishing water user groups).

Surat, in contrast, pursued innovative pilot projects aimed at building resilience in key sectors that the vulnerability assessment identified. The urban services pilot project develops and tests a new technological solution for an existing problem not explicitly identified in the vulnerability assessment. The safe habitat competition engages the private sector in developing solutions to flood resistant housing. These projects reflect both the greater capacity of Surat and the close engagement of TARU in conceptualizing and delivering the work. ■

VULNERABILITY ASSESSMENTS

GORAKHPUR

The Gorakhpur vulnerability assessment was conducted by a local NGO, Gorakhpur Environmental Action Group (GEAG), working in conjunction with the Gorakhpur Municipal Corporation (GMC, the local city government). The vulnerability assessment used primary data compiled through community and household questionnaires, supported and validated by consultations with the city steering committee (CSC) and a Gorakhpur citizens forum, to pinpoint, prioritize, and rank according to intensity the physical risks that Gorakhpur residents face. Concurrently, sections of the city were mapped by socioeconomic unit (lower, middle, and higher incomes) based on visual observa-



tion of residences and subsequent validation through field visits.

Combining these results with secondary data, the vulnerability assessment analyzed four main categories: vulnerability of infrastructure and services (including calculation of current demand and demand deficiencies for different socioeconomic groups); social issues of health and education; institutional challenges of addressing vulnerabilities; and economic consideration of losses associated with hazards (with particular attention to differential impacts on income groups).

Based on this compiled information, 14 wards (out of 70 total) in Gorakhpur were selected for further study. The four criteria used in ward selection were: 1) the number and intensity of risks in each area, 2) the coverage of various socioeconomic groups, 3) the severity of current impacts on economic activities, and 4) the diversity of the area. For these wards, earlier studies, the results of Gorakhpur's group SLDs, secondary data, and Participatory Learning and Action tools (see Figure 5.2) were used to analyze: vulnerability of infrastructure and services, including calculation of current demand and demand deficiencies for different socioeconomic groups; social issues of health and education; institutional challenges of addressing vulnerabilities; and economic consideration of losses associated with hazards, with particular attention to differential impacts on income groups.

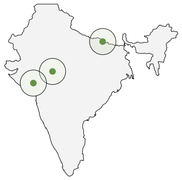
Data from the vulnerability assessment process was used to design and choose Gorakhpur's sector studies and pilot projects. This is described further later in this chapter in the sections on sector studies and pilot projects.

Excerpt from Gorakhpur Vulnerability Assessment Summary

Gorakhpur is vulnerable to waterlogging due to its natural topography of low slope gradients and large low-lying areas. Land pressures and increasing encroachments are shrinking the city's natural water bodies, and during the monsoon and post-monsoon months, twenty to thirty percent of the city is intensively waterlogged. A recent study by Opitz-Stapleton and Gangopadhyay (2008) (in Kull, Singh et al. 2008), conducted in the nearby Rohini River Basin (30 km to the north) projects potential increases in rainfall during the monsoon months (June-September) for the SRES A2 and B1 scenarios under a single general circulation model. Extrapolating the climate change projections from the nearby river basin to the city of Gorakhpur indicates that flooding and waterlogging might potentially increase due to climate change and land use patterns.

INDORE AND SURAT

TARU and ISET used a variety of techniques to conduct the Surat and Indore vulnerability assessments, to evaluate both socioeconomic vulnerabilities and vulnerability to hazard risks.



Socioeconomic vulnerabilities were assessed through a GIS-enabled sampling and aggregation method that allowed researchers to create an aggregated socioeconomic map of the whole city. Homogeneous socioeconomic clusters (SECs) were identified through visual observation of satellite imagery, using indirect indicators such as roof type, building size, road infrastructure, location, and distance from city center, etc. These findings were verified through rapid ground surveys. City maps were overlaid with homogeneous SEC polygons, which were then used to selecting sample locations for community/household surveys and an Infrastructure Services Deficiency Analysis (ISDA).

Survey research focused on the lower SECs by intentionally favoring slums and low-income communities in sample selection. Questionnaires compiled information on: household size; member details; occupations; income and expenditure; water, sewerage, and electricity infrastructure; assets; health; floods, water scarcity, and other risks and coping strategies; and other relevant topics. The ISDA was carried out through representative transect in sample neighborhoods, and included roughly 1200 households in 120 communities in Surat and 750 households in 75 communities in Indore.

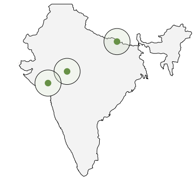
From survey results, researchers were able to aggregate data up to the scale of each polygon and to comparable polygons. Combining the survey results with ward maps and existing tax database information, researchers created ward level SEC and vulnerability maps. A rapid (hydro-meteorological) risk analysis was carried out in parallel with the socioeconomic assessment, using drainage and contour maps, records of historical events, hydro-metrological, tidal, and other relevant data sets. In this way, risk maps were created to compliment the SEC and vulnerability maps.

Concurrent stakeholder consultations also helped inform the vulnerability assessment process and sector study selection. The first round of consultations aimed to identify major issues and problems through discussions with key groups, such as, in Surat, the Surat Municipal Corporation (SMC), Southern Gujarat Chamber of Commerce and Industry (SGCCI), other industry groups, and representatives of slum communities.

In analyzing vulnerability assessment results, ACCCRN partners employed the Sustainable Livelihoods Framework, using various proxy indicators such as education; social networks and assets; income stability and loans and insurance; infrastructure access; and water scarcity/flood as proxy indicators for human, social, financial, physical, and natural capitals. These factors were considered in light of downscaled climate projections from a single general circulation model, supplied by the Climate Systems Analysis Group (CSAG) at the University of Cape Town. (Chapter 3 discusses the validity of this dataset.)

Observations on the India Vulnerability Assessments

Overall, the Surat and Indore vulnerability assessment approach resulted in significantly more quantitative



results than the Gorakhpur vulnerability assessment approach. However, the way these results were subsequently used by the three cities was very similar. In part this may be due to city size and community structure. Gorakhpur is significantly smaller than Indore and Surat, making a community-based, focus-group approach to collecting vulnerability information possible; a similar approach could not have been implemented in Surat and Indore, given time and budget constraints. It also appears that, due to the city's smaller size, Gorakhpur officials and citizens already were aware of the vulnerable locations and populations in the city. The vulnerability assessment further focused and nuanced this information, but the basics were already well understood and quantification was unnecessary. In contrast, given the size of Surat and Indore, both in terms of population and geography, an approach that could provide a citywide overview of vulnerability quickly and effectively proved highly useful.

For all three cities, however, when selecting sector studies and pilot projects and constructing resilience plans, the general structure of vulnerabilities — in terms of communities and sectors — rather than the more specific quantified data, focused the work. This highlights those aspects of the vulnerability study results that are most important:

- Clear identification of vulnerable peoples, locations, and sectors within the city; and,
- Sufficient justification of findings to achieve buy-in from stakeholders.

What is required to achieve this second point will vary from city to city and from country to country, as the Indian ACCCRN cities illustrate.

SECTOR STUDIES

GORAKHPUR

Saving a Dying Lake: The case of Ramgarh Tal in Gorakhpur, Uttar Pradesh

Documents the encroachment and pollution of the largest lake in Gorakhpur over the past half century, and the associated loss of ecosystem services, including potable water and drainage, issues that will have growing consequences under climate change. Briefly describes a government effort to rejuvenate the lake.

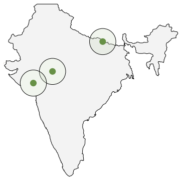
Servicing the City: Migrant Workers and Deprivation In Gorakhpur, Uttar Pradesh, India

Evaluates the immigration of manual workers and other essential service providers to Gorakhpur. The study addresses the causes of migration, the dynamism of social deprivation in source and destination, and the living conditions of migrants.

Geo-hydrological Study of Gorakhpur

Assesses the geo-hydrological condition of Gorakhpur and the role it plays in creating and/or mitigating physical and anthropogenic problems like water logging, solid waste and sanitation, deterioration of surface and ground water quality, etc.

Gorakhpur is significantly smaller than Indore and Surat, making a community-based, focus-group approach to collecting vulnerability information possible; a similar approach could not have been implemented in Surat and Indore, given time and budget constraints.



INDORE

Urban Environment and Health

Reviews current solid waste disposal practices and proposes alternatives; reviews current city air quality and water logging problems and notes options for addressing them; and proposes an awareness-raising campaign for communities, school curriculums, and policy makers around climate change risks.

Urban Transport

Examines current and proposed urban transportation scenarios and notes that current proposals for implementation by 2025 will not be enough in terms of infrastructure or mitigation needs. Also examines additional impacts to transport sector from climate change and concludes with a matrix of 16 adaptation and mitigation options.

Electrical Energy Scenario of Indore, Year 2020

Assesses current and projected 2020 electrical energy demand, current and projected future electrical energy supply, and explores options for improving current efficiencies and meeting future demand.

Study on Green Buildings in Indore

Examines the potential of energy efficient buildings — both public and private — for reducing projected energy demand increases. Indore's rapid growth is accompanied by equally rapid building construction, much of it climate-controlled. Meeting the growing energy demand for air conditioning is projected to be a major challenge for the city.

Water Security for Indore

Analyzes current and future (2024 and 2039) water availability and demand and highlights adaptation measures to ensure water supply under projected increased flooding and water scarcity conditions in the future. Adaptation options focus in particular on demand management, leakage and waste reduction, rainwater harvesting, conjunctive use, and other soft path approaches.

SURAT

Environment Study of Surat

Summarizes current status of land use, water quality, wastewater, solid waste, transportation, and air pollution and makes recommendations to improve services and increase resilience and sustainability in these areas.

Flood Risk Management

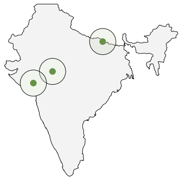
Reviews flooding history of Surat, with particular emphasis on 2006 flood and citizen responses to the flood, including adaptation measures taken during and after the flooding. Proposes strategies and approaches to make city resilient to flooding via prevention, mitigation, and adaptation.

Energy Security for Surat

Assesses current and projected energy demand from different sectors in Surat for the year 2020. The study also explores options for improving current efficiencies (like having green building codes for Surat) and increased role of renewable energy as a way of meeting the future demand.

FIGURE 5.2 | Participatory Learning Action Tools Used in the Gorakhpur Vulnerability Assessment

OBJECTIVE	TOOLS	INFORMATION COLLECTED
SITUATION ANALYSIS	Transect walk Satellite images Social mapping Service mapping	Nature of houses: single house (separate), double storied, multi storied, rented/own house, flats, wall types (bricks, stone, mud/earth) • Socio-economic status of community: SEC identification, inter-class variability • Available services in area: health, Public Distribution System, education, toilets, sanitation, etc. • Major risks of area: water logging, sewage, solid waste management, drinking water, electricity, etc. • Livelihood pattern • Insurance and debt pattern
TREND ANALYSIS	Trend diagram Focus group discussion	Changes occurred in physical area over a period of time: constructions, settlement pattern, etc. • Changes occurred in services and choices over a period of time: livelihood choices, health, education, PDS system, etc.
PREFERENCE & CHOICES	Preference ranking and scoring Matrix Chapati diagramming	Preference of different services and causes: livelihood, health, education, PDS, toilets, electricity, etc. • Prioritization of problems associated with services: access and availability • Distance of services • Distances from risks: water logging, sewage, solid waste • Responses towards service providers: Municipal Corporation, Electricity Board, Jal Nigam, etc.
PROBLEM ANALYSIS	Causal loop diagramming Problem tree Focus group discussion Seasonalities of problems	Structure of problems: water logging, sewage, solid waste management • Interconnections and mutual contributions: linkages between different risks • Reinforcing and balancing nature of factors prevailing problems • Seasonality of available services • Seasonality of risk intensity • Seasonality of demands



Water Security Plan

Analyzes current water infrastructure and resources; assesses impacts of city growth, changes in demand and climate change on current supply; and evaluates potential mitigation and adaptation measures to ensure a minimum of 20 liters per capita per day of delivered piped water for all municipal dwellers under future crisis conditions. Includes broader systems issues such as energy requirements to deliver current and future water.

Health Impacts and Adaptation

Suggests public health adaptation strategies and projects impacts of climate change on human health, indicators of vulnerability, and preparedness. Urban health systems are an increasing priority for India. Although urban health on average is better than rural health, basic and preventative health services for vulnerable groups (e.g., slum dwellers) are poor or lacking.

Climate Scenario of Gorakhpur

Analyzes the changing climatic patterns in Gorakhpur in the recent past using available national and international data sources. Data analysis is coupled with downscaled climate projection for the period 2046-2065 to produce scenarios of future climate change.

Technical Feasibility Study for a Low Cost and Low Energy Drainage System in Rasoolpur, Gorakhpur

A case study of Rasoolpur area, a low-lying area within Gorakhpur where people are severely affected by water logging. Recommends simple, practical (low cost and low energy), short- and long-term mitigation measures to improve flooding conditions in the area.

Role of Indiscriminate Use and Disposal of Plastics in Enhancing Climate Change Induced Vulnerability in Gorakhpur

Assesses usage pattern, magnitude, and problems related to indiscriminate disposal of plastic bags in the city of Gorakhpur, including their impact on the environment and role in increasing city vulnerability to climate change impacts. Also focuses on sensitizing stakeholders and decision makers and encouraging exploration of possible solutions through multi-stakeholder and multidisciplinary partnership.

PILOT PROJECTS

GORAKHPUR

Decentralized Solid Waste Management through Community Participation

200 households engaged in implementation of decentralized, community based solid waste management. Project provided livelihoods creation, ecosystem benefits in the form of greater recycling and composting of waste, reduction in flooding and water logging from waste-blocked drains.

"Polyethylene No More" Campaign

Building on the waste sector study, GEAG produced and distributed a series of four-page leaflets to communicate challenges associated with sanitation

and waste in Gorakhpur, encouraging citizens to change their habits regarding waste and recycling and to actively participate in community solicitation of better services from city government.

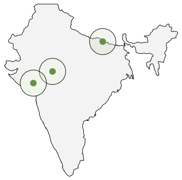
Ramgarh Lake Conservation Campaign

Building on the Ramgarh Lake sector study, the campaign worked to raise understanding within the community of the risks to Ramgarh Lake. Work obtained supplemental funding and support from India's Ministry of the Environment

INDORE

Urban User Groups for Conjunctive Water Management (CWM) of Local and Distant Water Resources with Focus on Building Resilience to Climate Change

Building on the water sector study, this project addressed water scarcity, which is pervasive across the city, through establishment and training of community water user groups in four communities who will begin to address managed conjunctive water use. In parallel, the communities were surveyed regarding water sources, use, and perceptions to provide the basis for action.



SURAT

Surat Safe Habitat: Planning and Design Competition

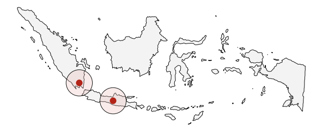
Competition addressed two themes: 1) planning and design of low-income group cluster housing in areas prone to frequent flooding; and 2) urban planning of low-lying area with high flood risk. Competition was the first of its kind in the country. The Municipal Corporation considers winning designs for implementation; design competition may become annual event. Based on the pilot experience, a larger project proposal on UCCR initiatives through competition is being explored by the CAC.

Urban Services Monitoring System

To improve monitoring of lifeline services, such as water supply, sewerage, solid waste and storm water drainage systems, a structured, SMS based application with supplementary web-GIS interface was developed. The resulting Urban Service Monitoring System (UrSMS) system, which supports the current monitoring processes already in place, is currently being tested within three departments of SMC: the water, sewerage, and solid waste complaint redressal; water supply and monitoring; and health (Disease surveillance system). The system can be expanded for use as an emergency two-way monitoring system during flood emergencies like floods.

Building and Implementing Spatially Explicit Database of Vulnerable People Requiring Special Care During Emergencies in One Neighborhood

Project developed a database of approximately 1200 households as a tool to aid emergency response entities in identifying the most vulnerable population in the city who may require critical care/ immediate relief during emergencies such as floods. Systems developed and tested in this project can be extended to entire city.



INDONESIA

VULNERABILITY ASSESSMENTS, SECTOR STUDIES, AND PILOT PROJECTS

VULNERABILITY ASSESSMENTS

In Indonesia, the vulnerability assessments were conducted as three-part studies: a citywide vulnerability assessment (CCROM), a community-based assessment in sub-districts identified through SLDs as vulnerable (Mercy Corps), and an assessment of governance in relation to climate adaptation (URDI). Results of the studies were combined approximately five months later into synthesis documents for each city. These documents began with assessments of current vulnerability and capacity in Semarang and Bandar Lampung down to the Kelurahan or sub-district administrative level. Scenarios of future vulnerability, capacity, and climate variability were extrapolated from a variety of information sources and from the current vulnerability and capacity profiles. The assessments are described in detail below.

SECTOR STUDIES

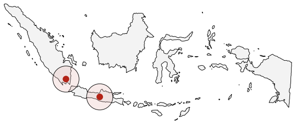
Unlike India and Thailand, where sector studies were completed prior to the initiation of pilot projects, or Vietnam, where sector studies and pilot projects were done more or less in parallel, Indonesia began the sector studies after reviewing the results from the vulnerability assessment and pilot projects.

Just as they added a separate governance component to the city vulnerability analyses, the Indonesian cities added an additional condition to their selection criteria for sector studies, requiring that the study be congruent with the vision and mission of relevant institutions in enhancing city climate change resilience.

Indonesian cities selected sector studies with the intention of collating information needed for the development of city resilience strategies while simultaneously enhancing stakeholders' understanding of the interaction of urban systems. Local institutions that are members of the city team carried out the sector studies.

The Bandar Lampung sector studies, which address drainage and solid waste management, were developed in response to information gaps identified in the vulnerability assessment and during the pilot projects. The communities engaged for the Bandar Lampung pilot projects were used as the foci for the sector studies. Both drainage and solid waste management play a major role in current and projected future city challenges; poor systems and management increase community vulnerability to extreme weather events. The Semarang sector studies assess drainage, erosion, and flood — all areas of current vulnerability that are anticipated to be exacerbated by climate change.

The concerns about the vulnerability analysis spurred the working group to review and discuss the CCROM assessment in great detail. The lessons that emerged from these discussions may prove, over time, to be significant contributions to the overall resilience planning process in the Indonesian ACCCRN cities.



Sector study results were presented and discussed during SLD 5, too late to influence preparation of the city resilience strategies. However, as ACCCRN Phase 3 progresses, the sector studies are influencing formulation and development of implementation activities in both cities.

PILOT PROJECTS

The Indonesian pilot projects were designed to meet the following criteria:

1. Replicability
2. Addressing current and future risks
3. Benefiting local communities
4. Innovation
5. Collaboration
6. Scalability
7. Sustainability strategy

The cities also hoped that the pilot projects would create positive changes within the city by enhancing local stakeholders' understanding of climate change impacts, by offering ways to strengthen their capacity to respond to climate change, and by improving networking among stakeholders. The pilots offered input to local governments in particular about the policies, strategies, and action plans relevant to climate resilience-building in the city.

A total of six Indonesian pilot projects were conducted, four in Semarang and two in Bandar Lampung. All were developed based on information and findings in the vulnerability assessments.

The Indonesian pilot projects have effectively served as "proof of concept" projects, implemented at a small scale and over a short timespan to test approach and methodology. Several are now being turned into larger engagements. In Bandar Lampung, additional information gained through the sector studies (which stemmed directly from the pilot projects) is also contributing to the development of these broader projects. ■

VULNERABILITY ASSESSMENTS

Indonesian Citywide Vulnerability Assessment

In both Bandar Lampung and Semarang, citywide vulnerability was assessed via a series of indices developed and applied at the Kelurahan level. Indices included:

- Vulnerability and capacity index — measured using a number of socioeconomic and biophysical indicators, including number of households/buildings located on the river bank, availability of piped drinking water, population density, economic status of households, proportion of Kelurahan near river or coast, and proportion of green open space;

- Adaptive capacity index — measured using household education level, sensitivity of main income sources to climate hazards, health facility access, and road infrastructure;

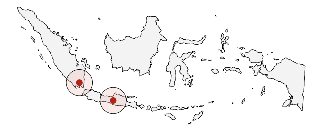


TABLE 5.2 | Indicators of Adaptive Capacity and Vulnerability Used in Indonesian Vulnerability Assessments

Adaptive Capacity	Vulnerability
Economic level	Number of households living on river bank
Education level	Number of buildings on river bank
Main source of income	Drinking water
Health facility	Population density
Road infrastructure	Poverty
	Fraction of coastal area
	Fraction of river
	Drainage facility
	Non-green open area

- Composite climate hazard index — measured using level of exposure to flood, drought, landslide, and sea level rise.

These indices were assessed both for current and projected future vulnerability and climate risk. Future climate conditions were based on the A2 and B1 emissions scenarios simulated by a suite of 14 IPCC GCMs (further details in chapter 3). Future socioeconomic conditions were projected based on historical trends.

Index results were presented in a number of ways. Indicators were plotted both individually and as normalized, composite values on maps, as illustrated in Figure 5.3.

Indices were also cross-plotted, as shown on Figure 5.4, allowing rapid assessment of most-vulnerable and least-vulnerable villages. Figure 5.4 classified villages into five coping capacity categories/quadrants. Villages categorized as quadrant five will have a high vulnerability index and low capacity index, indicating they will experience the most severe impacts in comparison to other quadrants, while villages in quadrant one will receive will be least affected.

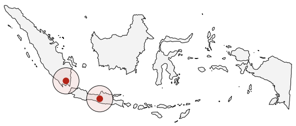
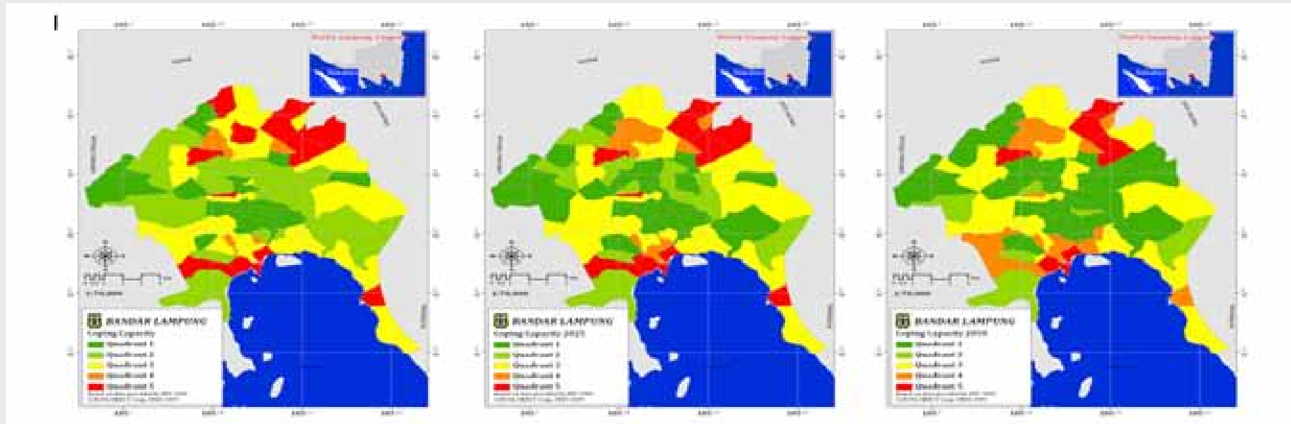


FIGURE 5.3 | Adaptive Capacity Index of Villages within Bandar Lampung



A (2005–Baseline) **B** (2025) **C** (2050)

Indonesian Community-Based Vulnerability Assessment

The Indonesian community-based vulnerability assessment was similar to the Vietnamese HCVA in that it focused on two or three previously identified, high vulnerability communities, and it used surveys, focus group discussions, and interviews to collect information. In each city, three highly vulnerable sub-districts with varying characteristics and climate hazards were selected for analysis. Health, education, and sanitation were all considered in particular during selection.

Information gathered for this particular assessment comes from different sources:

- Block survey with questionnaire
- Focus group discussion
- In-depth interview
- Observation
- Desk study

Unlike the Vietnamese HCVA, however, the Indonesian community-based analyses included extensive discussion of the implications of their findings. This included an assessment of the factors contributing to vulnerability; informal, voluntary, community-led adaptation

Findings from the Indonesian Community-Based Vulnerability Assessment (Excerpted from Indonesian ACCCRN documentation, April 2011)

Having assessed the current socioeconomic condition in all villages, the following lessons can be learned:

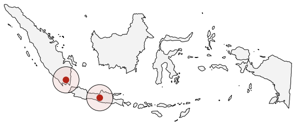
- Vulnerability is closely linked with poverty;
- Relocation of communities can be potentially devastating, or not;
- The presence or absence of the State can play a large role in reducing or increasing vulnerability;
- Vulnerability is compounded by lack of knowledge and access to resources;
- The market is the ultimate determinant of vulnerable conditions, unless there is intervention, e.g., the poor can only access poor job and highly exposed lands without government intervention;
- Women, children, and the elderly experience vulnerability differently than men, and are more vulnerable to severe climate events;
- People are most concerned with their economic vulnerability. This can lead to remaining in highly exposed locations to preserve livelihoods/ employment.

Reviewing the adaptation strategies communities have put into practice on their own, there are some lessons that can be learned about successful adaptation strategies:

- Quite simply 'they work';
- They are inexpensive and work with what materials are available;
- Accessible in times of need;
- They don't rely upon big government projects or interventions;
- Adaptation to severe climate events must work together with other adaptation strategies;
- The whole is greater than the sum of the parts;
- Leveraging government support leads to better results;
- More access to information can lead to better outcomes.

The study was also able to identify voluntary adaptation strategies that have been undertaken by communities in the aforementioned villages. The strategies are:

- Progressive reclamation of land, frequently using solid waste as fill;
- Structural improvements and infrastructure, e.g., construction of low, floodwater prevention walls around housing;
- Upgrading housing to improve resistance and utilization of recycled scrap materials for house construction;
- Living above the water to retain easy access to aqua-based livelihoods; housing on stilts even in areas not above water to address seasonal flooding;
- Gradual consolidation of neighborhoods with associated improvements to drainage, addition of retaining walls and water pipes;
- Water harvesting and animal husbandry;
- Ability to access cash through credit, fungible assets, and via informal financial sources, e.g., informal lenders, community saving groups, sale of personal assets;
- Community collaboration projects;
- Data collection and modernization, e.g., developing comprehensive community risk mapping;
- Developing alternative access to basic services;
- Informal social safety nets;
- Flexible economic survival strategies, e.g., home-industries based on making products from reclaimed waste materials; switching from fish and shrimp farming to fish and shrimp processing;
- Raising community capital to leverage government support;
- Political engagement and local community organization.



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measures that are already being implemented; and a list of attributes seen in successful adaptation strategies.

Indonesian Governance Analysis

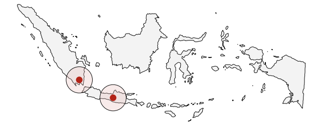
Finally, the URDI-led governance and institution assessment examined the key sectors and stakeholders and identified strengths and weaknesses of mechanisms for addressing climate adaptation. It consisted of three main parts: a stakeholder analysis, an assessment of the effectiveness of current initiatives and programs (short- and long-term) to cope with future climate risks, and an assessment of the local government's capacity to integrate climate change into development planning.

The Indonesian cities were the only ACCCRN cities to conduct an analysis specifically focused on governance issues. They also have done the best job of integrating their strategies with the local planning processes. Whether the climate change governance component of the vulnerability assessment directly contributed to that success is difficult to determine; however, as far as it indicates a focus on and engagement around governance issues, perhaps it is not surprising that Indonesia is ahead in this arena.

Observations on the Indonesian Vulnerability Assessments

Though the citywide vulnerability assessment conducted by CCROM looks very quantitative and well thought out, in application its value to the Indonesian cities was mixed. Some of the issues the city partners flagged were:

- The cities didn't like the indicators that were selected for analysis. In part, this was because



some of the indicators were misleading, such as the number of educational facilities in an area, rather than the average level of education. Because the indicators were not made transparent in the document, the city team spent considerable effort to discover what was actually being measured, and also lost confidence in the analysis;

- Aggregating the hazards resulted in losing information about which hazards impacted which areas;

- Analyses were based on national datasets, which are not considered reliable;

- Areas currently unexposed to flooding were identified as vulnerable to future flooding, but the city team was not convinced this was realistic;

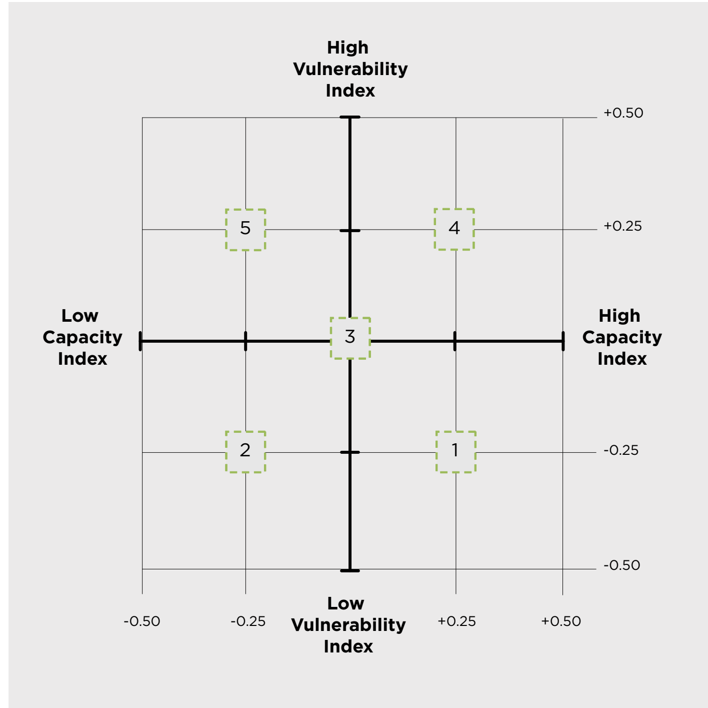
- CCROM only minimally consulted with partners, which exacerbated confusion;

- The report writing style was academic which made it difficult for many of the city partners to understand and increased the challenges in giving feedback to CCROM; and,

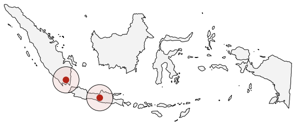
- Overall the results were not practical because they didn't focus enough on specific hazards.

Though many of the Indonesian cities' concerns overlapped, they were not identical. ISET also identified problems with the climate data used in the analysis, as chapter 3 discusses.

FIGURE 5.4 | Classification of Village Based on Coping Capacity Index



These concerns about the analysis, however, spurred the working group to review and discuss the CCROM assessment in great detail. The members also learned a lot about what should not be done in future vulnerability assessments. Both the discussions and the lessons that emerged may prove, over time, to be significant contributions to the overall resilience planning process in the



Indonesian ACCCRN cities. Semarang and Bandar Lampung ultimately supplemented the CCROM report with other secondary sources with which they felt more comfortable, and explored development trajectories under different climate scenarios via scenario development.

In part because of their discomfort with the CCROM citywide vulnerability assessment, the Indonesian cities relied more on the community-based vulnerability assessment. This is particularly evident in the Semarang Resilience Strategy (see chapter 6) and in pilot projects for both cities. The community-based vulnerability assessments helped define vulnerable areas and vulnerable people in those areas, as well as nuances such as gender issues, water pricing challenges, etc.

SECTOR STUDIES

BANDAR LAMPUNG

Study of Interception Drainage Models for Water Management and to Support Ground Water Recovery

Assesses appropriate drainage model for water management, develops scenarios to address flooding and water scarcity in Bandar Lampung, particularly in areas with high population density. Explores three possible drainage approaches: retention, infiltration, and surface drainage. Also recommends implementation of non-physical control via floodplain management to further reduce flood risk.

Integrated Solid Waste Management

Evaluates integrated waste management models for resolving existing solid waste management problems and simultaneously enhancing community's livelihood by increasing economic value of recyclable waste. Proposes an integrated waste management model focused on the implementation of R4P principle (Reduce, Reuse, Recycle, Replace, and Participate). Emphasizes the need to restructure existing solid waste management systems in the city.

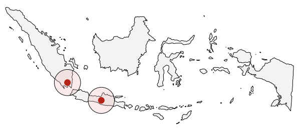
SEMARANG

Assessment of Semarang's Drainage Master Plan to Cope with Climate Change Impacts

Evaluates the extent to which Semarang's Drainage Master Plan — developed to reduce flood risks and hazards within the municipality, but without accounting for climate change — can assist the city in addressing drainage-related issues while simultaneously building city resilience to climate change.

The Impacts of Coastal Erosion on the Livelihood of Fishermen in Tugurejo Village and Measures to Address the Challenge

Coastal Erosion in Semarang's coastal communities is projected to increase with climate change. Using Tugurejo village as a case study, the study explores current erosion impacts on the environment and on residents, and mitigation measures. Recommends ways to address erosion impacts, including: socioeconomic and cultural (i.e., trainings and strengthening community groups), political



(e.g., legitimization of relevant policies and regulations), and technical (i.e., installation of breakwater devices, rehabilitation of Tapak River).

PILOT PROJECTS

BANDAR LAMPUNG

Participatory Design of a More Climate Resilient Community, Kangkung and Kota Karang Districts

Participatory approach to addressing climate-related issues. Activities included: socialization, surveys, and focus group discussions to identify current risks and local responses; education and awareness campaign to alert citizens to how climate change will interact with current risks, and what can be done to address this; training on solid waste recycling and clean water provision; making of a documentary movie.

Capacity Building to Cope with Climate Change in Panjang Selatan Sub-district

Focused on building the adaptive capacity of the Panjang Selatan community towards climate change impacts. Activities included: waste management training; land rehabilitation via tree planting and natural resource education; clean water provision; media campaign.

SEMARANG

Micro Finance Program: Community Based Revolving Fund for Improving Sanitation in Kelurahan Kemijen

Established a revolving fund to improve sanitation for poor, female-headed households; coupled with community education campaign on sanitation and climate change.

Land Arrangement Models for Disaster Minimization in Kelurahan Sukorejo

Addressed landslide and drought issue in the Sukorejo village by implementing demonstration models for water and land conservation. Demonstration models include reforestation, demonstration terrace plots, and installing recharge wells and Bio pores.

Coastal Community Adaptation in Tapak Tugurejo: Building Climate Change Resilience

Enhanced the resilience of the coastal community of Tapak Tugurejo via: capacity building for both community and wider institutions; promotion of the installation of a 180m breakwater device (APO) along Tugurejo coastline; and implementation of mangrove conservation measures both on locally critical land and in the vicinity of the APO.

Building Resilience to Landslide and Cyclones in Sub District of Tandang

Enhanced community resilience to landslide and cyclone disasters that frequently occur in the sub-district of Tandang and that are expected to intensify under climate change. Founded a disaster preparedness committee and developed a Local Action Plan to begin working on an Early Warning System; planted vetiver grass in areas prone to landslide disaster. All accomplished via community participation, with focus group discussions a key activity.

THAILAND

THAILAND

VULNERABILITY ASSESSMENTS, SECTOR STUDIES, AND PILOT PROJECTS

VULNERABILITY ASSESSMENTS

The Thai cities' approach to the vulnerability assessments was more informal than the other countries because there is no formal data, such as a baseline census, with the socioeconomic status of Thai residents. During the first SLD the ACCCRN working groups identified vulnerable areas within the cities and then selected communities within those vulnerable areas as targets for the vulnerability assessments. The process is described in more detail below.

SECTOR STUDIES

The Thailand sector studies were conducted in parallel with the vulnerability assessments, due to the compressed ACCCRN timeline in Thailand. Discussions during SLD 1 about vulnerable sectors and city groups informed both the vulnerability assessments and the sector studies, the results of which were presented and discussed in SLD 2. Because of the compressed timeline, the Thai sector studies were prepared very rapidly.

The Chiang Rai sector studies developed new information and proved to be very useful documents to the resilience planning process. The agricultural study highlights the value of ecosystem services to poor farmers; it documents that rural farmers with access to community forests are significantly less vulnerable to drought than farmers close to urban areas, who are more likely to be forced into the cities in search of work. The linkages between rural crises, urban in-migration, and impacts to urban services, previously not fully understood by the city team, became readily apparent with this study.

The Chiang Rai tourism study is similarly informative. Prior to the study, the Chiang Rai Working Group had not considered the possible impacts to tourism from climate change. Tourism is one of the dominant economic sectors in Chiang Rai, and it employs many of the urban poor, so this shift in perspective significantly affected the subsequent resilience planning work in the city.

Regretfully, the Hat Yai water management study had little to no impact on the Hat Yai work. In part due to poor research, in part due to the compressed timeline for the Thai ACCCRN engagement, the study merely compiled data and provided no analysis, rendering it inaccessible for the planning process.

PILOT PROJECTS

The Thailand pilot projects were discussed and selected during the third SLD. Both were started in late February 2011, are currently in process, and will be completed in late-summer 2011. ■

VULNERABILITY ASSESSMENTS

Mae Fah Luang University conducted the vulnerability assessment in Chiang Rai, and Prince of Songkhla University conducted the assessment in Hat Yai. The general focus of the studies was on what types of climate impacts residents are dealing with now in terms of temperature, rainfall, etc., and how residents see these impacts as differing from the past — e.g., when they might have equated vulnerability with current exposure to floods and droughts. This was implemented via a community-based approach, using focus groups and questionnaires, supplemented by interviews with selected local representatives.

Because of problems obtaining climate projections (see chapter 3), the Thai vulnerability assessments focused on current, rather than future, climate risks. The researchers' lack of familiarity with the concept of vulnerability was a further challenge to the analysis. In Chiang Rai, most researchers involved were from the health faculty, and in Hat Yai, most were from the environmental department. Consequently, the Chiang Rai and Hat Yai vulnerability assessments are preliminary documents and should be significantly revised once climate projections are available.

Thai Vulnerability Assessment

The definition of vulnerability as current exposure to climate disasters had significant implications in both cities, in different ways. In Hat Yai, because ALL residents, regardless of socioeconomic status, experience flooding, the definition was modified to: vulnerability = capacity to recover.

In Chiang Rai, where current disasters are limited primarily to drought, and are seen as affecting only poor rural farmers, not urban dwellers, city stakeholders had trouble identifying vulnerable populations on which to focus.

SECTOR STUDIES

CHIANG RAI

Farming and Climate Change

Evaluates appropriate climate for the growth of six key local cash crops (rice, maize, longan, lychee, tea, and coffee) and how changes in climate, particularly temperature and rainfall amount, would impact their farming. Provides broad recommendations regarding ecosystem enhancement for farmers under potential future conditions.

Tourism and Climate Change

Identifies potential future climate hazards for tourism sector. Recommendations focus primarily on promotion and networking involving community tourism models and green initiatives.

HAT YAI

Water management in U-Tapao Canal Basin

Compiles existing information on flood risk, past flooding impacts, existing preventative measures including both hard- and soft-path measures. Provides no new information or analysis.

THAILAND

PILOT PROJECTS

CHIANG RAI

Urban Development Program to Cope with Climate Change

To address projected increases in summer drought, winter flooding and landslide under climate change, this program: promotes water resource development and conservation including dredging and infrastructure improvements to Nong Peung reservoir; conducts a participatory biodiversity survey; trains farmers on GHG emission caused by crop and agricultural waste burning and on alternative farming practices; and encourages citizens to more actively engage government around these issues.

HAT YAI

Flood Control and Management Network Program in Klong U-Tapao Watershed Area

Government officials will collect flood information data, update flood maps at the municipal and provincial level, and generate the data and analysis needed to support design and implementation of a Flood Early Warning System. Parallel to this work, two communities will be engaged in community based flood prevention and mitigation planning and capacity building to test approaches and methodologies for future citywide systems.

CONCLUSIONS

The breadth, depth, and sheer volume of the work that has been produced by the ten ACCCRN cities over the first two years of the ACCCRN program is both impressive and impossible to summarize effectively in one chapter. Thus, this chapter attempts to provide a flavor of the work that has been completed, highlighting some of the similarities and differences between cities.

The diversity of the vulnerability assessments, sector studies, and pilot projects, both in terms of context and also methodology and approach, limits the opportunity for comparison among cities. This diversity, however, largely stems from the fact that the work has been locally driven, which has compelled local engagement and therefore greatly increased local learning.

The three activities described in this chapter engaged different groups at different scales within each city. The variety of approaches enabled the work to reach and engage a broader audience. And, in all cities, the experiences of doing these studies helped to shape understandings of climate change, and thus influenced the city resilience strategies, which are discussed in the following two chapters.

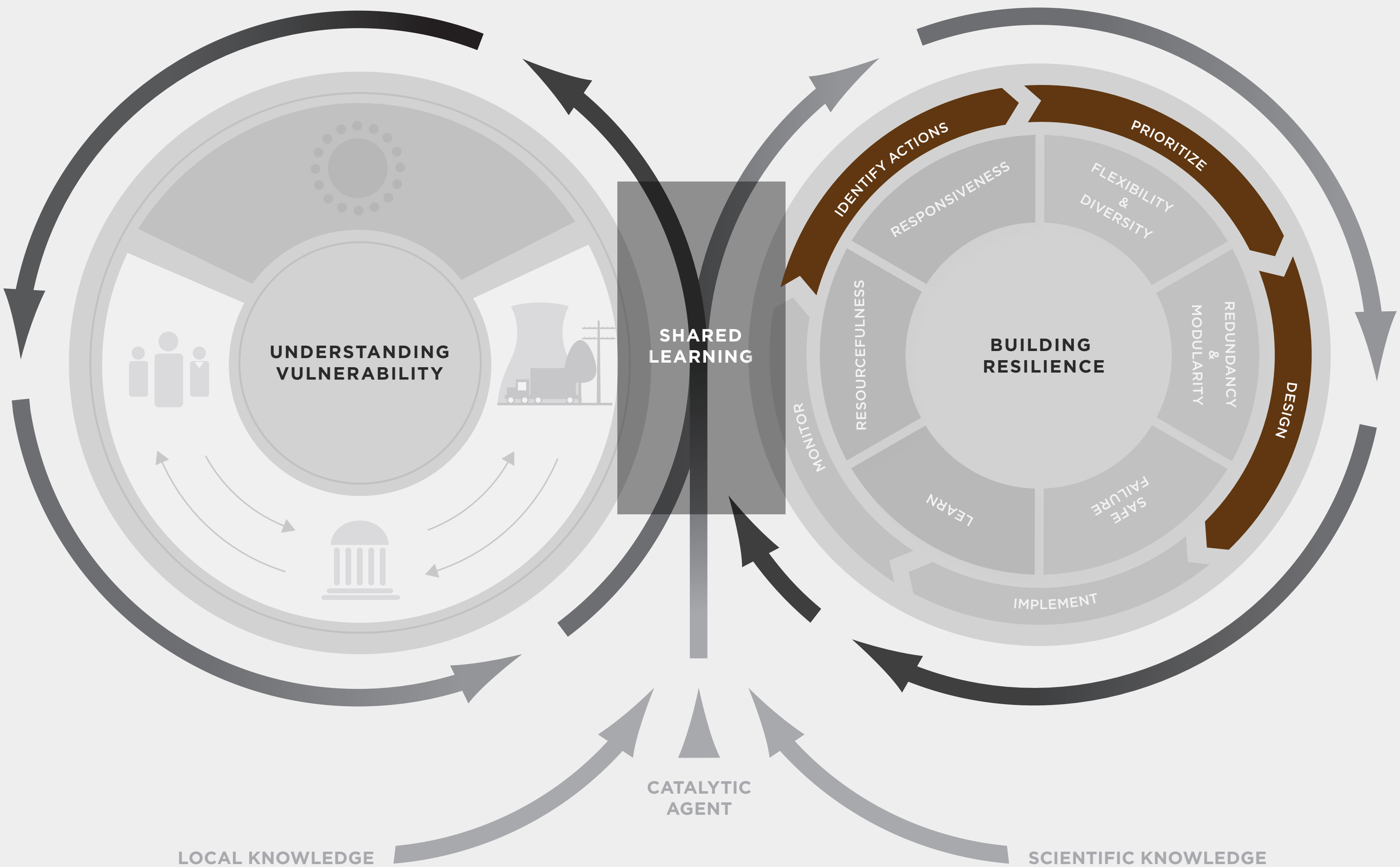
CHAPTER 6

PREPARING URBAN CLIMATE RESILIENCE STRATEGIES

Stephen Tyler and Sarah Orleans Reed
with Karen MacClune and Shashikant Chopde

FIGURE 6.1 | The Urban Climate Resilience Planning Framework: Building Resilience

This chapter focuses on the first three actions that appear in the right loop of the resilience planning framework: identifying, prioritizing, and designing resilience interventions. These steps led to the city resilience strategies that each of the ten ACCCRN partner cities produced (described in chapter 7).



INTRODUCTION

Since 2009, ACCCRN cities have been experimenting with a range of new planning tools and methods aimed at gaining knowledge and catalyzing action for building climate resilience. Previous chapters described the process of shared learning with inputs from climate studies, vulnerability assessments, pilot projects, and sector studies. This chapter describes how ACCCRN cities developed city resilience strategies. These cumulative strategic planning documents were a key milestone for the resilience planning process, assembling lessons from a year or more of engagement, analysis, and capacity building. The strategies lay out initial priorities for local action to strengthen climate resilience. These priorities can be used to support proposals for donor funding and to serve as a platform for ongoing learning and revision.

This chapter first describes the connection between the city resilience strategies and the Urban Climate Resilience Planning Framework (UCRPF; see chapter 2) that underlies this work and describes the planning practices as instituted in the ten ACCCRN partner cities. It also outlines the common but flexible guidelines for resilience planning that were presented to city and country level partners in the ACCCRN program and that formed the basis for the city level work, and then explains and compares the development of resilience strategies in each of the cities.

The chapter concludes with a discussion of comparative lessons from resilience planning processes as implemented so far in the different ACCCRN cities. The following chapter (7) describes and compares the main products of these processes — the resilience strategies themselves—analyzing the key conclusions of the strategies in relation to the planning framework introduced in chapter 2, and comparing the experiences within and between countries. The purpose of both chapters is primarily to describe and analyze the practice of resilience planning as it has emerged in these cities, rather than to describe the implementation or monitoring of the resilience building measures. The publication as a whole focuses on the engagement phase of ACCCRN, which did not include implementation of local resilience interventions. This chapter draws on the discussion, analysis, and related activities of climate studies, shared learning dialogues, and vulnerability assessments described in chapters 3 through 5.

LINKS TO THE URBAN RESILIENCE PLANNING FRAMEWORK

The UCRPF, described in chapter 2, emphasizes the fundamental role of critical urban systems in supporting dense and productive urban populations, and makes clear that both the capacities of agents and the

A City Resilience Strategy Should:

- Provide context, evidence, and analysis to justify actions for strengthening urban resilience;
- Set priorities for action by local government;
- Provide background information to support greater awareness and autonomous adaptation measures by community and private organizations;
- Link to existing development policies, procedures and plans;
- Identify actions that could be funded from various sources, including local resources, senior governments and external donors.

qualities of institutions linking systems and agents are vital to assessing urban vulnerability to climate change. Strengthening urban climate resilience entails an iterative process of assessing vulnerability, strategic planning, and monitoring resilience interventions, all linked through a shared learning mechanism (see Figure 6.1).

WHAT IS A CITY RESILIENCE STRATEGY?

A City Resilience Strategy, as introduced in the ACCCRN process, has several purposes. The intended output of resilience strategy development is a set of high priority resilience intervention proposals for funding and implementation — but the exercise of assembling a strategy has a wide range of outcomes. The purposes of resilience strategies include: to consolidate earlier learning about future climate and local vulnerability from SLDs, the vulnerability assessments, pilot projects, and sector studies; to disseminate these findings to key decision makers; to reinforce new knowledge, concepts, and strategic planning approaches among "core" resilience planning stakeholders; to strengthen new coordination mechanisms and partnerships; and to provide a platform for ongoing engagement and learning. In this way, the process of strategy development is at least as important to successful outcomes as the documented output. For that reason, we focus in this chapter on the nature of that process in each city.

A City Resilience Strategy is a broad local-level guidance document prepared by local government or by an advisory public or private organization. It should provide the context, evidence, and analysis to justify actions to strengthen urban resilience to climate change. While city resilience strategies will be different depending on the local conditions, climate vulnerabilities, and capacity for response, they should respond to existing development policies, procedures, and plans (recognizing that in many cases these are not internally consistent), and should be linked to the budgets and work plans of existing agencies so that they can be applied fairly readily. The strategy should identify high priority resilience actions that can be linked and coordinated with other local initiatives, and funded through available local resources or external sources. This is not only a matter of identifying "projects" but could also include changes to existing practices, the need for new practices, or discrete new activities to respond to specific issues.

The resilience planning process follows a series of assessments and interactions, driven at each step by the SLDs:

1. Developing technically credible information on climate, urban systems, interactions among agents, and existing development plans;

2. Engaging vulnerable groups and communities in diagnosing problems and designing actions to respond to these effectively; and

3. Developing mechanisms for coordination and for learning across multiple local government departments and non-government actors.

Chapters 4 and 5 describe the earlier phases of resilience planning, all of which provided input for the resilience strategy. Vulnerability assessments, in-depth sector studies, and lessons gleaned from pilot projects assembled new knowledge from various sources (science, analysis, experience), while the SLD approach helped ensure the engagement of local knowledge and key implementing partners (local government officials, NGOs, vulnerable groups, private sector representatives, and scientific experts). Planning and implementation of measures to build resilience are expected to follow a familiar strategic planning cycle, starting with formulating planning objectives to address the issues identified in prior analysis. Proposed actions are then to be identified and prioritized; priority actions designed, funded, and implemented; and implementation monitored to ensure effectiveness in addressing the original objectives, and to improve subsequent rounds of implementation (see Figure 6.2 and chapter 2).

In an idealized process of resilience planning, each of the previously described inputs (vulnerability assessments, sector studies, pilot projects) would follow sequentially, using SLDs at each stage to validate new information and inform the next step. Comparison and analysis of alternative proposed actions in the resilience strategy would then serve to justify funding of priority activities. (See Figure 6.3 for a summary of these inputs and processes.)

However, idealized processes are seldom possible in the real world. While some ACCCRN cities approximated this procedural model, others faced delays and deadline pressures that compelled them to undertake activities simultaneously rather than sequentially and limited the number of SLD iterations. In some cases, planning was concluded before sector studies were complete, and SLD discussions had to rely only on fragmentary inputs.

FIGURE 6.2 | Resilience Strategy Planning and Implementation Cycle (Showing Desired System and Agent Characteristics)

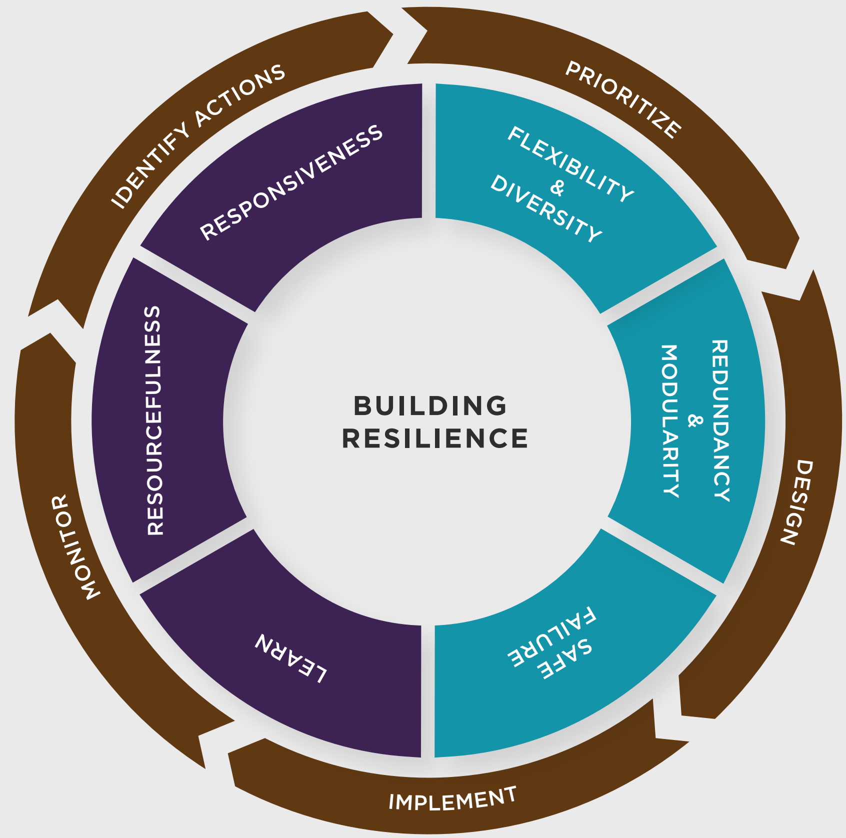


FIGURE 6.3 | Inputs to Resilience Planning at the City Level (Idealized Sequence)

GUIDELINES FOR RESILIENCE STRATEGIES

ISET introduced the concept of resilience planning to ACCCRN partners in a Resilience Planning Methods Workshop in Bangkok, Thailand in March 2010 and, in coordination with ACCCRN national partners, provided ongoing support for applying these tools. The climate resilience strategy document was described to ACCCRN city partners as being structured in three sections: the first dealing with future climate, impacts, and vulnerability; the second presenting potential actions in terms of their contributions to resilience of urban systems or to the capacities of agents and their linkages to other city plans and priorities; and the third section establishing priority areas for city intervention and for seeking external support.

As with the approach for conducting vulnerability assessments described in chapter 5, ISET expressly did not provide a structured outline of a strategy document when devising guidelines for developing the strategies, in order to prevent the process from becoming a checklist or a step-by-step procedure. Because each city's conditions and capacities were different, the process had to be flexible enough to respond to the varying interests and approach in each.

The resilience planning process had several points in common in all the ACCCRN cities, including:

- Inputs to the planning process;
- Suggested outline of the resilience strategy; and
- Suggested tools for comparing proposed activities in order to identify priorities for donor funding and implementation.

These elements were designed to encourage city-level project partners to work through the issues themselves, with the deliberate intent of having them struggle with new concepts and information in order to generate a practical plan with high local commitment, rather than a more technically sophisticated analysis by expert consultants with limited local comprehension or buy-in. The application of the guidelines and tools varied across cities and countries, as described above.

Tools introduced in the Bangkok workshop included:

Urban development and climate change scenarios
Scenario development helps planners examine the needs of their city under a variety of possible future conditions. It can be useful for considering uncertainties in climate and development trajectories.[1]

Qualitative cost-benefit analysis
This tool provides a simple mechanism to engage multiple stakeholders (including non-technical participants) in comparing the costs and benefits of a proposed action. Though this analysis does not substitute for rigorous quantitative evaluation necessary before making investment decisions, it is a useful means of eliciting critical thinking and collecting impressionistic data from stakeholders.

Technical feasibility and capacity assessment
Choosing appropriate interventions requires planners to systematically consider "Can this be done?" "How can it be done?" and "Who can do it?"

Resilience matrices
Based on the UCRPF, this tool helps planners assess whether their proposed suite of interventions promote the characteristics of resilience: flexibility and diversity, modularity and redundancy, and safe failure.

Multi-criteria analysis
Planners use this tool to evaluate their intervention options against selected criteria. It can be used to aggregate the conclusions drawn from other tools.

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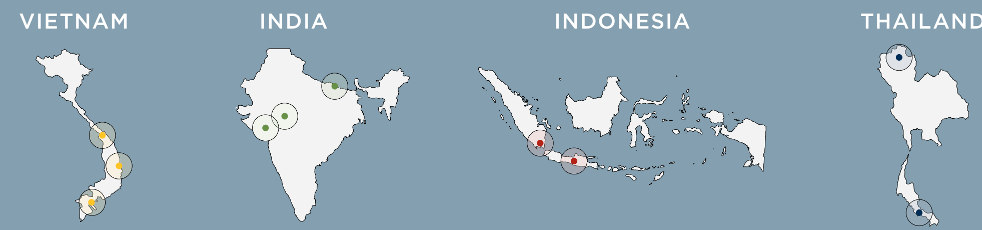


COUNTRY BY COUNTRY: DESCRIBING EXPERIENCE AND PRACTICE

The timeline on pp. 16 shows that Vietnam was the country that most consistently followed the idealized planning sequence as presented above. Indian cities adjusted sequence and timing to suit their conditions; and in Indonesia and Thailand, some of the studies and planning processes took place in parallel rather than in sequence, in order to meet tight project deadlines. In all cases, the city climate resilience strategies drew on available information from completed or ongoing analysis.

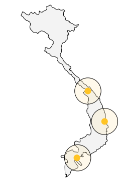
The approach to resilience planning described above was novel for ACCCRN cities in several ways: it was their first systematic effort to assess and respond to potential climate change impacts, and because it was a completely new area of technical analysis and integration, there was very limited local expertise in the subject matter. In addition to unfamiliarity with the subject matter, the planning process was new in that it integrated expert and local knowledge, and provided for both top-down technical direction and bottom-up local needs articulation.

To facilitate collaboration and practical integration, in each city a technical working group composed of multiple agencies within or outside local government directed the planning. In six of the cities (all three cities in Vietnam, both cities in Indonesia, and Gorakhpur in India), local personnel prepared the plans, while in the other four cities national technical agencies prepared them. Because analyzing and prioritizing options was often new to those involved, and because the plans did not always fit neatly into existing mandates, procedures, and government requirements, capacity building was an essential part of the planning process. It took the form of providing guidance documents (translated into local languages) and trainings on methods and tools. Importantly, in each city there was extensive technical support for the process from national program partners and ISET.

RESILIENCE STRATEGY DEVELOPMENT PROCESS

This section describes the process of resilience strategy preparation as implemented in ACCCRN cities in Vietnam, India, Indonesia, and Thailand. The information presented here is based on the English versions of strategy documents, on experiences of the authors of this chapter with key elements of the resilience planning process in these cities, and on the results of interviews conducted with city level partners and/or national partners in the four countries.

Each country section begins by outlining the participants and structure of the planning process in each city and describing how each city generated and assessed interventions. Recognizing that the process of resilience planning depends heavily on the governance context in which it occurs, each section then outlines some of the key local political and social considerations impacting the strategy development.



VIETNAM

RESILIENCE STRATEGY DEVELOPMENT PROCESS

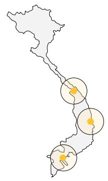
CONTEXT

The unique planning and political context of Vietnam — strong centralization of planning processes, hierarchical government structure, and urban development pressures — strongly shaped the ACCCRN resilience planning process. In Vietnam, city governments play a leading role in land use and development decision making, both because they control land tenure and zoning, and because an extensive formal planning system directs not only public expenditures but also private investment toward sectoral and regional economic development targets. Local governments (city, district, and/or ward level) are also responsible for providing most services.

However, planning in Vietnam is commonly understood as the prerogative of senior levels of government. This is somewhat contradictory and reflects the frequent divergence in practice of locally determined details from formally approved general plans and strategies. While local authorities can propose and recommend local planning policies, national ministries review all master urban development plans and public expenditure plans before central approval. Planning and implementation of plans is largely a top-down process, with approvals and directions from higher-level agencies sent "down the line" to be implemented and enforced locally. For example, all urban master plans are either prepared or guided by the national Ministry of Construction and approved by the prime minister. Similarly, disaster response mechanisms such as local committees for flood and storm control follow national guidelines and models.

Resolution of complex development problems, therefore, is mostly understood as the result of properly defining and measuring the problem and then providing expert direction for the implementation of "solutions," often based on idealized models that are applied uniformly under diverse conditions. The concept of strategic planning, which prioritizes action areas in a context of limited resources and specific opportunities, is not well understood, and the conventional Vietnamese approach thus differs quite starkly from the principles of resilience planning (see above). Partners in Vietnam thus frequently struggled to understand and accept the planning methods presented in ACCCRN.

An important and somewhat contradictory dynamic in Vietnamese urbanization is the expansion of built urban areas through government-led land transfers. In contrast to systems in many other countries, city administrative boundaries in Vietnam normally include large areas of surrounding agricultural land. Under the Vietnamese constitution, the national government owns all land and leases it out under long-term transferable tenures. On the fringes of cities, the



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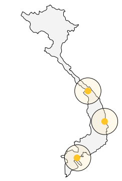
local government (acting as an arm of the national government) can expropriate land from farmers if it is determined to be for over-riding public benefit. The government must pay the fair value of agricultural land to the farmers; however, it can then re-zone the land and lease it to developers for industrial or other purposes. There are obvious financial incentives to the city in this kind of urban expansion and peri-urban land conversion, which often gives little attention to formal planning or site-specific climate hazards.

Resilience planning efforts in Vietnam benefit from a high level of climate change awareness and demands for effective adaptation responses on the part of the central government — as compared, for instance, to governments in developed countries. The government of Vietnam adopted a National Target Program to Respond to Climate Change (NTP) in late 2008. This policy framework specifically recognizes the need for adaptation to climate change at all levels and in all agencies of government, and requires all provinces (and provincial-level cities) and state ministries to prepare climate action plans to address both adaptation and mitigation objectives. This means that all cities such as Can Tho and Da Nang as well as provinces like Binh Dinh (within which Quy Nhon is situated) will be required to prepare and submit their own climate change action plans. To date, however, there have been no appropriate models and little consistency or consensus about how these plans should be prepared. The products of ACCCRN resilience planning in Vietnam were referred to by cities as “Climate Change Resilience Action Plans” rather than “resilience strategies,” partly because the Vietnamese terminology for “strategy” seemed inappropriate and partly to help link the ACCCRN work to already established national policy.

The executive level of local government (the Provincial People’s Committee, or PPC) is the key local political decision-making body. In the case of ACCCRN, the local project holder (formal partner) was the People’s Committee, but in all cases the PPC created a formal steering committee to manage the ACCCRN project activities for the city.[2] ■

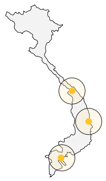


Who Was Involved in the Planning Process?

The main players engaged in development of the city resilience plans in Vietnam were the local governments, ISET, the National Institute of Science and Technology Policy and Strategy Studies (NISTPASS), and Challenge to Change (CtC). In addition, Dr. Michael DiGregorio, an ISET consultant, worked with Quy Nhon on urban analysis, scenario building, and proposal development. At the city level, the resilience planning work was headed in each case by a steering committee composed of senior members of various city/provincial departments, including Department of Natural Resources and Environment (DONRE), Department of Agriculture and Rural Development (DARD), Department of Planning and Investment (DPI), Department of Construction (DoC), and often the Department of Foreign Affairs (DoFA). Each city steering committee was chaired by a vice-chairman of the PPC but effectively managed by a standing deputy chair, who functioned as the local project leader, from one of the relevant technical departments. In the larger cities of Da Nang and Can Tho, city governments have the equivalent of provincial administrative status, while Quy Nhon is an administrative district under the authority of Binh Dinh province. Therefore, the leadership and coordination structure in Quy Nhon came from the provincial departments, but the steering committee and working group both included senior officials from the Quy Nhon district.

As the process unfolded, from preliminary information to vulnerability assessments and locally led resilience strategies, each city also established a climate working group composed of operating level technical officials from several key departments. This was the group that actually met to undertake the development of the climate action plan, under the leadership of the deputy chair of the steering committee (local project leader). As described in chapters 3 through 5, other stakeholders involved in the resilience planning process through SLDs, vulnerability assessments, pilot projects, and sector studies included other technical departments, city agencies, mass organizations (e.g., Women's Union), non-government organizations (Red Cross), local community leaders (particularly for the pilot projects), local research organizations, and local universities (e.g., Quy Nhon University, Da Nang Technical University, DRAGON Institute of Can Tho University).

In each of the three cities, however, there was at least one important agency that was not well represented in the resilience planning process. In Quy Nhon, the private sector was not involved at all and the Department of Construction was only peripherally involved. In Da Nang, a solid waste company participated early on but did not stay engaged; a local INGO that expressed interest in participation was dissuaded from joining the SLD for Phase 2 to allow the city government players to build solid working relationships first. And in Can Tho, it proved difficult to engage departments outside DONRE in a consistent and substantive manner throughout the planning process. With a few exceptions, the representatives of other departments changed frequently until near the end of the planning process, leaving DONRE to carry most of the work.



Vulnerable groups in the cities were involved mainly through interview and consultation during the hazard, capacity, and vulnerability assessment (HCVA), the participation of representatives at SLDs, and as targeted sectors during the pilot programs and sector studies. Consulting with these groups was a new approach for Vietnamese planning departments, and most of the key working group members found the information obtained from these interactions useful.

External organizations also played an important role in the resilience planning process in each city. Climate change and resilience planning is a new, uncertain, and consequently confusing topic for Vietnamese organizations. Working groups and strong inter-departmental cooperation are also unusual. Technical assistance from national and international organizations via workshops, training in methods and tools, active engagement with the city throughout the process (e.g., via attendance at SLDs and working group meetings) and feedback on city progress were crucial to building the cities' knowledge, capacity, and understanding of climate change, resilience, and the resilience planning process.

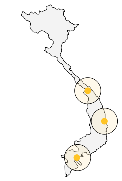
NISTPASS provided direct technical support for planning, including: application of methodology and tools; review and editing of most of the related city documents; and access to informational resources, particularly national data sources. The primary role of CtC was conducting and communicating the results from the HCVAs in all three cities, capacity building for local facilitators and communities, and providing project development and implementation support for the pilot projects.

ISET provided support on methodology and approach for adaptation planning, including training and transfer of tools and methods. ISET was in frequent email contact with the working groups, made regular in-person visits to the city, and attended steering committee meetings and SLDs.

In the strategy development phase, technical advisors from ISET and NISTPASS offered support, reviewed draft materials, and helped to translate the final documents into English for external audiences. The leadership and responsibility for producing resilience strategies in each case rested with local governments, however. Their technical working groups assembled the information and drafted the document, and their steering committees reviewed and approved the Vietnamese-language strategies and authorized them for release to local and national audiences.

Resilience Strategy Preparation

A critical component of the resilience planning process is the generation and prioritization of intervention proposals. In Vietnam, the cities obtained intervention ideas from the SLD discussions, working group interactions, vulnerability assessments, and studies. Ideas were further developed by taking into account the Rockefeller criteria for proposal funding,[3] priorities of local government, working group discussions, and socioeconomic conditions of each area of the city



where interventions were proposed. The cities then selected a subset of interventions to pursue based on: studies and pilot projects supported by ACCCRN (see chapter 5); discussion with the working group; review of existing and future programs, city plans, and department feedback; and consideration of opinions and comments from local communities and local technical departments.

Once the cities had selected the subset of interventions for inclusion in the resilience plans, they prioritized the interventions to provide an action plan. Interventions were ranked using the tools and techniques provided by ISET at the March 2010 ACCCRN Resilience Training Workshop, particularly the qualitative cost-benefit analysis and multi-criteria analysis tools.

City working groups met weekly, in most cases, with support from NISTPASS. For qualitative cost-benefit analysis, the most significant costs and benefits (including indirect costs) in the economic, social, and environmental categories were assigned a rank related to their estimated relative magnitude to provide comparison between options and ratios of the rankings derived. Higher ratios indicated more effective actions for initial prioritization. This approach ensured that both costs and benefits of proposed initiatives were discussed and compared in at least a qualitative sense.

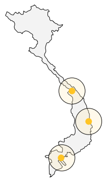
The criteria for multi-criteria analysis included: builds diversity, flexibility, re-organization capacity, and learning capacity. Each option was rated on a scale of one to five for each criterion and the ratings compared and ranked.

To establish final priorities, the cities took the resulting CBA and multi-criteria rankings, and incorporated additional criteria such as local capacity, local priorities, local development policies, and the links between those actions with other programs and projects. In particular, Quy Nhon working group members explained that they had explicitly given higher ranking to activities that would improve adaptive capacity of more than one group/area/sector and activities that were consistent with policy priorities for the city government.

The proposed interventions arising from this first round of resilience planning are discussed in chapter 7.

Assessing the Process: Vietnam

SLDs functioned as the mechanism to launch the process and engage scientists, communities, and technical departments in climate resilience planning. The SLDs contrasted with conventional workshops in Vietnam because they integrated participants from diverse levels of government, technical departments, and communities, with varied expertise; and because they were designed around local participant contributions and feedback rather than only expert presentations. According to city partner interviews, the SLD process and information accumulated throughout the process led to much deeper and broader understanding of the key issues and potential impacts of climate change than had existed previously in the city. Local participants



Working group members from the Vietnamese cities provided the following feedback on the process:

Support and training for core team
Local participants felt there was insufficient detail provided at the beginning of the process about the objectives, end products, methods, and procedures to be followed, which led to initial confusion. Working group members also felt they needed more support from their own department heads to allow team members to devote time and attention to the work.

Integrating planning processes
Many working group members did not fully understand existing city planning processes (e.g., for urban master plans or for the Socioeconomic Development Plans, SEDPs). Gaining familiarity with planning processes was suggested as a good starting point for resilience planning because the participants could then start from a common understanding before applying new methodologies to existing practices; it could also raise the confidence level of professional staff working on climate issues and submitting climate plans to senior officials, and allow better integration of climate issues into key planning documents submitted to the PPC. A key problem for cities was that drafts of their resilience plan did not adequately refer to existing planning documents and citywide policies.

Integration of existing research
Existing research should be reviewed to identify useful inputs to the process. This should be done in collaboration with local experts to avoid duplication of existing studies or knowledge.

Local collaboration on vulnerability assessments and sector studies
There was concern that the climate studies by outside experts did not adequately engage local partners. It was suggested that national experts doing specialized technical studies should work more collaboratively with local departments, review progress regularly, and share interim results. Where possible, local technical experts should facilitate this collaboration and ensure that study results would be applied locally.

Community consultations and outreach
More attention should be given to community consultation. It is difficult for communities to provide useful knowledge if they do not understand what is being requested. Likewise, more focus should be on raising awareness of communities, city officials, and the private sector about climate change, potential impacts, and approaches to building resilience.

Nature of planning document
There is no formal mandate for a local resilience plan, so it has no official status. In order for it to carry weight with other departments, there must be a formal policy mandate created, and the document should follow normal approval requirements and be approved by senior local government officials. That way, it will be treated more seriously across the entire city. One way to accommodate this in the short term is to incorporate resilience plan conclusions into the city's climate action plan, which each province is mandated

to prepare and report to the national Ministry of Natural Resources and Environment (MONRE)

Coordination and leadership

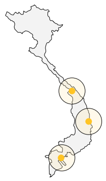
The Vietnam experience demonstrates that although engaging technical expertise is a critical component of building resilience, the most important organizational capacity is the ability to coordinate. In Da Nang, the Department of Foreign Affairs (DOFA) played a key role as standing deputy chair of the climate change steering committee. Although lacking technical expertise on climate change or urban development planning, the DOFA staff's authority and interpersonal capacity to coordinate with other departments fostered a highly collaborative process that crossed sectoral boundaries and fostered buy-in across a range of local departments and agencies Technical department leaders may also be capable of this kind of collaborative and coordinating behavior, but line departments even in local government are more often arranged in competitive "silos" and may be more likely to consider their own skills and expertise as sufficient for strategy development to the exclusion of other inputs.

also came to recognize that traditional top down approaches would not be effective in responding to local climate vulnerabilities. In addition, the forum raised local awareness and increased participation in subsequent iterations of the process.

Partners felt that because of the positive experience with ACCCRN, municipalities would continue to use the new technique of sharing information among different technical departments and social groups. Several respondents suggested the SLD process should be replicated in other provinces in Vietnam.

Working group members from all three cities agreed that their biggest challenges in this work were a short timeframe, the lack of full-time staff to devote to the work, and a lack of knowledge and experience with potential climate change impacts and ways to build resilience.

Beyond this, however, challenges varied by city. In Can Tho, the greatest challenges were limited absorption of the technical information, methods, and tools, and continually changing players. Only two members of the Can Tho Working Group attended the Resilience Training Workshop, but there were several opportunities for training and technical workshops delivered by NISTPASS and CtC for working group members. Still, ongoing involvement of departments outside the core working group members (DONRE, DARD, and later on, the Department of Public Health) was



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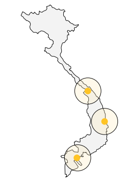


limited and they failed to assign regular staff to support the preparation of the resilience strategy.

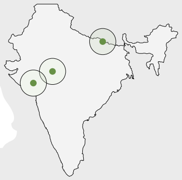
In Quy Nhon, senior staff with extensive planning experience initially could not see the value of the process proposed for the ACCCRN work, so getting them to sign onto the plan was an early challenge that was overcome only with time and effort. In Da Nang, junior staff with little experience in planning did most of the work on the resilience strategy. Additionally, in Da Nang, two city departments shared leadership of the program, because it was difficult to identify a single agency in the city that combined both the technical capacity in this field and the political clout to mobilize and coordinate resources from other agencies.

Unlike partners in other ACCCRN cities, the Vietnamese cities did not develop urban climate scenarios. Vietnamese partners reflect that this would have been useful to help focus analytical attention on potential future conditions, especially during the vulnerability assessment stage.

Local plans in Vietnam require the approval of national agencies, which means that key local plans can be difficult to change — even if local climate working groups recognize maladaptive features in existing plans. In the case of Quy Nhon, destructive floods in October 2009 have led local officials to question whether current plans for development in vulnerable low-lying areas should be re-assessed, but this decision would require considerable evidence. In chapter 7 we describe some of the strategies Quy Nhon is adopting to build the case for revisiting plans that may be maladaptive.

It is not clear what cities will do with their resilience plans. These documents, while related to the climate change action plans now required from all provinces and provincial-level cities, are different from the mandated content and structure of the national requirements. The cities have each proposed support to deepen engagement, institutionalize climate resilience planning, and continue holding SLDs through new climate change coordination offices, which would also prepare the formal climate change action plans. Working groups in each city strongly recognized the need for these offices as a mechanism that could institutionalize the resilience plans, turning them into formal documents that would go through the normal approvals process and thereby gain legitimacy at the local government level.

INDIA



INDIA

RESILIENCE STRATEGY DEVELOPMENT PROCESS

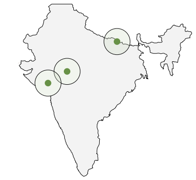
CONTEXT

Planning and governance in India differs from that in Vietnam. The state-level Town and Country Planning Office (TCPO) typically prepares development plans, focusing on socioeconomic development, which are further disaggregated to zonal-level plans. Municipal corporations in each city then prepare zonal plans. In principle, the 74th Constitutional Amendment provides for devolution of planning functions to municipal corporations by devolving funds, functions, and administration (including technical expertise of various departments) to municipal corporations. Yet in practice, the progress of devolution, decentralization, and implementation of the 74th Constitutional Amendment has been slow. Even in one of the most progressive states on this front — Madhya Pradesh, where Indore is located — the TCPO still continues to perform the function of preparing and revising development plans, with assistance from the Indore Development Authority (IDA), a parastatal body. Only recently has the Indore Municipal Corporation taken over preparation of two zonal plans (with assistance from the U.K. Department for International Development — DfID). At the same time, IDA regulates the implementation of the development plan.

The development plans mandate that the TCPO, with support from IDA, is responsible for coordinating public and private investments (in development areas beyond jurisdiction of municipal corporations). For either private or public investments, the respective departments, the such as the department of Industrial Development, are required to inform IDA/TCPO before finalizing their plans. The 74th Constitutional Amendment aims for municipal corporations to perform all the above functions, but major institutional restructuring will be required before this is possible.

In areas within the jurisdiction of municipal corporations, the flagship urban programs of the national government (such as JNNURM)[6] provide large funding to municipal corporations for development of city infrastructure (water supply, drainage, solid waste management, etc.). However, access to funds is generally slow, due to limited capacity of municipal corporations to develop and manage projects, and the delays in implementation of institutional reforms such as the 74th Constitutional Amendment.

In relation to ACCCRN, the vague definition of responsibility and capacity at different levels of government underlines the need to engage stakeholders at both state and municipal levels, while remaining aware that institutional changes may affect the development planning process in coming years. In addition, while nominal authority for planning may technically exist



within municipal corporations, in practice, the power and capacities to implement may not.

From the beginning of the ACCCRN process, partners were aware of functional differences between Surat and the other two cities. Surat is a high capacity city with a strong economy driven primarily by the diamond polishing and textile industries, and the highest per capita income of any city in India. Business leaders and the South Gujarat Chamber of Commerce and Industry (SGCCI) are thus key players in planning and city development and had an existing relationship with the municipal corporation. In contrast, local government administrative and management functions are relatively weak both in Gorakhpur and Indore.

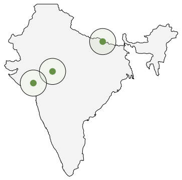
Indian partners relied on a series of one-on-one meetings, focus group discussions, and smaller group SLDs rather than large multi-stakeholder SLDs (see chapter 4 for a more detailed description). During the pre-planning phases of the ACCCRN program (June 2009-January 2010), the advisory committees met more or less regularly, although meetings became less regular and more infrequent from January through May 2010. ■

Who Was Involved in Resilience Planning?

TARU and GEAG led the ACCCRN process in India. Members of ISET's Delhi-based India team also provided technical support on tools and methods for the process. The ACCCRN program began in early 2009 in India, with a series of consultations between stakeholders and TARU, GEAG, and ISET. These initial engagements promoted knowledge sharing about existing challenges, climate impacts, and key potential vulnerabilities between the facilitators, members of various local government agencies and departments or urban local bodies[7] (ULBs), private sector actors, civil society representatives, and members of academic and research institutions.

From these initial engagements, TARU, GEAG, and ISET identified interested individuals/representatives from key organizations to join the newly created city advisory committees (CAC – Surat and Indore) or city steering committee (CSC – Gorakhpur). SLD consultations and intensive interactions with the CAC/CSC helped inform work by TARU and GEAG on inputs, including vulnerability assessments, sector studies, and pilot projects. The composition of the advisory committees varied between cities, but in each case TARU, ISET, and GEAG encouraged the involvement of members from agencies with strong decision-making powers from among the various ULBs. CAC and CSC members included Municipal Corporation representatives from relevant departments, business leaders and private sector representatives (particularly in Surat), and members of academic institutes, representatives from civil society organizations, and individual and institutional experts.

The strength and predominance of the business and commerce community in Surat was reflected in the composition of the Surat CAC. Along with the local chamber of commerce and other industry



representatives, the Surat Municipal Corporation and the municipal commissioner (the administrative head of the Municipal Corporation) herself were heavily involved and helped to drive the process in a strong local direction. In Indore, TARU also sought the involvement of ULB/MC members, but they struggled to secure a similar level of buy-in and interest until later in the planning and implementation stage. In contrast, due partly to weak local governance in Gorakhpur, GEAG strongly encouraged and secured the participation of citizens groups and academia in the CSC and in resilience planning, rather than relying on the Municipal Corporation.

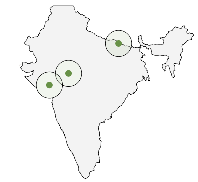
The CAC membership did not include members of poor or slum communities identified as vulnerable. GEAG worked closely with these groups through separate SLDs conducted as part of the vulnerability assessments on their conditions and concerns, and in Surat and Indore CAC members had awareness of poor people's needs from the surveys and consultations conducted by TARU. There was resistance to involving representatives of poor communities directly in the advisory groups on the grounds that it would not improve communications.

Resilience Strategy Preparation

GEAG prepared the resilience strategy documents for Gorakhpur with inputs and review from the CSC. As described by GEAG, a dynamic process, with inputs from all actors at all stages, contributed to the evolving strategy. ISET provided technical assistance and guidance for preparation, assisting in conducting planning workshops and drafting the plan. TARU led the consultations and drafted the resilience strategy documents in Indore and Surat. Their process focused on generating and feeding to the CAC the required information and knowledge, which often involved extensive analytical and quantitative assessments. GEAG, in contrast, relied more on qualitative assessments and participatory techniques. Chapter 5 describes the inputs to the resilience strategies (vulnerability assessments, sector studies, and pilot projects).

From May to July 2010, partners held three planning workshops in each city with CAC members and some external stakeholder participants. The first workshop focused on developing scenarios for future city growth trajectories, led by TARU and GEAG (see box below). The latter two workshops discussed and prioritized actions to respond to the identified challenges. Key decision makers, including the municipal commissioners in Surat and Indore, attended the latter workshops and participated in discussions regarding resilience actions.

In Surat and Indore, TARU conducted individual and small group meetings to collect and validate data (for example, information on salient aspects of master plan and city development plans) needed for the next CAC consultation. The results of analyses were documented and circulated in advance of each consultation, and presented for comments and ratification. The consultations used various participatory techniques such as card methods, group work, etc. GEAG, in contrast, instead



Scenario Development for Resilience Planning in India

Indian cities used scenarios to address the uncertainties of both urban development and climate. In terms of climate, TARU relied on scenarios developed by other agencies for both Surat and Indore, while Gorakhpur mainly used data from ISET modeling work in a related project, and from historical flood events.

The uncertainties of future urban development led each city's CAC/CSC to frame its own urban scenarios based on the issues that were felt to be most critical locally. In Surat and Indore, the CACs defined four alternative scenarios based on the interaction of two determinant but highly uncertain variables: in Surat, economic growth (low or high) and social cohesion (conflicts or harmony); in Indore, type of migration (whether "push" from impoverished rural areas or "pull" from increased demand for skilled labor and services) and efficiency of infrastructure management (poor or efficient). In both cities, these two variables were arranged on two axes, from low to high, generating four different quadrants that characterized the four alternative urban future typologies that could result. In Gorakhpur, economic growth (high or low) and political support (poor or good) were identified as the two key uncertainties.

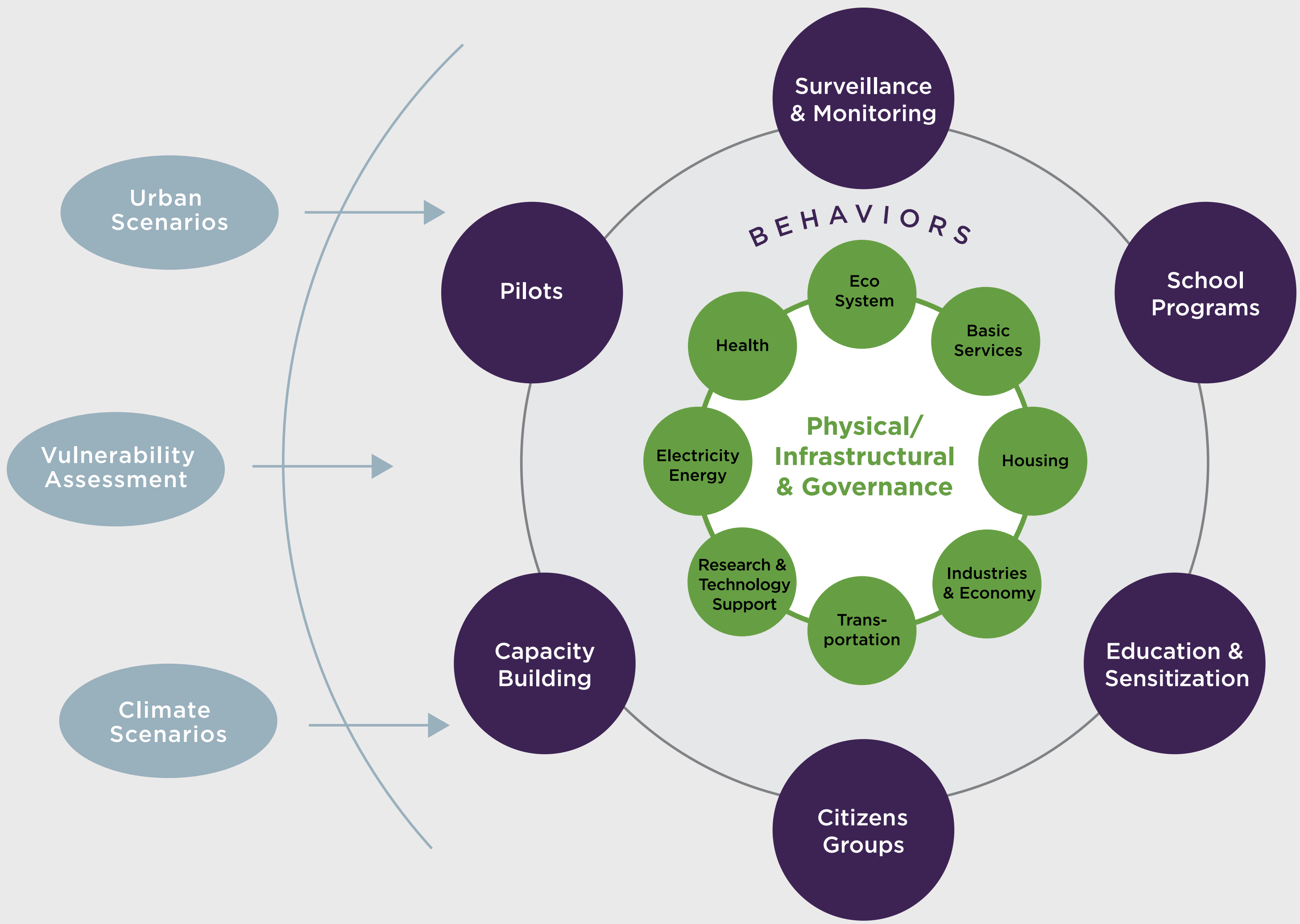
The CACs discussed the interactions of the climate and urban development scenarios to identify "issue-impact matrices" for Surat and Indore, which were subsequently used for identifying and prioritizing resilience building options. And in Gorakhpur, the CSC developed future vulnerability scenarios by overlaying future climate scenarios against these urban development scenarios.

The scenarios served as tools for the advisory committees and local experts to consider alternative futures in consultations. This enabled the CACs and the CSC to identify how they could shape deliberate choices of governance and investment in order to avoid the most damaging climate impacts and foster positive socio-economic development.

of relying on meetings between CSC workshops, held longer workshops with larger groups, involving CSC members and vulnerable communities. The meetings touched upon most of the issues and challenges related to Gorakhpur's growth, including governance system, city infrastructure, urban services, population growth, migration, tourism etc. (see Figure 6.4).

In all the Indian cities there was thus an extensive period of discussion, interaction, and deliberation among a number of stakeholders, especially the CAC/CSC, which bridged the vulnerability assessments and formal sector studies, the scenarios, and the emerging resilience strategies being drafted by TARU and GEAG.

FIGURE 6.4 | Resilience Strategy Preparation in Gorakhpur



(SOURCE: GEAG)

How Were Interventions Generated and Prioritized?

In Surat and Indore, intervention ideas were generated primarily by TARU and through sector studies, with workshop participants providing inputs for prioritization. In Gorakhpur, partners describe that intervention ideas emerged over the course of the process, in consultation and interaction with multiple groups. GEAG used a "risk frame" to characterize causal factors, system fragility, and identify needed actions (see Figure 6.4 above). For prioritizing these actions, GEAG employed additional tools such as qualitative cost-benefit analysis (CBA), multi-criteria matrices, capacity assessment and technical feasibility assessments.

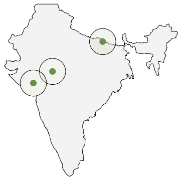
TARU and GEAG drafted the city resilience strategies based on advisory committee recommendations, discussion, and review. The strategies were directly mainly toward the advisory committee members as interested and powerful city decision makers. Though all three strategies recommend actions to be taken by urban local bodies and municipal agencies, they have encouraged other players to be involved as well. For this reason, the strategies also encourage actions for NGOs, particularly in Indore and Gorakhpur. In Surat, the strategy is likely to influence local government due to the high degree of official involvement in the process.

Assessing the Process: India

Overall, the ACCCRN process varied considerably among the cities, reflecting the disparate contexts of governance and local interest. Surat benefitted from a highly engaged and proactive business community and municipal commissioner, both of which promoted regular meetings driven and facilitated by the CAC itself, rather than by TARU. The involvement of Municipal Corporation representatives has also made partners more confident that the Surat Resilience Strategy will actually impact the city's actions.

Local government, especially at the senior level, in Indore and Gorakhpur did not show the same level of commitment to the process as in Surat. Gorakhpur's municipal commissioner in 2009 showed interest and support for the ACCCRN program and its goals, but a new commissioner was appointed in February of 2010. In Indore, though initially disengaged from the process, the municipal commissioner joined the effort starting in early 2010.

The credibility of the city-level facilitating agency plays an important role in its influence. Despite challenges associated with weaker governance, GEAG's deep roots as an NGO in Gorakhpur have enabled the organization to employ its extensive network of contacts in a variety of sectors to engage influential partners. This advantage allowed GEAG to thoroughly engage communities, civil society, and citizens groups throughout the process. GEAG partners noted, however, that they were not very successful in engaging state government, which has an important role in city planning and governance. By comparison, TARU's prior experience and technical skills helped garner state-level support for their process in Surat from agencies such as the Gujarat State Disaster Management Authority.



Pilot projects lent tangibility and seemed to have good potential to influence policies. For example, the pilot competition on housing design for flood prone areas in Surat has generated designs that the Municipal Corporation is keen to integrate in its housing schemes. In Gorakhpur, due to the encouraging outcomes of the pilot on solid waste management (SWM), the mayor has expressed interest in the Gorakhpur Municipal Corporation adopting a similar program. In both cases, the pilot experiences have provided practical examples and evidence for success that has stirred broader local interest and may lead to continued action by local government.

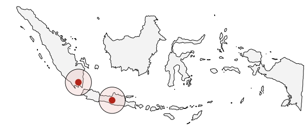
Securing key stakeholder buy-in is a time consuming process. Even once mobilized, it proved difficult to maintain the continued engagement of government agencies and departments. Transfers of senior staff often drastically reduced the level of engagement — indicating that engagement is primarily a function of personalities. Connecting with second-in-line leadership of key organizations could reduce this risk. For example, when the municipal commissioner of Gorakhpur was transferred, it took considerable time for GEAG to re-engage at the desired level.

The planning process becomes richer when some of the key stakeholders are actually involved in preparing studies and sharing results at various levels. Stakeholders' level of participation in the project, in terms of interest, consultation attendance, and contributions, grew after some of the key players were engaged in sector studies and implementation of pilot projects. For example, the SWM pilot in Gorakhpur did initially increase the level of participation of the specific population where the pilot is being implemented and now has received the proactive support of communities from other wards as well.

The strong engagement of various local groups in Gorakhpur helped to foster and build the greater levels of citizen awareness that the resilience strategy itself recommended. GEAG used the waterlogging and flooding problems as "entry points" to mobilize popular interest and concern, and to generate new experience and examples that can build capacity. This process in Gorakhpur undoubtedly contributed to the focus of that strategy on small-scale, community-level actions that would serve as models and motivators to demonstrate the possibilities both for other local organizations and for the Municipal Corporation. This contrasts with the recommendations put forward in Indore, which, while also favoring local awareness building, mostly relied on local-government-led actions and other large organizations (despite the limited confidence in these organizations).

Overall, the process of resilience planning as implemented in India has led to significant gains in awareness and commitment in all three cities. The iterative engagement of local stakeholders in learning, planning, and validating new information, as well as their engagement in pilots and studies, has helped to build local interest and buy-in for the strategies.

The strong engagement of various local groups in Gorakhpur helped to foster and build the greater levels of citizen awareness that the resilience strategy itself recommended. GEAG used the waterlogging and flooding problems as "entry points" to mobilize popular interest and concern, and to generate new experience and examples that can build capacity.



INDONESIA

RESILIENCE STRATEGY DEVELOPMENT PROCESS

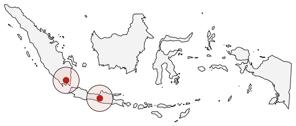
CONTEXT

In Indonesia, the cities of Semarang and Bandar Lampung finalized city resilience strategies in January 2011. The timeline in Indonesia was compressed relative to India and Vietnam. Partners began the process six months later, but were initially expected to quickly catch up and follow a similar timeline; however, by the time resilience strategy development got underway, the process had lost its intended sequential ordering of inputs. Pilot projects for instance, were selected and implementation commenced before researchers released conclusions of the vulnerability assessments; sector studies fed into the process at a late stage of strategy development. City teams were also pressured to produce both intervention concept notes and full proposals for donors at a premature stage, before the resilience strategies had been drafted or finalized. Contributing to time pressures was city-level partners' strong skepticism about the quality of the vulnerability assessments (see chapter 5).

For these reasons, original plans for Indonesia teams to complete their city resilience strategies at the same time as the Indian and Vietnamese cities proved unfeasible. In addition, both Mercy Corps and city partners identified a strong advantage to extending the period of resilience strategy development in order to influence concurrent midterm development plans.

The pillars of public sector planning in Indonesia are socioeconomic development plans and spatial (land use) planning, both coordinated by the National Development Planning Agency (BAPPENAS) and its regional-level counterparts (BAPPEDA). Socioeconomic development plans outline the priorities and visions for development in 20-year long-term plans, five-year midterm development plans, and annual public expenditure plans. Spatial plans meanwhile are drafted every 20 years but revised every five years. Provincial, city, and regency governments are likewise responsible for formulating socioeconomic and spatial plans at similar intervals. Local spatial plans must be in accordance with those adopted at the national level, but recent reforms have led to greater planning autonomy for provinces and cities. Once local legislatures approve the plans, all budgets and development projects in principle must be in strict accordance with these plans, although in practice, enforcement — especially of spatial plans — is inconsistent.

Integrating climate resilience concerns and initiatives into city planning was a key objective for Mercy Corps and the local city teams. Local authorities were formulating midterm development plans (RPJMD) for 2011 to 2015 during October and November 2010 in Semarang and Bandar Lampung, respectively. During



this period, city BAPPEDA boards were responsible for circulating drafts to local agencies, which had to review the emerging plans and coordinate with BAPPEDA to make recommendations. Partners saw this period as an opportunity to integrate resilience priorities into the new midterm development plans by developing their resilience strategies concurrently.

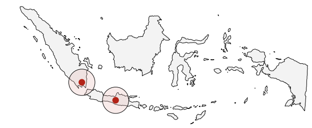
At the national level, the Indonesian Climate Change Sectoral Roadmap (ICCSR) provides guidance for planning and mandates coordination between sectors identified as relevant to climate change. Mercy Corps and city partners sought to maintain consistency between this framework and the emergent resilience strategies. ■

Who Was Involved in Resilience Planning?

As chapter 4 describes, stakeholder groups or "city teams," formed after the first SLD, led resilience planning in Indonesia. The teams included representatives of government agencies (i.e., city planning, disaster management, environment, health, public works, etc.), local NGOs, and universities. There was also limited involvement from the private sector in Semarang, in the form of a large private company that engaged as part of its corporate responsibility program. In early stages, the Environmental Board chaired the city team in Semarang. The chairmanship shifted later to the Development Planning Board (BAPPEDA), a strategic decision that recognized BAPPEDA's authority and capacity for coordinating across city departments. Members of the Environmental Board nevertheless remained involved throughout the process.

City working groups were formed after the second SLD, each composed of four or five members from the city team. Working groups met regularly between SLDs and have played a central role in coordinating the resilience planning process, synthesizing new knowledge, and drafting the resilience strategies. In Bandar Lampung, a member of BAPPEDA leads the city working group, whereas an NGO representative and university faculty member co-chair the working group in Semarang. Each working group also included a local Mercy Corps member, who played a support and liaison role between the city team, Mercy Corps in Jakarta, and regional ACCCRN partners.

The leadership structure in the two cities demonstrates an interesting contrast: the Bandar Lampung team had more direct access to local government and ability to affect development planning and government processes than the Semarang team. Mercy Corps and working group members were well informed and able to attend meetings of relevant departments and planning meetings. The civil society emphasis of the Semarang team promoted a highly inclusive and dynamic process that more seamlessly integrated non-government stakeholders and initiatives. As chapter 4 describes, the ACCCRN process presented a rare opportunity for NGOs in both cities to work closely and on equal terms with government agencies, generating a great deal of enthusiasm and proactive involvement among these partners. Working group members in both cities



brought diverse technical expertise and contributed their own research as input to the SLDs and resilience strategy.

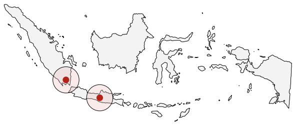
The working groups in each city normally met weekly throughout the resilience strategy development phase, and have been involved in most decision-making processes, including pilot project selection, intervention concept note preparation, and resilience strategy development. Through ACCCRN, Mercy Corps has been able to compensate NGO and university working team members for both their time and expenses (meals and transportation), but is not legally able to provide compensation for time of government department representatives.

Aside from local staff members who served as working group members, two dedicated project staff from the Mercy Corps Indonesia central Jakarta office traveled regularly to Bandar Lampung and Semarang to support all aspects of the resilience planning process, providing ongoing guidance and feedback on the emerging resilience strategies. ISET and urban specialists John Taylor and Olivia Stinson also provided guidance, input, and review for the process. Several of the working group members in both Semarang and Bandar Lampung have strong English language skills and thus were able to access ACCCRN documentation and/or communicate with regional partners directly.

Resilience Strategy Preparation

Planning for resilience strategy development began in July 2010. At this early stage, the working group members were struggling to overcome a sense of confusion and frustration among city team members. Partners worried about the inadequate opportunity to absorb new knowledge from various process inputs, the loss of sequential ordering, mixed feedback received for their concept notes, and the lingering skepticism about the vulnerability assessments. The approval from the Rockefeller Foundation to extend the strategy development period was critical in helping to alleviate these issues. The extra time allowed teams to synthesize knowledge from ACCCRN activities, compile complementary data and analysis, and generate ideas for actions thorough city team consultation. It also provided the opportunity for the Bandar Lampung team to introduce the project to members of its new mayoral administration.

In response to partner requests, ISET provided additional guidance to Semarang and Bandar Lampung working groups for resilience planning, including process recommendations and case study examples (ACCCRN cities in Vietnam and India, as well as others including Durban, Quito, Toronto, and Chicago). In July, Mercy Corps engaged John Taylor and Olivia Stinson to develop "synthesis reports" for both cities, summarizing key points from the vulnerability assessments, pilot projects, sector studies, and SLDs. The reports were intended to organize analytical inputs for the resilience strategy by highlighting



existing capacities, strengths, and weaknesses for four areas of consideration: government and stakeholders, economy, civil society, and physical environment.

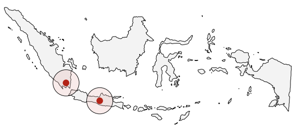
In drafting their strategy, Semarang partners did not include contested socioeconomic and vulnerability mapping analyses from the vulnerability assessment, but did use its analyses of climate, community-level vulnerability, and governance. Other studies produced independently of the ACCCRN process contributed to the strategy, along with results from sector studies and pilot projects. The Bandar Lampung team did include the CCROM-produced vulnerability map, but likewise supplemented this analysis with scenarios, a BAPPEDA-produced study on disasters, and pilot and sector lessons.

Resilience strategy development relied on a series of small meetings between working group members and Mercy Corps, along with larger SLDs involving the entire city team and other stakeholders. In both cities, partners initiated the strategy development component by holding SLDs or smaller focus group sessions to review the SLDs, vulnerability assessments, sector studies, and pilot projects, and to discuss urban development trends. These sessions were used for generating scenarios and brainstorming intervention actions. Working group members met separately to apply qualitative CBA and resilience matrices to prioritize actions. These were presented for discussion and validation with the city team, target groups, and specialists in the relevant intervention areas.

In the final stages, the working group focused on integrating the resilience strategy with midterm development planning documents (RPJMD), as well as examining the resilience strategy for consistency with other relevant plans and documents. As described above, a key justification for extending the period of resilience strategy preparation was to promote integration between midterm development planning and the resilience strategy. This process occurred in October and November 2010 in Semarang and Bandar Lampung respectively. The structure of the working groups was conducive to facilitating this process. Because BAPPEDA members served as members of the working groups, they were able to share resilience planning knowledge with the RPJMD boards. In turn, other members of the planning boards joined the city team for SLDs or small working group meetings, and additional working group members participated in development planning sessions.

Assessing the Process: Indonesia

The Indonesian cities have overcome significant obstacles to produce sophisticated, locally owned resilience strategies. The resilience strategy development process contrasts with the conventional planning process in Indonesian cities, where government agencies usually contract external consultants to conduct special city planning projects. Though they consult city agency leaders, the consultants draft the plan independently. The ACCCRN process, in contrast, has demanded that the cities themselves devise actions and priorities based on analytical inputs. This has produced some



anxiety for partners, many of whom saw themselves as under-qualified for the task at hand. The compressed timeline contributed to pushing city partners beyond their normal comfort zones.

By the same token, the Indonesia team had a number of advantages over partners in other countries. In contrast to the Vietnamese case, partners did not have preconceived or rigid notions about the process of planning. Indonesian teams were eager to learn from ACCCRN and to apply and improve upon the approaches presented by ISET and Mercy Corps. Further, partners demonstrated a willingness and capacity to challenge professionally produced research material, to an extent unique to the Indonesia case. This led to delays, but more importantly initiated a set of innovative responses and problem solving. Overall, the success of the Indonesian program must be primarily attributed to the enthusiasm and tenacity of skilled working groups and the ongoing support from Mercy Corps.

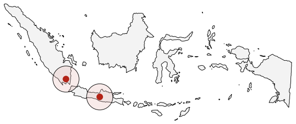


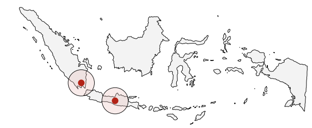
TABLE 6.1 | Flooding Scenarios for Bandar Lampung

WET SEASON	EXISTING CONDITIONS (2010)	DRAINAGE SYSTEM IMPROVEMENT 60% (2030)	INTEGRATED WASTE MANAGEMENT 50% (2030)	DEVELOPMENT OF IPLT 40% (2030)
	Total Flooding Days per Year			
6-7 Months	15 days	6 days	8 days	9 days
8-9 Months	23 days	8 days	12 days	14 days
	Number of Flood Points			
6-7 Months	42 points	17 points	21 points	25 points
8-9 Months	56 points	22 points	28 points	34 points
	Inundation Duration			
6-7 Months	2 hours	0.83 hours	1 hours	1.2 hours
8-9 Months	3.5 hours	2.1 hours	2 hours	1.4 hours

Scenario Development

The scenario development process in the Indonesian cities differed from that in India. While the Indian cities chose two broad development themes and produced four scenarios based on differing potential trajectories, Bandar Lampung and Semarang, in contrast, developed a series of more narrowly focused scenarios, each encompassing a particular climate change parameter (i.e., rainfall) considered against expected city development activities.

For instance, one Bandar Lampung scenario considers the duration, frequency, and extent of flooding, based on wet season scenarios and in the context of drainage system, waste management, and water treatment interventions. This is illustrated in Table 6.1, taken from the Bandar Lampung Resilience Strategy.



Guidance documents prepared by technical partners had varying levels of usefulness. In addition to the tools and methods provided by ACCCRN, partners in Bandar Lampung were initially enthusiastic to use international case studies of climate adaptation planning and examples from the other ACCCRN cities; these turned out to be more limited in application than they expected, partly due to the unavailability of materials in the local language. Moreover, the types of issues raised in the case studies provided by ISET did not correspond well to the issues and intervention priorities in Bandar Lampung. The synthesis reports generated by Mercy Corps consultants were useful in highlighting key issues emerging from the full set of ACCCRN activities, but they did not, as a Mercy Corps staff noted, provide critical information about hazards that the team was seeking.

Semarang partners felt that the prioritization tools introduced by ISET (qualitative cost-benefit analysis and multi-criteria analysis) were inadequate for strategy development. In particular, partners were concerned that their cost-benefit analysis was based on very rapid speculations of working group members rather than on accurate data (which would take much more time and resources to produce). Indeed, the tool presented by ISET was intended for public discussion among non-technical stakeholders to encourage critical, comparative thinking rather than to produce quantitative findings — so although Semarang used the tool appropriately, they were uncomfortable relying heavily on the results. Semarang partners also remarked on the need for a tool to help them identify linkages between actions to ensure that they developed a complementary suite.

As seen throughout ACCCRN, the involvement and support of key local leadership in Indonesia was extremely useful — and conversely, the loss or change in this leadership was challenging. New mayors have recently taken office in both cities. In Semarang, the new mayor has been supportive of and interested in the ACCCRN program, but the transition has been rockier in Bandar Lampung. Some key city staff members have been reassigned from the ACCCRN project as a result of administrative changes and the transition has resulted in significant delays. Mercy Corps and working group members have made strides with the new administration by building professional relationships with mayoral staff. The shared focus on community empowerment, a key issue for the mayor, has been an asset for this partnership.

In both cities, partners are concerned with the sustainability of their efforts once the ACCCRN project officially concludes in 2013. The integration of the midterm development plan with the resilience strategy was an important achievement to help sustain focus on climate change and urban resilience. In particular, BAPPEDA in Semarang adopted a new mandate for capacity development among all government departments. However, since partners have still not identified an appropriate institution to facilitate capacity building activities, the resilience strategy prioritizes the establishment of a climate change resource center. The new RPJMD plan in Bandar Lampung integrates all

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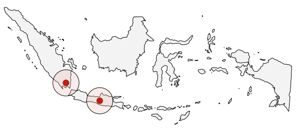

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17 priority actions identified in the resilience strategy as action areas for the appropriate agencies. In the coming months, Mercy Corps and the city team plan to provide awareness-raising workshops aimed at the heads of all these agencies and members of the legislatures. Both city teams will have the opportunity to integrate their priorities into revisions of the city spatial plan (RTRW) in 2015. Until then, it will be important to demonstrate success and gain support for building resilience through implementation of the proposed actions, according to the Mercy Corps staff in Bandar Lampung.

THAILAND

RESILIENCE STRATEGY DEVELOPMENT PROCESS

CONTEXT

The ACCCRN national partner in Thailand, Thailand Environment Institute (TEI), was involved in the assessment and selection of the two Thai cities to be included in the ACCCRN program, Hat Yai and Chiang Rai. TEI structured the engagement phase with locally hired staff in each city to coordinate local meetings and SLDs, together with technical support from TEI and from local universities. Thai cities joined ACCCRN later than all other countries, only beginning in early 2010. Thus, as in Indonesia, the timeline in Thailand was condensed compared with India and Vietnam, although the cities were not subject to the same intervention concept and proposal deadlines as Indonesian partners.

The Thai state has traditionally been highly centralized and unitary. Sub-units of national agencies handle provincial and district administration respectively. It was only in the Thai Constitution of 1997 that elected local government councils were introduced for the first time. So the municipal level of government is relatively new, compared to the long-established and geographically larger district-level administration. Basic municipal administrative responsibility for delivery of local services has only been in practice for about a decade. Most planning and technical services still reside at the level of the district or the still higher scale provincial administration.

The process of introducing basic climate science and the urban implications of climate change was particularly challenging in Thailand for several reasons. In stark contrast to Vietnam, national climate policy and popular media discussions have paid very little attention to adaptation issues, compared to mitigation and emissions reduction. The notion of unavoidable climate impacts, then, was a new one for local officials. In addition, because local administrations have only limited authority for planning of any sort, municipal officials were not accustomed to thinking about the long-term future and considering contingencies. Finally, Thai cities have had limited exposure to climate disasters. While Hat Yai has a history of regular and serious flooding of the city center, Chiang Rai lacks any similar catastrophic experience. For these reasons, local partners frequently struggled to grasp what the implications of climate change might be on their community and economy.

One of the challenges for local partners in Thailand was connecting climate impacts to the responsibilities of specific local government agencies. With the new municipal level of government, a number of jurisdictional and practical issues remain to be resolved. Even at the existing district and provincial levels, however, responsibility for issues like water

management, transport, or infrastructure is dispersed between multiple agencies. The agency responsibilities are poorly defined and there are numerous areas of overlap. Coordination between agencies or across scales is weak. As a result, for crucial issues like watershed management, water supply management, ecosystem management, or infrastructure maintenance, it was often difficult for local officials to know which agency should be responsible or involved in those specific aspects linked to planning for climate change. ■

Who Was Involved in Resilience Planning?

Working groups were established in each city under local leadership to guide the process and engage key stakeholders through a series of SLDs. In Hat Yai, the working group included 26 members from NGOs, the municipal government, district administration, and the provincial government. Of this total, a core group of ten included members from a local environmental NGO, several municipal agencies, and Prince of Songkhla University. A representative of the Hat Yai Chamber of Commerce chaired the core group, but the municipality more strongly influenced decision making than the Chamber of Commerce. Despite the chair being from the Chamber of Commerce, the private sector was little involved in any aspect of climate change studies or resilience planning in Hat Yai; the chair's role seemed to come more from personal interest than from organizational commitment. In Hat Yai, all parties in the resilience planning process had considerable experience with the flooding situation in the city, and they focused on this perspective.

In Chiang Rai, the climate change working group was comprised of 20 people and was chaired by the permanent secretary of the municipality (the senior administrator), who attended each meeting. Her enthusiasm and support for this work played a crucial role in building interest and engagement from the other members, who included municipal, district, and provincial staff, NGO representatives, and faculty from Mae Fah Luang University.

In both cities, interests of vulnerable communities were not represented directly. The NGOs in both cases worked closely with poor and marginalized communities, but they focused only on the narrow interests of that particular organization (e.g., environmental awareness and flood prevention, or public health). There was no real opportunity for community representatives to engage directly with shared learning or with the working group members.

Thai participants needed more background explanation about the fundamentals of climate change, the potential implications for local environmental and economic development conditions, and the need for planning to meet these potential impacts than did participants in other countries. This was partly because the key participants in municipal government had very limited authority for planning, so they were not accustomed to taking leadership in the key sectors directly related to climate adaptation. Neither did they

have ready access to the analytical tools and supporting data needed to approach long-term development planning issues in an integrated fashion. But it was also because there was limited experience with climate related hazards in Chiang Rai, and the experience in Hat Yai was completely one-dimensional (i.e., focused only on historical flooding through the central city). As a result of the struggles to explain the relevance of focusing on future climate issues to the local working groups, the Thai ACCCRN team implemented their SLDs in two rounds each: in the first round the topics were introduced to the core teams of the local working groups; this discussion was used to plan the SLDs with larger groups and external representatives. Thus, there were twice as many SLDs for the core group, and some core group members became fatigued from too many meetings.

Inputs

The climate projections obtained from a regional climate modeling center proved to be less helpful than originally anticipated, because the model was still under development and outputs had not yet been calibrated with historical data. Users therefore viewed the climate projections as unreliable. As a result, only very general climate trends could be introduced and discussed in SLDs at the local level. This did not provide a substantive base on which local stakeholders could confidently develop clear parameters for planning.

Local researchers who had no prior experience with this kind of analysis conducted the vulnerability assessments. Given the lack of useful sub-regional climate projections, the researchers adopted a sectoral focus, looking in particular at agriculture, tourism, and health in Chiang Rai, and at flooding in Hat Yai. Because of the short time frame and limited funding for these studies, and the relatively limited experience with climate vulnerability assessment in Thailand, finding well-qualified experts to take on the vulnerability assessments was difficult. In many cases, local and national partners were not satisfied with the quality of this work (see chapter 5). In Hat Yai, one of the pilot projects essentially refined and completed the sector study by adding analytical depth to the data presented on flooding and vulnerability. In both Hat Yai and Chiang Rai, provincial level authorities or NGOs implemented the pilot projects, because the municipal government lacked technical expertise to develop or implement the pilot projects themselves.

Resilience Strategy Preparation

Resilience strategies were drafted under TEI leadership. Municipal governments shared their vision and mission statements as the foundation of these strategies, but because municipal authorities were not accustomed to undertaking planning exercises, it was difficult for them to consider how different development trajectories might interact with future climate. To simplify the task for them, TEI developed three scenarios in each city that could be represented as three alternative plausible future conditions. These scenarios were characterized as: a) rapid economic development, with a focus on private investment, trade, and commercialization; b)

ecological development, with a focus on sustainability, local products, indigenous and traditional culture and knowledge, and ecosystem services; c) business as usual, characterized by relatively haphazard development, lack of coordination, weak leadership, vision or governance, and increasing conflict. The cities could describe local conditions under each of these development scenarios, and use these options to consider climate impacts.

TEI drafted these strategies based on the inputs from the vulnerability assessments, SLDs, and various studies. On key sectoral issues (e.g., agriculture and tourism in Chiang Rai and water management in Hat Yai), TEI also consulted with the relevant provincial government agencies. Each of the city working groups then reviewed the draft strategies. In Hat Yai, the working group made extensive revisions to the draft document, while Chiang Rai accepted the draft with very few changes. However, in both cities, the implications of the strategy for planning of public investments, land use, or watershed management are still not clear. For example, it was very difficult for participants to identify which organizations would have the mandate to actually implement some of the strategic recommendations. More time and interaction is needed for these strategies to be discussed among different levels of government, and between different agencies, to be able to sort out a practical approach to implementation.

Assessing the Process: Thailand

In both of the Thai cities, it was difficult for the local working group to provide strategic direction for the resilience strategies. The municipal government's preoccupation with current climate hazards (flooding in Hat Yai, smoke from forest fires in Chiang Rai) and their limited mandate and planning experience compounded this difficulty. In addition, the Thai municipalities lacked familiarity with climate change processes or their likely local environmental consequences.

The lack of reliable sub-regional climate projections for these regions of Thailand further compounded these challenges. Without useful climate data, it was even more difficult to describe likely changes to local planners. The fact that many climate resilience measures require the engagement of senior levels of government also made it more difficult to retain the concentration and attention of local partners.

Lack of coordination is a chronic problem with local government in Thailand, but in this case, the unfamiliarity of climate change, the limited timeframe for each of multiple steps in the process, and the lack of concern about climate change issues compounded the problem. All of these factors made it difficult to engage the large working groups in each city. In hindsight, ACCCRN partners felt that the working groups should have been smaller and more focused on those who were likely to have a direct mandate that would be clearly affected by climate change.

Land use planning and approvals, environmental management, infrastructure planning and development, economic development strategies, and public investment planning are mainly the responsibility of

THAILAND

higher levels of government. However, jurisdiction over environment, natural resources, and land use planning issues likely to be important to resilience planning is also fragmented by the allocation of responsibilities to multiple departments and agencies. Many of the relevant provincial agencies (e.g., agriculture, water resource management, forestry, and conservation) were represented in working groups, but their relative influence on planning and policy measures was limited.

The main benefit of the planning process was that it introduced new strategic considerations in both cities. In Hat Yai, while all the participating groups were familiar with floods, they did not previously have a common platform through which to discuss and plan collaborative responses, from community-based risk reduction to local early warning systems to provincial level watershed management. The shared platform created the opportunity for innovative new approaches to the flood problem. In Chiang Rai, the local authorities recognized for the first time that climate effects on the agriculture and tourism sectors could lead to significant indirect impacts in the city, such as rural-urban migration or economic losses. This enabled them to identify a whole range of ecosystem services from local rivers, watersheds, and farmlands that were climate sensitive but that had not previously been recognized as strategically and economically valuable.

The process that led to city resilience strategies in all ten ACCCRN cities was an ambitious one that tried to balance capacity building, local ownership, and practicality with technical quality and content in a relatively short timeframe. City partners had a very limited understanding of climate change and adaptation issues at the outset of the ACCCRN engagement phase. Thus, they had to quickly grasp challenging technical issues, uncertainties, and novel concepts and then apply them in a completely new planning process to determine priorities for future adaptation investments. These challenges were complicated by the fact that resource materials had to be translated from English into local languages, and then the products had to be translated back into English so that advisors could provide feedback. This entire engagement phase leading to the city resilience strategies lasted about 20 months in Vietnam and India, and even less for Indonesia and Thailand. The challenge of grappling with new concepts, information, and planning processes in the short timeframe imposed by the program architecture inevitably led to a few rough spots, but it also provided a good test for the practicality and operability of the methods.

The challenge of grappling with new concepts, information, and planning processes in the short timeframe imposed by the program architecture inevitably led to a few rough spots, but it also provided a good test for the practicality and operability of the methods.

The approach varied depending on the country, in part because local governments have different authority in each. In Vietnam, for example, governments are responsible for providing most services, but local governments can only implement authorities granted or specified by the national government (e.g., national programs, legislative mandates, public works projects). In India, recent constitutional amendments have given ULBs greater autonomy and authority, but these gains are constrained by resources and capacity, and the state governments that still oversee many aspects of local development remain key players in any effective planning process. India demonstrates how much the process can vary within one country: Surat relied heavily on its Municipal Corporation for implementation, whereas Gorakhpur and Indore looked for more dispersed strategies of enhancing resilience due to weaker local governments.

Thailand, like India, demonstrates some of the challenges of working directly with local government on resilience planning when key implementation authority lies with senior levels of government or is in the process of gradually being transferred. Indonesia's decentralization reforms have progressed further than those in Thailand and India, and local governments have formalized medium- and long-term planning processes that should integrate the results of climate resilience planning. In Indonesia, however, it was challenging to align the donor preferences on timing for ACCCRN deliverables with the local planning processes.

The ACCCRN process shows that the most effective leaders for resilience planning are not necessarily those with technical skills, but rather people and agencies who have the institutional and personal capacities to coordinate technical expertise.

The shared learning dialogues (SLDs) demonstrated effective ways to engage scientific experts, local government officials, civil society, private sector, and community representatives in deliberation on the available data and future scenarios, local implications, and potential responses. They provided a unique platform for building shared knowledge and commitment to action that met multiple interests. They also served as the mechanism for linking all the inputs to the resilience planning process: diagnostic studies, vulnerability assessments, local knowledge, community feedback, technical agency inputs, and prioritization of proposed actions.

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Lessons from the Process of Resilience Planning

The SLD process created new learning and opportunities for engagement
Local partners reported that the SLD process proved innovative and helpful as a tool for learning and planning. In Vietnam, the experience of convening scientific and local knowledge in the same forum, creating opportunities for open and structured deliberation, was a new one for most participants and led to significant gains in understanding and consensus on actions. In Indonesia, the SLDs provided the first occasion for local government to work directly with local NGOs and helped create opportunities for their ongoing engagement in local planning processes. In Thailand, the need to have the core working group members participate in twice the number of SLDs led to a degree of "meeting fatigue." Partners in India and Indonesia described that a similar phenomenon at times threatened their processes as well.

A core group representing multiple agencies or interests was important to coordinate the process
The ability to seed a locally driven process depended on a "core group" that acted as a repository of information and capacity, and led or coordinated integration across sectors. The ideal core group is comprised of organizations whose mandate is likely to be directly and clearly affected by climate change; if not, representatives are likely to lose interest or direction.

The core group members can in turn act as ambassadors of climate resilience for other processes or to build demand for resilience planning in their own organizations — for instance, in Semarang, where working group members joined the development planning board as it drafted midterm development plans.

Resilience planning requires dedicated, long-term, local staff to lead the process
ACCCRN activities benefitted from consistent participation of the same partners throughout the process. In Vietnam and Indonesia, the working groups led the planning, with technical and facilitation support from NISTPASS and Mercy Corps. This was a successful model that promoted high-level capacity development for these individuals and ensured that knowledge and priorities were shared between resilience planning activities and the normal responsibilities of working group members. The home organizations of working group members (local government departments, NGOs, universities) allocated staff time for resilience planning, for which ACCCRN sometimes compensated them. In Indonesia, government departments are not allowed to receive external compensation for work, which constrained the amount of time those staff could devote to ACCCRN. In the absence of such dedicated staff in India and Thailand, country coordinators TEI and TARU took on greater responsibility.

Coordination skills are essential to developing an effective resilience strategy
The ACCCRN process shows that the most effective leaders for resilience planning are not necessarily those with technical skills, but rather people and agencies who have the institutional and personal capacities to coordinate technical expertise. This was shown in both Da Nang and Semarang, where the DOFA and BAPPEDA were highly successful in fostering collaboration, integrating priorities of diverse stakeholders, and laying the strategic groundwork to influence city-planning processes.

Resilience planning would probably be more effective with a more flexible timeline

In all countries, the ACCCRN program deadlines were difficult to meet, and a variety of unexpected delays created additional pressure. In particular, all partners involved (including ISET) expected that climate data would be more readily available and interpretable than turned out to be the case (see chapter 3). ISET work plans in collaborating with partners turned out to be consistently optimistic. In certain respects, time pressures prevented the process from dragging or losing momentum, but the SLD and resilience planning process must be flexible enough for partners to absorb new information and feedback; to build trust and collaboration; for studies to be rigorously completed and examined by partners; and for partners to gain familiarity with an unorthodox method of planning.

The condensed timeframes created considerable tension and jeopardized the quality and comprehension of analysis in all cities. This was especially true in Indonesia and Thailand, where haste contributed to early analytical errors in the climate data or the vulnerability assessment that had to be re-worked. Neither country could maintain the logical sequencing of analysis in the planning process, and steps that had been envisioned as sequential had to be conducted in parallel. This resulted in weaker analyses, less opportunity for review and absorption of concepts by partners, and reduced local ownership by forcing partners to rely more on external support. However, in a new field such as this one, external support cannot always be mobilized in sufficient depth or on short notice as local needs change, which can lead to further frustration and delay. A more flexible and responsive schedule for the information gathering, capacity building, engagement, and planning steps would likely result in better quality results and stronger local ownership.

Translation is a key example of the time required to introduce new concepts and practices to local practitioners

Developing the capacity of translators for technical work is a lengthy process. This project introduced new concepts and terminology for local partners — not national-level experts but local NGOs, practitioners, businessmen, and bureaucrats, most of whom worked on this project part-time and had very limited exposure to climate change issues. Many of the terms and concepts had to be clarified first even in English. Further compounding this challenge, many of these terms (“resilience,” “redundancy,” and “strategic planning,” for instance) did not have good analogues in local languages. Supporting materials were generated piece-by-piece, and international documentation in English was often referenced to support local processes. This made it difficult, however, to maintain a standard lexicon of terms and concepts in local languages and then to explain and use these consistently.

Challenges related to translation complicated the capacity-building effort and made it more difficult to explain key practical issues to local partners using available international technical advisors. Translating program documentation (reports, plans, concept notes, proposals) back and forth between English and local languages, was a lengthy process. The specialized terminology made it difficult to engage commercial translators. Translation was thus a major time-consuming factor in all steps of planning and proposal development.

Senior city leadership was a major advantage

Securing the support of city leadership, such as mayor or municipal commissioner, or the PPC vice-chairman and department head in Vietnam, helped to ensure participation of other key players or sectors and increased the likelihood that results were integrated into decision making. Surat, Chiang Rai, Semarang, and all three cities in Vietnam are good examples. Ultimately, in most cities, the local government became a key stakeholder, willing and able to integrate climate change priorities into their activities. Experience also indicates, however, the risk of relying on just a few key figures who may leave office or change positions. Gaining a wider base of knowledge and support reduces the risks of inconsistent or transient leadership.

Authorship enhances ownership of the process and results

In all cities, those who drafted or contributed to the resilience strategies were also part of the intended audience. The city working groups in Vietnam and Indonesia were responsible for most of the analysis of input studies and developed the resilience strategies. In India, the city advisory committees (Indore and Surat) and the city steering committee (Gorakhpur) contributed to insights from sector studies and approved the strategies, with TARU and GEAG responsible for drafting, analysis, and revisions. In Thailand, TEI prepared the resilience strategies with local input. In all cities, the process of drafting the resilience strategies engaged many of the decision makers and local officials who would also be responsible for implementation of priority activities.

ENDNOTES

[1] Documentation of these methods will be available from ISET separately.

[2] Terminology varied slightly: in Da Nang the steering committee is called a project management board.

[3] Rockefeller Foundation's main criteria for reviewing proposals included: builds urban climate resilience; impacts lives of poor and vulnerable populations; high prospects for replication; ability to achieve scale; potential to integrate with other resilience-building measures at city level; scale of impact; technical, operational, and financial feasibility; prospects for timely implementation; local ownership and ability to leverage other resources.

[4] However, it also obliged the local working groups to figure out more of these issues out for themselves. The consistency of approaches eventually adopted suggests they were able to do so.

[5] Vietnam has a unitary form of government, so the structure of national government is replicated at the provincial and city levels. For clarity in English the national-level "ministry" becomes "department" at the lower levels (there are also different words in Vietnamese). Vietnam also has district-level departments, referred to in English as the "district DONRE." In general, the provincial-level DONRE (the main ACCCRN partners in all three cities) reports both to the provincial Peoples Committee and to MONRE.

[6] Jawaharlal Nehru National Urban Renewal Mission: a seven-year national government plan for upgrading urban infrastructure across India, valued at over $20 billion, and implemented largely through state level agencies who provide grants or soft loans for cost-sharing projects with cities.

[7] Under recent constitutional amendments, ULBs are mandated with delivering all basic infrastructure and services in urban areas. They are essentially under the control of municipal corporations, which consist of an elected political council and a separate administration.

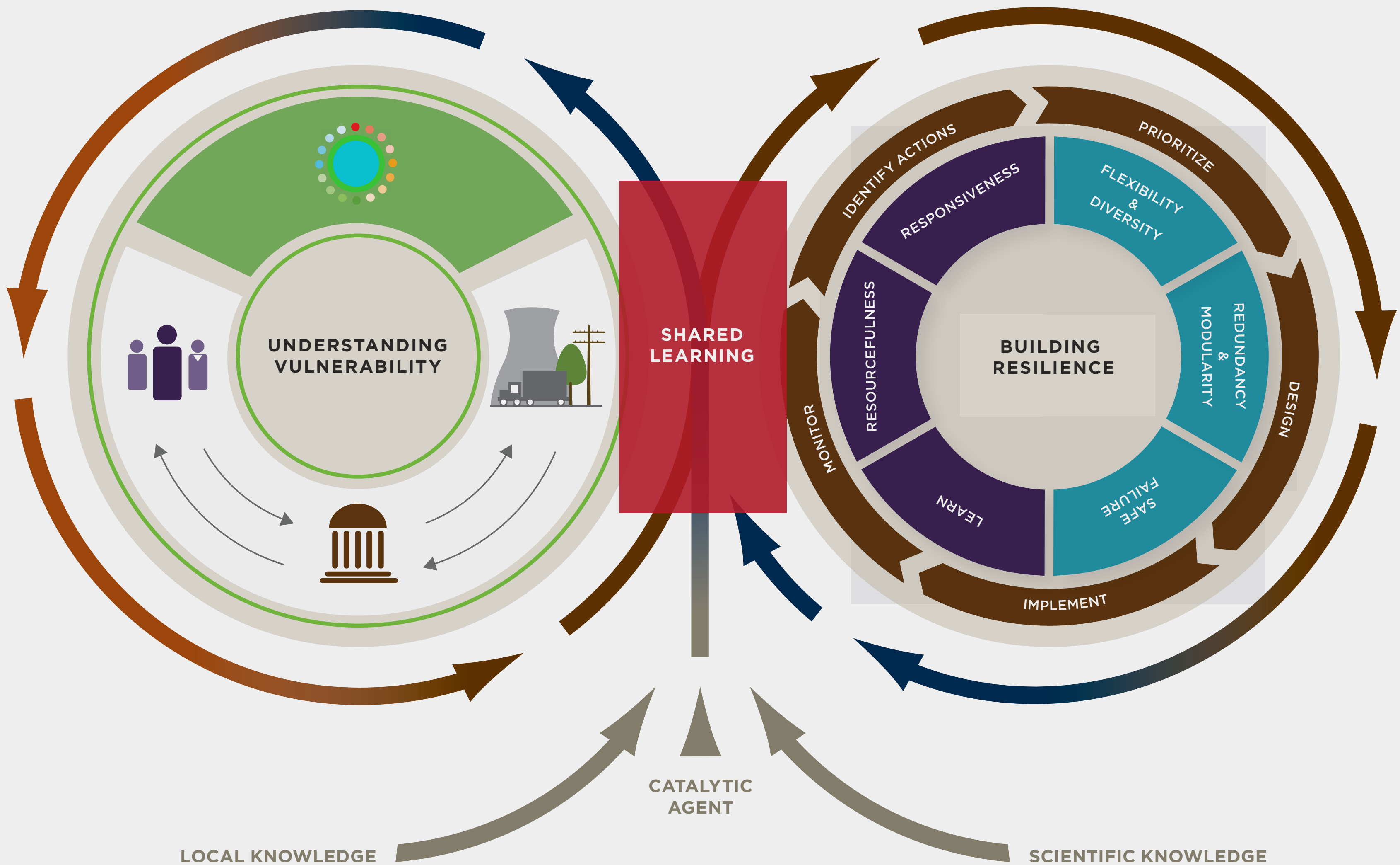
CHAPTER 7

RESULTS OF RESILIENCE PLANNING

Stephen Tyler and Sarah Orleans Reed

FIGURE 7.1 | **The Urban Climate Resilience Planning Framework: Results of Resilience Planning**

This chapter discusses the outcomes of the resilience planning process, including the strategic plans for each of the cities as well as the less tangible outcomes, like capacity development and stakeholder learning. All of these outcomes, developed through the iterative rounds of diagnosis represented in the left loop and the first three actions in the right loop, provide the foundation for implementation of resilience actions in the next phase of the ACCCRN program, represented in the rest of the right loop.



INTRODUCTION

This chapter addresses the central feature of ACCCRN Phase 2 — the city resilience strategies. Each city prepared a resilience strategy to guide their initial efforts to respond to the challenges imposed by climate change. The framework, guidelines, and process for developing these strategies are described in the previous chapter. Most of this chapter is dedicated to the content and comparison of these documents across countries, highlighting noteworthy themes and lessons.

We have already described numerous tangible outputs of resilience planning — shared learning dialogues, vulnerability assessments, pilot projects, and sector studies. These were the noteworthy, visible activities that preoccupied program partners through a relentless schedule of sequential deadlines, and they constitute significant accomplishments in and of themselves. In most cases, these studies and consultations were precedent setting. No work of this kind had ever been done before in these cities — and sometimes not in any city in the country.

Likewise, the resilience strategies and action plans produced in all four ACCCRN countries constitute a considerable and unique achievement. They are the first documents of this type generated by the ACCCRN program, which is one of the first donor-led initiatives to support local urban climate resilience planning and implementation in developing countries. In this respect, the strategy documents provide useful insights for other cities and instructive lessons for international discourse on urban climate resilience.

As the UCRPF explains, however, resilience is an on-going process — not an output or product. In the previous chapter we argued that the engagement, learning, and capacity building generated through the resilience planning process in the ACCCRN cities is more important than any single document or activity. Thus, this chapter also addresses the less tangible results or outcomes of the resilience planning process, including explicit changes in the capacities of local partners, in their interactions with each other and with outside organizations, and in the establishment of new institutions and processes. Capacity development refers not merely to building individual skills but to enhancing specific organizational capacities expected to better enable climate adaptation.

This chapter also links the priority interventions recommended in each city with the UCRPF to illustrate how their proposed interventions fit within that framework. These proposed climate resilience actions provide early examples of the kind of locally owned adaptation measures that might serve as starting points for other cities.

COUNTRY BY COUNTRY: RESILIENCE STRATEGIES

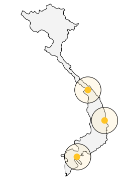
OUTPUTS OF RESILIENCE PLANNING: RESILIENCE STRATEGIES

The process of resilience planning and strategy development — its participants, structure, and components — is one of the important products of this pioneering work. The outputs of this process are the city resilience strategy documents themselves. As expected, resilience strategies took different forms in the various cities and countries. While this partly reflects divergent priorities and different city contexts — including vulnerabilities, governance systems, and planning processes — other factors, such as individual capacities and preferences and political realities, play important roles in any planning process. In all cases, the strategies were created through new collaborative multi-stakeholder groups created specifically for the ACCCRN program. In most cases, there are no official approval processes for these strategies. While they were created with strong local involvement, there is no mechanism yet for their formal "adoption" by local bodies with the authority to implement their recommendations. The strategies therefore remain largely as drafts for local discussion, and as internal documents to guide ACCCRN Phase 3 investments.

Below, we describe the contents of the ACCCRN resilience strategies, with special attention given to the following aspects:

- Linkages between identified vulnerabilities and proposed actions: this is fundamental to ensure that actions respond clearly to identified system fragility or to weak capacity of agents, and that any gaps are transparent and recognized by the authors;
- Types of actions identified and prioritized, in relation to the resilience framework;
- Responsibility for implementation of the top priority actions.

Country-level partners have validated the main contents of the discussion in this chapter through interviews and in the review process for this publication to avoid egregious errors, but the conclusions are those of the authors alone.



VIETNAM

RESILIENCE STRATEGIES

The climate change resilience action plans, as the city resilience strategies are called in Vietnam, are more closely tied to the original guidelines introduced by ISET than other cities' resilience strategies. Overall the plans are structured with logical, linear ties between vulnerabilities and hazards. Each of the Vietnamese city resilience plans is organized into three parts. The first part covers city background, including economy, geography, and climate; climate projections; identification of key vulnerabilities, institutional challenges, and opportunities; and objectives of the plan. Part two identifies climate impacts and potential actions to address them; and the final part presents a prioritized list of actions until the year 2020, indicating a timeline and, for Da Nang and Can Tho, the agencies responsible for implementation.

The availability of essential information largely determined the timeline for planning. In contrast to the other ACCCRN countries, local governments in Vietnam were not comfortable considering long-term planning scenarios. Cities recently prepared ten-year master plans that estimate target population and socioeconomic activity levels and generate spatial development plans for expected growth to 2020. They were reluctant to extrapolate beyond these approved planning horizons, mainly because any projections of urban development further into the future (e.g., population or economic forecasts, spatial development) had not yet been reviewed and authorized by central authorities and so lacked any basis for credibility.

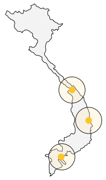
Because of the centralized Vietnamese planning system, the strategies largely seek to work within, rather than challenge or revise, existing plans — even if these are recognized as maladaptive. Only in Quy Nhon have circumstances (i.e., a major and unexpected flood) transpired to make revisions to the master plan feasible, as evident from their strategy.

Because of the centralized Vietnamese planning system, the strategies largely seek to work within, rather than challenge or revise, existing plans

The strategy documents themselves are in Vietnamese, so the following analysis in this chapter is based mainly on translated versions that in some cases omitted the full details of the original due to time constraints (see chapter 6). ■

Links between Vulnerabilities and Proposed Interventions

The climate change resilience action plans in Vietnam all frame their assessment of vulnerability around specific climate hazards with which they were already familiar, because of recent extreme events. They propose that exposure and associated risks to vulnerable sectors will increase under future climate change scenarios (see chapter 6).



In Can Tho, early in the process, stakeholders identified key issues as: potential future inundation due to the combined effect of seasonal floods and SLR, and saline intrusion impacts on agriculture, aquaculture, and infrastructure. Interventions in Quy Nhon and Da Nang were devised to respond to a long list of specific hazards, most prominent among them being typhoons, heavy rainfall, and flooding. They then provided a set of potential response actions for each that were ranked to provide priority interventions for each hazard. In this way, the assessment of vulnerable groups and future climate hazards led directly to proposed resilience-building actions.

The priority action groups in both Quy Nhon and Da Nang involve awareness raising and capacity building at all levels, both of which encompass community disaster preparedness.

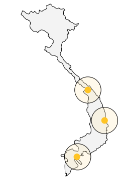
Types of Actions

The resilience strategies for both Da Nang and Quy Nhon group all proposed actions by prioritized type-of-action across multiple hazards. In Quy Nhon, for instance, these ranked categories are: 1) awareness and capacity building; 2) risk assessment of socioeconomic planning; 3) support for sustainable livelihoods in the face of climate threats; 4) research and assessment on key sectors or groups defined in the plan; 5) reforestation; 6) infrastructure planning and construction; and 7) disaster response and early warning. Each of the seven action groups consists of a number of actions responding to different hazards. Both cities' lists are long and comprehensive.

In contrast, Can Tho proposes a set of 22 interventions, grouped into the five (unranked) categories of climate change awareness, planning, infrastructure, natural resources, environment and health, and livelihoods. From this list, interventions are then prioritized into 11 discrete priority actions. In this way, Can Tho provides a clear and arguably more manageable set of actions until 2020. The list is less comprehensive than those of Da Nang and Quy Nhon, but it also explicitly outlines the gaps in the proposed work plan, specifying which of the identified vulnerabilities or hazards are not targeted.

The priority action groups in both Quy Nhon and Da Nang involve awareness raising and capacity building at all levels, both of which encompass community disaster preparedness. They also advocate more research, livelihood projects, and efforts to integrate climate issues into development plans and other department programs. In this initial strategic exercise, these types of actions seemed to the planners to represent the greatest return for value, as they considered the general magnitude of both costs and benefits in the light of current uncertainty. The Quy Nhon strategy additionally contains a strong ecosystem conservation and restoration focus. In Can Tho, actions include awareness-oriented measures, additional research and impact assessments, integration of climate change issues into existing plans and programs, and projects on health and continuing sector studies.

Both cities propose and strongly advocate for the creation of city government offices charged with coordinating climate change plans across city agencies.



The Quy Nhon strategy and proposed actions suggest a greater willingness to propose revisions to the city urban development master plan. Quy Nhon, unlike Da Nang and Can Tho, is facing a series of major land annexation measures in the coming decade that would greatly expand its area, as it addresses anticipated growth and industrial development. Its resilience strategy contains an analysis of historical and future development trajectories in the context of potential inundation and damages based on recent experience. The city's second action group priority is a detailed risk assessment of hazards for socioeconomic development and urbanization in peri-urban areas, with the suggestion that the current master plan be revised to recognize the potential risks once these are more clearly defined. The assessment would focus initially on plans for residential and industrial development in Nhon Binh district, using hydrological and hydraulic modeling to create an impact assessment of flood events under alternative climate and development scenarios.

Direct infrastructure investment is close to the bottom of the ranked lists for all three Vietnamese cities (if it appears at all). Most infrastructure-related interventions relate to storm-resistant housing and improvement of basic services rather than flood protection or drainage. However, a number of more detailed studies that could lead to infrastructure planning and investment do show up on the priority lists. This is discussed further in the cross-country comparison below.

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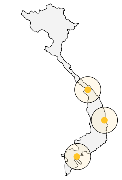
TABLE 7.1 | Prioritized Adaptation Actions in the Da Nang Resilience Strategy

Order	Typhoon	Flood	Drought	River Bank and Coastal Erosion	Saline Intrusion
1	Training and public awareness raising on active adaptation to disasters and climate change impacts	Public awareness raising on flood impacts and adaptation measures	Public awareness raising on environmental protection, tree planting, and appropriate usage of water resources	Improvement of natural resources management and reduction of exploitation in the riverside and coastal areas	Public awareness raising on community health care and water conservation
2	Diversification of production patterns for better adaptation to climate change and planting trees for wind break in coastal areas	Develop better information about potential future hydrological conditions and impact on urban development, including updated digital maps of flooding	Simulation models and maps of drought effects on hydrology and water supply	Public awareness raising on tree forestation at the river banks and the coast line	Simulation models of saline incursion in Han River and potential effects on water supply
3	Capacity building for government staffs and provision of equipment and facilities to improve early warning capability	Forest development and protection up stream and at the coastline	Expansion of upland and seashore protection and forestation	Agriculture extension for farmers whose cultivated land has been reduced for urban development plan	Low-water agriculture systems research and extension
4	Diversification of rural livelihoods	Construction and completion of early warning and flood control systems	Improvement of health care system at commune level and public awareness raising on drought-related disease preparedness in dry season	Support for the resettlement of people whose land has been lost due to erosion	Strategic plan for water exploitation and usage of underground water resources in the most effective way
5	Training on safe house construction	Studies for diversification of production patterns for better adaptation	Agriculture and aquaculture extension	Proper construction planning in erosion areas	
6	Feasibility study for underground services; selection and planting of urban trees	Hardening of infrastructure in low-lying areas, especially road system and construction of safe shelters	Upgrade of irrigation systems and existing pumping stations	Construction works for river bank erosion and sea expansion protection	



Implementation Responsibility

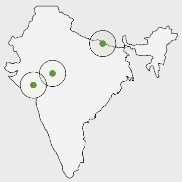
Both the approach to resilience planning and the strategy itself are experimental in Vietnam. The process and resulting documents lack formal senior government mandate and local governments thus have limited authority to take action. However, these local resilience plans are closely related to the Climate Action Plan that each province and provincial-level city must prepare under the National Target Program to Respond to Climate Change (see discussion in chapter 6). The fact that in all three cities these resilience strategies were overseen by the same agency responsible for preparation of the more formal Climate Action Plan makes it much more likely that the priority actions will become formalized and that agencies designated in the draft strategies will implement them.

The Da Nang and Can Tho action plans transparently identify which actors will implement the proposed actions according to their timeline. The Quy Nhon plan has a lower level of institutional analysis and does not explicitly designate implementation authorities in the document. All of the strategies propose that a Climate Change Coordination Office assume responsibility for coordinating climate change activities between government agencies. The office would also house and update climate-related information; engage government departments in climate change planning; encourage the integration of results into city programs and plans controlled by other agencies; integrate the needs of vulnerable communities into planning; lead capacity building, training, and awareness programs at various levels within the city; and provide liaison with national-government and related programs. The DONRE would be responsible for organizing and ensuring the staffing of these offices. (At the time of this writing, each city has established a Climate Change Coordination Office and the offices are already undertaking many of the activities listed above).

In Quy Nhon, the DONRE was proposed as the responsible agency for overseeing the hydrological modeling study for Nhon Binh ward and for coordinating the technical inputs of consultants. In Da Nang the hydrological modeling work will be overseen by the Department of Construction, together with DONRE, and with technical inputs from contactors. The Da Nang Women's Union, a local non-government mass membership organization, will implement the feasibility study for storm-resistant housing and livelihoods.

All of the strategies propose that a Climate Change Coordination Office assume responsibility for coordinating climate change activities between government agencies.

INDIA



INDIA

RESILIENCE STRATEGIES

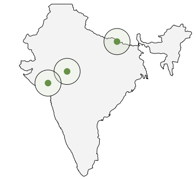
The resilience strategies for Indore, Surat, and Gorakhpur were completed in August 2010 by TARU and GEAG respectively, with input and review from the CAC and CSC as described in chapter 6. The Surat and Indore strategies focus on economic development of their communities as a key way to build resilience and to provide a framework for improving service delivery. The Gorakhpur strategy emphasizes the promotion of an active and conscientious citizenry as a mechanism for building greater public accountability and improving service delivery. The differences between these strategic perspectives is significant: while all three cities focus on the need for improved local services, in Surat and Indore the resilience strategy is framed mainly as a platform for strengthening economic development, while in Gorakhpur it is framed mainly as a platform for strengthening governance.

The strategies for all of the Indian cities focus heavily on existing hazards and development challenges as the points of entry into building climate resilience. In Indore and Surat, urban trends — such as growing population and migration, resource scarcity, and public sector management weakness — and economic trends are foremost in the analysis. Potential impacts of climate change are considered an additional and highly uncertain pressure that will exacerbate the impacts of other trends. Surat focuses on flooding due to upstream dam operation on the Tapi River and smaller but more frequent flooding on streams, and Indore, on chronic water scarcity and short-duration flooding. Flooding and water-related problems also represent the main point of entry for the Gorakhpur strategy, due to water logging problems in the city that are expected to worsen in the future (see discussion in chapter 6). ■

Links between Vulnerabilities and Proposed Interventions

In contrast to Vietnam, the Indian cities categorized proposed actions by sector rather than by hazard. In Surat, the sectors include: water resources, natural disasters/urban health, urban services, population (i.e., vulnerability and capacity of certain populations), environment, economy, social equity, and technology. In addition to these, the Indore strategy considers energy and urban services. The sectors considered for Gorakhpur are: housing, industry and commerce, basic services, transportation, energy/electricity, health, household-based livelihoods, ecosystems, and urban planning. The sectoral analysis is readily tied to existing sectoral conditions, but less clearly related to the climate vulnerabilities analyzed in each city.

The strategies that TARU prepared for Indore and Surat are similar in structure. A "Risk Assessment" section describes hazards and vulnerabilities based on



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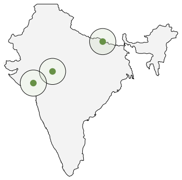
quantitative social and service access indices produced from surveys conducted during the vulnerability assessments. The strategies summarize results of various ACCCRN sector studies and describe the climate risks identified in the studies (see process description in chapter 6).

The final section of each strategy focuses on proposed resilience actions, categorizing by sector a series of interventions, both short-term (3-5 years) and medium-term (5-20 years). Each intervention is attached to one or more "potential partners/stakeholders" and each responds to an issue identified as a result of CAC discussions of the scenarios. A comprehensive chart lists each action, and priority action areas are described in greater detail. The strategies conclude with a list of linkages to national and state programs.

In the strategies for Indore and Surat, the urban growth scenarios function as a central framework for translating vulnerability assessment into actions. The scenario development assembles a series of potential challenges or positive outcomes that may result from potential urban growth trajectories, and which are then overlaid against future climate scenarios. The latter part of the document suggests resilience actions that respond to the challenges or outcomes from this interaction of climate and urban scenarios. The suggested actions arise from consultation and shared learning dialogues within the CAC, in which participants compared the previously identified climate vulnerabilities with urban development and climate scenarios. In the case of Indore and Surat, the proposed climate resilience actions arose not from the itemization of specific future impacts, but more from a pro-active effort to address short-term risks that arise from existing infrastructure and planning shortcomings. While addressing these issues



is expected to improve climate resilience, the main motivation at the local level was to support the most desirable urbanization and poverty reduction scenarios.

The Gorakhpur strategy outlines historical and future climate vulnerabilities, with special attention to potential impacts on waterlogging. The other main risks it emphasizes are sewerage and sanitation challenges and solid waste management. The plan then identifies vulnerable groups and sectors and highlights associated vulnerabilities. The strategy also reviews climate and urban development scenarios and categorizes actions by sector and by geographic area. It then specifies actionable interventions and groups them into six larger "Final Action Items."

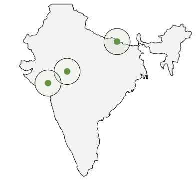
More so than others, the Gorakhpur strategy describes the participatory process through which partners assessed vulnerabilities and identified pathways for action and specific interventions (see Figure 6.4, Resilience Strategy Preparation.) As in Surat and Indore, partners utilized scenario development as a platform to formulate actions responding to key concerns, although in Gorakhpur the scenarios played a smaller role in driving priority actions than participatory consultations. The actions generated from these discussions target most of the sectors and groups identified earlier in the strategy as vulnerable, demonstrating that the strategy has clear roots in earlier vulnerability assessment. In Gorakhpur it is particularly clear how the participation of a broad cross-section of the community and the leadership of the CSC throughout the process contributed to this continuity.

Types of Actions

Each of the strategies provides a set of principles to determine which types of actions are strategically useful for building resilience. The Surat strategy aims to:

- Build on current and planned initiatives;
- Demonstrate resilience building projects to leverage further action at the local level;
- Generate multi-sectoral information and develop a portfolio of potential projects (i.e., identify diverse potential actions that could be supported by donors or state or national governments);
- Build synergies with state- and national-level urban initiatives that are already underway.

The Indore strategy uses the same set of action principles, with the additional goal of creating awareness about climate risks and generating demand (for resilience actions) using a bottom-up approach. Weak governance in Indore led the strategy authors to add this guiding principle in order to motivate political and administrative action — in this case by encouraging greater citizen awareness of the weak infrastructure services and attendant climate risks. Indore's approach compares with that in Gorakhpur, where the overall focus of the resilience strategy was on demonstrating small-scale resilience actions and building local awareness to motivate advocacy and strengthen political accountability.



For Gorakhpur, action principles are as follows:

- Build a community of practice — including government, NGOs, academics, and private sector institutions familiar with climate — to create a sustainable mechanism for climate resilience planning and implementation activities;
- Develop targeted local actions for drainage, housing, health, and communication systems to demonstrate how these actions address problems and build capacities;
- Establish an information base for long-term planning, emergency response, and social advocacy, especially communications systems and climate scenarios;
- Develop activities to raise public and political awareness and encourage policy change.

Common among these approaches is the strategy of demonstrating activities that provide examples of resilience as a way to leverage further action from local and state government agencies. In Indore and Gorakhpur, generating public awareness is viewed as high priority in order to change behavior and to build political commitment. The Gorakhpur strategy in particular describes developing climate change awareness in explicitly political as well as behavioral terms — as intended to improve governance through public advocacy and fostering more environmentally conscious behavior (e.g., reducing use of polythene bags, which contribute to solid waste and drainage problems). Due to a more effective Municipal Corporation that already recognizes climate problems, the Surat plan relies more heavily on technocratic action rather than advancing public awareness.

Implementation Responsibility

The CAC or CSC in each Indian city has endorsed their respective resilience strategies, but the strategy documents do not make clear whether these bodies — formed mainly for purposes of the ACCCRN project — will develop ongoing advisory or oversight responsibilities in the cities. The documents also do not specify the responsibility for reviewing and revising the strategies. The lead organizations in each case (TARU and GEAG) provided much of the initiative for the process, and it is unclear whether, absent their involvement, other local stakeholders would be able to take this initiative. It seems most likely in Surat, where there is a high degree of local interest and a strong public administration.

The Surat and Indore strategies indicate, for each proposed action, one or more "potential partners/stakeholders" who would be involved with implementation. The municipal corporations emerge as key players on which successful implementation of the strategy would depend. The Surat strategy also foresees the South Gujarat Chamber of Commerce and Industry as playing a major implementation role on various potential projects. Many of the organizations listed as potential implementers are represented on the CACs. The Gorakhpur strategy does not specify which actors would be responsible for each action.

In Indore and Gorakhpur, generating public awareness is viewed as a high priority in order to change behavior and to build political commitment. The Gorakhpur strategy in particular describes developing climate change awareness in explicitly political as well as behavioral terms – as intended to improve governance through public advocacy and fostering more environmentally conscious behavior.

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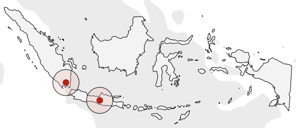


INDONESIA

RESILIENCE STRATEGIES

As illustrated in previous chapters, the Indonesian ACCCRN experience is unique in a number of ways. Chapter 5 describes city partners' skepticism over results of the vulnerability assessments, which led to extensive deliberation and efforts to revise the analysis. The resulting synthesis, which appears in the resilience strategy document, relies on information from a variety sources in addition to the ACCCRN-supported vulnerability assessment. Secondly, national partner Mercy Corps and the Indonesian city teams put strong priority on integrating the resilience strategies with national and local policy. These two issues demonstrably shaped the final strategies in both Semarang and Bandar Lampung, as described below.

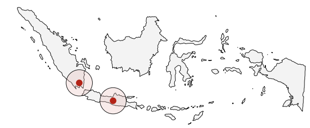
Both strategies begin by clearly outlining the city background and purpose of the document. They then describe the vulnerability assessment, discuss relevant national and local policies, and present and prioritize proposed resilience actions. The following description and analysis is more focused on Semarang, because at the time of this writing, only the summary of the official Bandar Lampung strategy was translated into English. ■

Links Between Vulnerability and Proposed Interventions

As in other countries, the vulnerability section of the Indonesian strategies represents the culmination of a number of studies, consultations, and deliberations between technical staff. This was particularly important in Indonesia, where discomfort with city vulnerability assessments catalyzed partners to adopt certain elements of each assessment, while replacing or supplementing other parts with information from other sources. The strategies in this way provided a forum in which partners could formulate a consensus-based understanding of vulnerability.

Unlike the Vietnamese and Indian strategies, the Indonesian strategies do not engage a single frame of reference to link actions to vulnerabilities. Both cities consider vulnerability in light of geographical location with regard to hazards and socioeconomic vulnerability factors, although this is not their exclusive focus. They also categorize action areas by sector, in part as a result of an effort to align the strategy with national government policy on climate change, as described further below. In this way the documents present a less linear logic, but in other ways their analysis is more complex.

The Semarang resilience strategy analysis draws on various sources to identify vulnerable areas. These are identified as hazard prone areas (lowland, floodplain, high-wind prone, landslide prone); areas in which residents have limited access to piped water; and areas deemed as nodal for city operations (e.g., transportation



hubs, the central commercial district, and historical and cultural assets). Each of these is considered in light of relevant hazards and specific vulnerabilities. In addition, the strategy highlights seven broad categories of vulnerable groups, some linked to specific sites and others citywide. The Bandar Lampung strategy draws on CCROM's vulnerability mapping and also uses a 2009 BAPPEDA (Development Planning Board) disaster study and results from the Mercy Corps community-level vulnerability assessment to characterize the general areas, sectors, and groups vulnerable to climate hazards.

Like the Indian strategies, the analysis in the Indonesian strategies depends heavily on scenario development to understand potential vulnerabilities. But whereas the Indian partners used scenarios primarily to consider urban development trends and build appropriate interventions, in Indonesia, the scenarios were an important part of efforts to revise the vulnerability assessments. As chapter 6 describes, scenarios developed in the Semarang and Bandar Lampung strategies refer to very specific, technical issues related to future climate and city infrastructure planning.

The strategies conclude with an outline of all proposed interventions, categorized by sector, as noted above: clean water; environment; infrastructure; marine, coastal, and fisheries; development of human resources; and development of institutional capacity. These sectors are consistent across the two cities and overlap in a number of ways with sectors prioritized in the Indonesian Climate Change Sectoral Roadmap (ICCSR) — a conscious effort by partners to draw clear linkages between the resilience strategies and national government plans. This approach is intended to increase the likelihood of leveraging national support for implementation and funding. In addition, Mercy Corps and the city team viewed their strategy as an opportunity to influence further iterations of the national guidelines, by emphasizing sectors that they view as most critical in Indonesian cities.

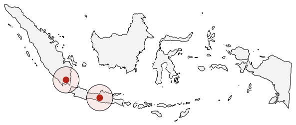
The importance of the selected sectors is evident from the vulnerability assessment. But when paired with action, it is clear that each of the priority sectors (with the exception of human and institutional capacity) correspond fairly directly with specific hazards: land movement, sea level rise, flooding, high temperature and water scarcity, wind storms in Bandar Lampung, and salinization in Semarang. In this way, actions connect also to hazards identified in the vulnerability section.

Types of Actions

The Semarang and Bandar Lampung strategies contain 16 and 17 actions respectively, categorized by the key sectors outlined in the national ICCSR, but these sectoral actions respond essentially to the key hazards identified through the strategy. Working group members used resilience matrices and qualitative cost-benefit analysis tools to rank proposed actions by priority. Other strategic factors impacted prioritization

Bandar Lampung Priorities

- Community empowerment in adapting to climate change
- Construction of infiltration or recharge well and biopores
- Development and maintenance of integrated drainage
- Rehabilitation of forest and degraded land
- Integrated waste management
- Establishment of technical implementation unit (UPT)



Semarang Priorities

- Rainwater harvesting
- Flood shelter construction
- Establishment of Center for Cities and Climate Change
- Domestic wastewater management to protect water resources

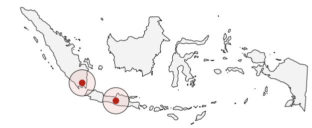
as well. In Semarang, for example, actions already slated for government implementation were not prioritized in the resilience strategy. And as in all of the ACCCRN cities, the Indonesian partners were motivated to select projects that could fulfill the Rockefeller Foundation's criteria for funding (see chapter 6).

In both cities, the full list of actions suggests an approach with greater focus on infrastructure than that of the Indian or Vietnamese strategies. Seven of Semarang's 16 actions relate to infrastructure. Centralized infrastructure actions include building sea walls, seawater desalination, constructing channel belts for rainwater distribution, and constructing a central flood shelter; decentralized (i.e., community- or household-level) actions include water harvesting, purifying public wells, and creating neighborhood drainage networks.

The overlapping membership of the climate working group and the city's Development Planning Board working on the midterm development plan may have benefitted those formulating the resilience strategy, helping them think in terms of infrastructure priorities that could be tied to land use and public expenditure planning. After using the prioritization tools, the Semarang city team designated the centralized infrastructure actions as lower priority, for long-term rather than short- or medium-term implementation (with the exception of the central flood shelter). Of the decentralized actions, rainwater harvesting was identified as the highest priority, purification of public wells as middle priority, and neighborhood drainage networks as lower.

In Bandar Lampung, many of the outlined actions are broad sets of activities rather than more discrete interventions. For instance, the proposed action "arrangement of settlements that build resilience to climate change and disaster" encompasses resettlement, construction of public housing, in-situ upgrading, and evacuation plans. "Community empowerment in adapting to climate change," the top priority identified in the strategy, similarly contains a range of educational and network building activities.

The Bandar Lampung strategy focuses on community empowerment, indicating the focus on vulnerable groups in its analysis. The Semarang strategy also stresses the importance of a community-based, participatory approach — especially for the decentralized infrastructure-oriented interventions. Decentralized actions that promote diversity and modularity (such as rainwater harvesting, wastewater treatment, flood shelters, and water filtration systems) are intended to enhance the resilience of vulnerable groups who cannot access centralized systems. The strategies also aim to enhance or develop integrated drainage, waste management, and water supply systems. The community empowerment orientation of both strategies reflects the involvement throughout the process of local NGOs and universities who have close ties to projects in vulnerable communities, as well as the organizational focus of Mercy Corps as a poverty-reduction NGO and their application of community-based assessment.

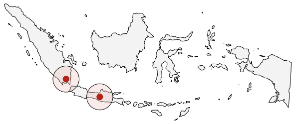


Similarly to most of the other cities, the Semarang strategy proposes a new local body to support climate resilience capacity building, planning, coordination, and knowledge development. In Semarang, this organizing mechanism would be known as the Center for Cities and Climate Change (C4) and have a stronger focus on knowledge development and human resources than coordination, in contrast to the CCCOs in Vietnam. The C4 would also have explicit linkages to a new provision mandated in the midterm development plan, which would require all relevant departments to integrate and build capacity for adaptation actions. As no existing agencies are able to provide training for this work, the city team envisioned that C4 would fill this role.

Bandar Lampung also prioritizes organizational capacity development. Though not explicit in the strategy, the city team and Mercy Corps plan to provide workshops for heads of relevant agencies and representatives in the local legislature. The strategy does prioritize the establishment of a technical implementation unit, which would provide technical support for agencies implementing resilience actions or mainstreaming climate into their activities. In both cities, the focus on organizational development reflects an anxiety among the city teams that unless strong local technical leadership is developed, the achievements of the ACCCRN projects will be lost after donor funding ends.

The success and influence of ACCCRN pilot projects in Indonesia clearly informed the actions generated by the city team; for instance, waste management, water purification, and land conservation models developed through the pilot projects resulted in intervention proposals.

Following analysis of vulnerabilities and hazards, the strategies consider links to national and local policy, funding and implementation opportunities, and planning processes. This includes the ICCSR, which provides guidelines for mitigation and/or adaptation coordination in water, marine and fisheries, agriculture, health, transportation, forestry, industry, energy, and waste sectors. Authors outline the (complex) process of accessing funding from ICCSR-linked sources, arguing the importance of having a city-level institution "specifically able to support local government to transform ICCSR policies into action." With regard to local planning, the Bandar Lampung strategy details all linkages to city spatial plans (RTRW), 2009 to 2025. The existing RTRW defines the specific areas susceptible to hazards ("natural disaster prone areas, areas prone to landslides and soil movement, areas of tsunami and tidal wave, and flood prone areas") and the statutory regulations or guidelines associated with these areas. The Semarang strategy likewise outlines its long-term development plan (RPJP). In neither instance do the strategies explicitly highlight areas of weakness in the existing plans. Both highlight their co-development with midterm development plans (RPJM) and the success in integrating climate change priorities.



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Implementation Responsibility

The Semarang strategy assigns responsibility for coordinating actions and financing to the city's BAPPEDA, with help from the working group and the Technical Team on Climate Change Adaptation of Semarang. Additionally, the strategy proposes several implementing partners (government agencies, NGOs, and/or research institutions) for each of the 16 intervention actions. In Bandar Lampung, the city team and BAPPEDA will likewise take responsibility for implementation and updating the strategy.

This achievement does not, of course, guarantee implementation of strategic actions. The strategies consider capacity development among city government leadership and staff a precondition for implementation and sustainability of resilience planning efforts in the city. The Bandar Lampung strategy recognizes that economic pressures may obstruct progress and that plans are often not well enforced: "local cultural wisdom to maintain environmental balance sometimes [is] still defeated by economic need, greed, and inefficiency in resource utilization. That [is] further coupled with weak law enforcement, and indiscipline." For this reason, Bandar Lampung includes an intervention on enhancing law enforcement; the specific actions associated with it, however, are not clear.

THAILAND

RESILIENCE STRATEGIES

Thailand Environment Institute (TEI) drafted the resilience strategies in Chiang Rai and Hat Yai, based on the vulnerability assessments, sector studies, pilot projects, and discussions with local working groups. However, the limited mandate and experience of municipal level governments and the weak climate data and vulnerability studies posed unique difficulties for the Thai cities, which were exacerbated by the especially short timeframe (see discussions in chapters 3, 5, and 6). As a result, TEI had relatively low-quality inputs to work with in constructing the resilience strategies, and local partners were still struggling to understand basic concepts and to keep up with the pace of the program. Preliminary drafts of resilience strategies were completed in May 2011, however — as in Indonesia and Vietnam — they were prepared in the local language and ongoing revision and translation of the documents into English has been problematic. A final English summary of the Hat Yai resilience strategy was not available to include in this analysis.

The limited domain for municipal actions in Thailand constrains the Thai resilience strategies. The strategies serve different purposes in the two cities. In Chiang Rai, which had never seriously considered climate change, the strategy serves to bring the potentially serious economic implications of climate change into focus for the first time. The Chiang Rai economy is heavily dependent on cool-weather agricultural crops and seasonal tourism (typically linked to river-based activities), both of which future climate change would likely affect.

In Hat Yai, on the other hand, the local government and other stakeholders were all very familiar with the climate problem they face (major flooding of the city center every decade or so). The resilience strategy — rather than introducing new implications as in Chiang Rai — provides a new opportunity for all parties to share their data and to begin to discuss collaborative approaches to flood risk reduction. This effort had been previously hampered by fragmented jurisdictions and differing perceptions of the problem, lack of clarity about the key social issues (mostly having to do with recovery processes), lack of access to sources of data held by different agencies at different scales, and the absence of a platform for collaborative planning. While the problems of coordination and overlapping jurisdictions for water management remain substantial in Hat Yai, the resilience strategy has provided a new opportunity to make progress in this area. ■

Chiang Rai Priorities

- Build awareness of climate change issues through ongoing collaboration and promotional events
- Promote sustainable agriculture and efficient use of irrigation water in and around the city
- Promote eco-tourism

Links Between Vulnerability and Proposed Interventions

The vulnerability assessment in Chiang Rai, although based on weak climate data and very limited analysis,

brought forward a number of strategic climate-related issues that the municipal government had not previously considered. The resilience strategy specifically addresses these issues, focusing on the potential problems for poor farmers and for the tourism industry. However, it appears that local partners still have a limited understanding of the climate change issues and vulnerabilities that they may face. The group has had a limited time to sort through these issues (see chapter 6), and it is not clear how the recommended interventions will reduce the identified vulnerabilities. The draft strategy proposes that poor farmers be trained in sustainable agricultural techniques and that the tourism sector shift to eco-tourism markets, but under climate stress both of these strategies could still have substantial vulnerabilities.

In Hat Yai, the city is clearly vulnerable to flooding, which has been the focus of the resilience strategy. But with limited capabilities to either invest in infrastructure or to manage the upstream watershed, the local government is not in a position to respond strategically on its own. It can only engage with local communities in awareness raising, risk reduction, and disaster response training.

Types of Actions

In both Hat Yai and Chiang Rai, local partners' efforts to assess climate vulnerabilities and to consider future climate conditions and potential climate hazards have led to many conceptual struggles (described in chapter 6). It is not surprising then that the strategies for both cities recommend pursuing additional information and climate data and raising stakeholder awareness. Both cities are increasingly recognizing the value of ecosystems in providing services that are essential to the local economy and to the health and welfare of the city's residents. Thus, the strategies also recognize ecosystem management as an important step to building long-term climate resilience. Other measures vary between the cities and are still being finalized.

Implementation Responsibility

Neither the Hat Yai nor the Chiang Rai strategy clarifies implementation responsibility. In both cities, the working group established for the project has engaged a broad group of technical staff from the municipality, the province, the district, and NGOs. While creating this kind of platform for exchange of information and views has been valuable, the group is not an implementing body and has no authority to direct government agencies to take action. Therefore, much of the implementation action in Thailand is likely either to result from the engagement of provincial-level agencies (who do have greater authority) or to remain at the level of general awareness and information and promotional activities.

Hat Yai Priorities

- Prepare for flood prevention and mitigation through enhanced warning systems, flood infrastructure, collaborative networks, human capacity, and risk information
- Improve quality of life through health, livelihoods, and housing in a manner consistent with climate-induced pressures
- Promote sustainable resource management through eco-tourism; urban greening; and community capacity building, participation, and resource management

Despite the differences in framing urban development and climate change futures, the ten ACCCRN cities came up with many similar intervention approaches in their resilience strategies.

Climate information and uncertainty

At the core of resilience planning practice is the challenge of planning for an uncertain climate future with limited climate information. All of the ACCCRN cities struggled to understand the concepts associated with climate change and uncertainty and to make effective use of available climate information despite large uncertainties and unfamiliar or unhelpful data formats (see chapter 3). In early stages of the program, many partners expressed frustration at the lack of probabilistic data regarding future climate impacts, which they had hoped to use to design infrastructure standards. Instead of being paralyzed by these uncertainties, however, all the cities overcame their initial frustrations and developed resilience strategies that address climate uncertainties in several common ways:

- The planners focused on existing climate vulnerabilities. Most of the cities already face climate-related challenges and future climate change and greater climate variability are only expected to exacerbate these conditions. By focusing on current vulnerabilities and extrapolating trends, all the cities could point to problem areas that need urgent attention (e.g., waterlogging, water scarcity, flood protection, ecosystem degradation, solid waste management).

- Planners adopted "no-regrets" intervention strategies. These are likely to yield positive outcomes across a wide range of potential future climate conditions (e.g., awareness building, improved coordination, early warning systems, wastewater management, rainwater harvesting).

- City partners focused on the need for better local data and for more detailed scientific evidence of local climate impacts under a range of plausible future conditions. These needs were expressed in terms of both improved data collection and management, but also in terms of specific research studies. They were able to define a small number of crucial areas on which to focus these research needs (drainage and sewage system design, hydrologic/hydraulic modeling of peri-urban flooding, water management).

- Planners looked for ways to avoid maladaptation. They could recognize the potential increasing risks of further development in exposed sites, or overexploitation of key resources (groundwater), or the vulnerability of particular sectors (e.g., fishing, agriculture) and sought approaches that would redirect "business as usual."

- Partners in all of the cities recognized the need for building awareness among different groups, from the general public to private businesses and elected officials, in order to generate broad support for resilience actions and to build capacities for behavioral change and autonomous adaptation.

Major infrastructure

Semarang and Bandar Lampung put the greatest emphasis on technical and infrastructure solutions to build climate resilience, although many of these actions received lower ranking following the prioritization process. Their strategies highlight a number of action areas that have both centralized and decentralized solutions: for instance, solid waste and wastewater management, drainage, and fresh water supply (e.g., rainwater harvesting). In these instances, infrastructural solutions would be complemented by very localized strategies, thus building modularity and diversity of services.

Most other cities, despite identifying water supply or flooding problems, do not prioritize specific infrastructure investments, focusing instead on more detailed studies of climate impacts on key hydrological parameters and water management systems (e.g., Surat's studies of storm water drainage and sewerage design parameters in light of new climate conditions). Part of the reason for this may be that most cities felt the climate data available was not yet sufficient to justify large infrastructure investments.

Another reason for the lack of emphasis on infrastructure in these resilience strategies could be that all of the cities except Gorakhpur currently have major infrastructure investment programs underway, funded through either multilateral development banks or through large national government programs (or both). It may not be clear yet how these existing or committed infrastructure investments will address climate vulnerability issues.

Disaster Risk Reduction

A number of the cities present suggestions for Disaster Risk Reduction (DRR). Surat probably has the most comprehensive DRR approach, from an improved early warning system to greater community involvement in decentralized DRR plans. Other cities also see the need for early warning systems for floods and severe storms, and several suggest posting flood depth markers in publicly visible spots in low-lying districts. (For Surat, TARU suggests color-coding these markers to match flood-warning levels, e.g., blue, orange, or red). Better floodplain identification and evacuation procedures were also suggested, including building these measures into community development programs in Bandar Lampung.

Awareness

The various actions proposed to raise awareness levels are not only intended to change the behavior of the general public in order to improve broader urban resilience (e.g., through elimination of polythene waste in Gorakhpur), but also to change the behavior of decision makers. So in Gorakhpur and Indore, awareness programs are partly intended to strengthen user knowledge of service improvement potential, in order to put pressure on local elected officials to upgrade services. In Vietnam, the resilience planners in the city understood the need for building awareness among both the public and among local government officials in order to build support for climate adaptation efforts. In Thailand, the resilience strategies emphasized the need for greater awareness on the part of local government officials and community members of the need for adaptation measures. Similarly, in Indonesia, partners see an urgent need to build capacity and awareness among government as well as among communities so that private businesses, community organizations, households, and individuals can take autonomous adaptation actions.

Coordination and capacity building

Most of the cities also recognize the need for some kind of local coordination or information repository to improve the quality and usefulness of climate data and to support its application by diverse local actors. This suggestion takes different forms: Surat proposes a voluntary Climate Watch Group to assemble data and undertake analyses that lead to policy advocacy. Gorakhpur proposes a community-oriented public information center that would interpret local climate information and make it more widely available. The Semarang strategy identifies the need for a center to coordinate climate information for decision making and capacity building. In Vietnam, where local governments have broad authority over planning and delivery of public services, and where governments are already obliged to prepare Climate Action Plans to meet national policy requirements, all three cities strongly felt the need to create a dedicated Climate Change Coordination Office to take responsibility for ongoing planning, data management, and coordination of climate adaptation actions throughout the city.

Maladaptation

All the cities recognize that a major contributing factor to higher future climate risk is ongoing urban development in sites exposed to climate hazards (such as low-lying areas or steep slopes), or inappropriate infrastructure design (e.g., new roads that lack drains or block surface flows, creating flood impoundments). These appear to be common problems in Gorakhpur, Indore, Da Nang, and Quy Nhon, especially in peri-urban areas. Both Semarang and Bandar Lampung identify risks associated with deforestation and development of sloping land in watershed areas. Cities recognize the need to avoid further maladaptation by identifying these risks and preventing them in future urban development. One of the ways they proposed to avoid future maladaptation was to undertake detailed hydrological modeling and flood risk mapping in areas of the city that were potentially vulnerable (Da Nang, Quy Nhon, Can Tho, and Surat all proposed this kind of study).

Identifying vulnerable social groups

Most of the strategies have a strong focus on vulnerable groups. Gorakhpur, Da Nang, Can Tho, and both Indonesian cities are more explicit about the links between the geographic and social nature of vulnerability (i.e., that poor people live in exposed and vulnerable places). In the Vietnamese cities, these vulnerable groups were most often considered to be the poor farmers and fishers on the outskirts of the city, whose housing and livelihoods are already quite susceptible to climate hazards. Interestingly, all three Vietnamese cities point to resettlement of vulnerable groups as a resilience planning issue — both as a positive solution and as a negative impact on those displaced — but this issue is not raised in any of the Indian cities. In Chiang Rai, the climate vulnerable group was perceived to be poor farmers in peri-urban areas, but it was recognized that climate impacts on this group (e.g., due to drought) would also affect the city through migration and economic losses. The Bandar Lampung and Semarang strategies promote community empowerment and autonomous adaptation of vulnerable groups through decentralized strategies.

Strategic in nature

While the strategies adopt different formats, tools, and processes, they are all strategic in nature: they develop priorities to identify a limited range of realistic measures in the short term, and link these to existing plans and policies at the city level, as well as to the actions of senior levels of government. This strategic nature, including the ability to identify priorities, is important in order for the plans to be actionable. The strategies are well grounded in local realities and each responds appropriately to its own situation. The strong role of local (provincial or city) government in Vietnam, the relatively weak and limited role of municipal corporations in India, and the limited scope for action by municipalities in Thailand leads in each case to the need for a different action. In Vietnam, for example, the creation of a new local government office with coordination authority was seen as a key strategic action. Indian cities emphasize the need for stronger citizen engagement to prompt political action and for a broader range of state-level organizations, quasi-independent service providers, and parastatal organizations to become involved. In Thailand, where the locus of responsibility for action is much less clear, there was a greater emphasis on awareness raising and further study. Both Indonesian cities do an excellent job of tying their strategies directly into the key local planning agencies and the official planning documents that could serve to implement them. Partners note, however, that integration with planning does not guarantee implementation or even enforcement.

A key lesson from the ACCCRN program is the importance of institutional analysis and of understanding the local political context. City-level activities were generally more successful when facilitating partners (for instance, GEAG in Gorakhpur) brought extensive experience in the city context and understood planning, authority, and power dynamics. With the help of Mercy Corps and URDI in Indonesia, partners followed a strategic approach that resulted in the integration of resilience planning with national and local policy.

Gaps

The resilience strategies identified some key vulnerability issues that were not matched by resilience actions. One issue is migration: some of the strategies point out the likelihood of indirect climate impacts on the city through higher levels of rural-urban migration as climate stresses increase risk and reduce returns to marginal agricultural production in surrounding areas. The resulting population pressures would exacerbate urban development issues. Both Indore (Deccan Plateau) and Can Tho (Mekong Delta) are at high risk of these kinds of impacts; Chiang Rai also identified migration as a possible problem. Surat identified the need for building social cohesion and social capital among poor migrants, most of whom were young and male, in order to improve their resilience to local floods and climate-related disasters. While the likely stress on already-burdened urban systems is clear, solutions are less obvious.

Public health generated widespread concern in the cities, but it was not a high priority for immediate investment because of uncertainties about what effects future climate change might have on public health (other than current sanitation, drainage, solid waste, and vector-borne disease issues). Instead, most strategies designated public health issues as meriting attention and further study. It is clear that while diseases can be linked to climatic factors, health outcomes are obviously also affected by many other factors (such as surveillance and reporting, socioeconomic status, migration, and infrastructure investments). Different kinds of health effects require different kinds of management intervention.

Another issue of this type is water supply. In Surat, Can Tho, Da Nang, and Semarang, water supply systems will need to be relocated, augmented, or redesigned as current intakes become more saline or simply inadequate in the face of longer droughts and higher demand. Indore already suffers from acute water scarcity and has proposed some measures to address this issue. In other cities it is less clear what needs to be done or when. Semarang has put the highest priority on this issue and specifically proposed some decentralized infrastructure measures.

Institutionalizing resilience planning

One of the issues that the cities deal with in quite different ways is how resilience planning becomes institutionalized in local decision making. In Vietnam, where local governments are highly organized and dominate strategic economic and social decision making and where national policy already has created a requirement for local climate action planning, it was fairly obvious that the way to incorporate climate resilience into decision making was to create a coordination and planning group within the government to take responsibility. In Indonesia, local governments are also highly structured and have existing formalized planning responsibilities. In Indonesia, the initiative for resilience planning has been led by civil society and taken up by local planning agencies. However, in recognition of the need for widespread capacity development among local government officials, Semarang has proposed a local center to develop skills and methods for resilience planning. Non-governmental organizations are likely to continue to play a strong role in the processes of both planning and implementing resilience actions, while supporting their integration into formal local planning processes.

Indonesia was arguably the most successful of any of the countries in embedding and integrating their strategies into local planning. This was due to the strategic configuration and composition of their working groups and pointed effort made by city partners and Mercy Corps to ensure that their strategies correspond effectively with national and local plans to demonstrate credibility, raise their profile, and increase likelihood of implementation. Both successfully provided informed, climate-related input to the midterm development planning process, ensuring that all action areas were included in this plan.

All of the strategies are also explicitly tied to the development of proposals for project funding, not only to the Rockefeller Foundation but also often to senior levels of government. In most cases, the authors of the strategies point out the linkages to potential government funding opportunities. For Surat and Indore, for example, TARU highlights multiple sectors and opportunities for funding under various national and state-level schemes. In Vietnam, all three cities make explicit the linkages between their local actions and the national Target Program on Climate Change, and the Indonesian strategies link funding streams accessible via the national ICCSR. In the above ways, the strategies largely succeed in creating an initial road map for resilience actions at the local level.

OTHER OUTCOMES OF RESILIENCE PLANNING

In this section we move from understanding the resilience strategies themselves as the major milestones in the process of resilience planning, to understanding some of the other outcomes of the resilience planning process as a whole. We describe capacity development as a key area with clearly demonstrated outcomes (though less tangible than the strategies themselves). Secondly, we assess the ways in which the ACCCRN experiences illustrate the process described in the Urban Climate Resilience Planning Framework in chapter 2.

CAPACITY DEVELOPMENT OUTCOMES

Before the resilience planning process began, the Rockefeller Foundation, as ACCCRN's sponsor, established as series of "result areas," in which they hoped to see measurable signs of achievement over the course of the five-year program (2008-2013). While the Rockefeller program results framework changed during Phase 2, with the hiring of a formal external evaluation firm, the initial result areas provide examples of the kinds of capacity changes that program designers initially hoped to be able to identify, including:

- Cities develop internal coordination mechanisms for adaptation planning;
- Diverse groups demonstrate awareness and initiative on interventions for vulnerable communities
- Local governments and other groups are able to use new information to develop resilience plans;
- Local governments establish new relationships with other actors to generate, share, and apply new knowledge.

These capacities are all measures of increased ability to collect, understand, and apply relevant information in order to address climate resilience at the city level. Below, we review the results of ACCCRN Phase 2 in terms of these capacity development outcomes.

Develop city-level coordination mechanisms for adaptation planning

An initial planning mechanism has been developed and put in place in Indonesia and in Vietnam. In all the cities in these countries, multiple local government organizations, academic experts, and national-level partners have been actively engaged in coordinating local climate resilience planning. Since completing their draft strategies, all three Vietnamese cities have established formal climate change coordination offices. In India, the CAC in Surat is also likely to continue its operations and has functioned well in coordinating local planning efforts. GEAG has led and coordinated the process in Gorakhpur, and despite inconsistent participation and support from the local government, coordination on resilience planning is likely to continue thanks to the presence of GEAG as a long-term local NGO. This will be more difficult to assure in Indore, where local coordination mechanisms have been weak. Thai cities have also developed multi-stakeholder coordination mechanisms, but these are ad hoc and are still working to understand and analyze climate adaptation issues.

Diverse groups demonstrate awareness and initiative on interventions for vulnerable communities

Gorakhpur has clearly met the expectation of raising broader awareness among diverse audiences and generating initiatives that benefit vulnerable groups; vulnerability assessment, broad community engagement, and resilience initiatives in Gorakhpur focus directly on the issues of poverty and vulnerability. Both Bandar Lampung and Semarang involved NGOs actively in the planning process to represent the interests of vulnerable groups. Most other cities have addressed these issues as well to varying degrees in the vulnerability assessment process. The process ensured that strategy results (e.g., in Surat and Indore, or the HCVAs in Vietnam, or social vulnerability studies in Indonesia), were brought to the attention of the relevant working groups. In all countries, vulnerable groups have been engaged directly through pilot projects, which provided direct input for analysis or priority local actions in the resilience strategies.

Local governments and other groups are able to use new information to develop resilience plans

In all cities, local organizations (city governments and other partners) have used new climate information and new information about urban development and urban problems to help identify vulnerabilities and develop resilience plans. Most of the cities explicitly prioritize the value of new information in helping them to assess risks and to select effective resilience interventions. For this reason, most cities also set a high priority on specific studies that will generate strategic new information to support adaptation decision making.

Local governments establish new relationships with other actors to generate, share, and apply new knowledge

In Vietnam, the climate and impact studies introduced new sources of expertise to local government planners, and engagement in planning has led to the development of a variety of new relationships at the local government level. The same is true in Indonesia and Thailand, where local academics and NGOs have been engaged in new relationships with local government planners. In India, however, while there is little evidence of new relationships with local government emerging from the process so far, existing relationships with private sector or civil society groups have in most cases been strengthened through the iterative consultations in the process.

The above capacity development outcomes show that the ACCCRN process has augmented local capacities for climate resilience planning over a relatively short period of time. Local governments and other partners have demonstrated their ability to use new sources of information, establish coordination mechanisms for planning, focus on the issues of differential vulnerability, and establish new relationships to support these efforts. All these capacities will be important for sustaining resilience planning efforts.

URBAN CLIMATE RESILIENCE RESULTS

To conclude this chapter, we return to the Urban Climate Resilience Planning Framework. In each city, the resilience planning process has included several iterative rounds of diagnosis, integrating climate information with analysis of the vulnerability of urban systems and agents. This represents the left loop of the UCRPF (see Figure 7.1). The process of urban resilience planning has emphasized shared learning (the central axis of the diagram) by engaging a broad range of local stakeholders and decision makers in most of the cities. The results of the process have included strategic plans for each of the cities — the focus of comparative analysis in this chapter — but they have also included the less tangible outcomes discussed above, like capacity development and stakeholder learning in each of the cities. All of these outcomes provide the foundation for implementation of resilience actions in the next phase of the ACCCRN program (i.e., the right loop of the UCRPF diagram).

The ACCCRN process has augmented local capacities for climate resilience planning over a short period of time. Local governments and other partners have demonstrated their ability to use new sources of information, establish coordination mechanisms for planning, focus on the issues of differential vulnerability, and establish new relationships to support these efforts.

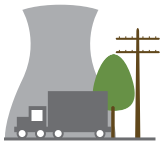
All of the ACCCRN cities proposed a broad set of potential actions in response to the climate vulnerabilities identified. These actions included measures to address fragility in infrastructure and ecosystems, as well as inadequate institutions and gaps in knowledge. They included awareness raising and capacity development aimed at individuals, households, private organizations, and government bodies throughout the city in order to build their capabilities to anticipate and respond to climate threats and opportunities. Figure 7.2 illustrates how proposed interventions in each city would address elements of urban climate resilience by strengthening urban systems, building the capacity of agents to take effective actions, and enhancing the function of key institutions.

Even in this initial iteration of the planning process, the cities were able to consider both short-term and long-term interventions. For example, despite the formal reluctance of Vietnamese cities to extend planning beyond the officially sanctioned ten-year horizon, they were able to consider long-term issues such as sea level rise and flooding or salinization, as well as interventions such as mangrove restoration and wetland rehabilitation that require long time horizons. Similarly, the Indonesian cities specifically included interventions in their strategies that could be implemented over the short, medium, and long term. Other cities had similar provisions. This attention to various timeframes in both issue identification and proposed interventions is noteworthy because it shows that cities are understanding some of the novel features of climate adaptation, even if their current planning mechanisms do not easily incorporate this mix of planning horizons.

The planning process introduced in ACCCRN cities also builds resilience by helping to institutionalize mechanisms for iterative shared learning, such as the SLDs and the proposed new agencies for climate change planning, coordination, and capacity building. The new platforms for multi-stakeholder engagement, learning, and consultation introduced through the resilience planning process have delivered useful local results even where technical understanding of climate adaptation issues remains weak (as in Thailand). Implementation of resilience interventions, together with monitoring of results and re-assessment of vulnerabilities, can now be built on this familiar platform to continue the resilience planning process.

FIGURE 7.2 | Resilience Interventions and the UCRPF

High priority interventions listed in ACCCRN city resilience strategies, categorized according to the Urban Climate Resilience Planning Framework.



SYSTEM FRAGILITY

Actions related to:

- Coastal and riverbank dikes
- Storm- and flood-resistant housing
- Water demand management
- Drainage system improvement
- Hydrological and hydraulic studies
- Watershed reforestation and slope stabilization
- Mangrove and wetland restoration
- Riverbank stabilization
- Rainwater harvesting
- Flood shelters
- Flood monitoring and early warning system
- Resettlement
- Evacuation planning
- Groundwater recharge

AGENT CAPACITIES

- Build awareness
- Engage community in resilience planning
- Incorporate CC into school curriculum
- Build citizen engagement and reporting
- Train in CBDRM and disaster response
- Improve public health surveillance
- Promote alternative livelihoods
- Improve agriculture extension services

INSTITUTIONS
(Entitlements, Decision Making, Information)

- Study water management and allocation system
- Limit development rights in floodplain areas and vulnerable zones
- Improve disaster response and evacuation services
- Increase community involvement in flood management and risk reduction
- Create new coordination and technical support agency
- Integrate climate into socioeconomic development planning
- Improve public information on climate, flood markers, adaptation options
- Improve climate forecasting and warning systems
- Develop water use auditing and reporting system
- Engage community in resilience planning

CONCLUSIONS

The pioneering work of ACCCRN cities may provide guidance for other cities or for development organizations undertaking urban climate work. In the early stages of the process, city partners perceived climate primarily as a technical issue, but as the process evolved, they developed a more holistic, resilience-based approach. The types of actions included in the strategies, addressing a wide range of developmental and institutional challenges, reflect this shift in thinking on the part of city partners.

The various approaches to managing climate and development uncertainties demonstrate an appreciation of the central challenges of urban climate resilience. The cities have already begun down an iterative path of generating and interpreting new knowledge, producing shared learning, taking carefully defined action, monitoring outcomes, and integrating lessons in further rounds of shared learning and action. This is close to the path envisioned in the UCRPF.

The results of resilience planning reflect the fact that these were novel and unusual procedures for every country. Approaches varied considerably, and responded to differences in local leadership, organization, professional, and political strengths. The organizations that worked on the plans had few precedents in their own experience, and indeed almost no useful examples of similar work undertaken elsewhere. The local partners were simultaneously trying to understand the basic concepts and tools as they applied them in a very brief project timeframe. The inevitable technical flaws and weaknesses in the products — the resilience strategies — can be remedied in future iterations of the process.

In conclusion, the strategies illustrate how the UCRPF can be applied to guide local adaptation planning. The ACCCRN city-level partners systematically considered the nature of current and future climate hazards, the capacities of vulnerable groups and of local government agencies, civil society, and technical support organizations in developing their plans. They reviewed the ability of urban infrastructure, key institutions, and surrounding ecosystems to absorb stresses and shocks, and they identified key knowledge gaps that require further study. Each city implemented a multi-stakeholder SLD process to share knowledge about climate and local conditions and to validate inputs to the planning process. Strategies suggested a broad range of potential actions but prioritized those that could be most clearly justified in the face of high uncertainty and limited experience.

Resilience strategies are a useful tool and are replicable by other cities. However, we emphasize that the process of resilience planning contributes more to urban climate resilience outcomes than the resilience strategy

document itself. To summarize the most important results described above, local engagement in the development of these plans gave a much greater understanding of climate change issues and resilience processes among local and national partners, so that future iterations of resilience planning in each city under local leadership are not only possible, but likely. The resilience planning process will be most successful if the strategy is updated, as implied in the iterative UCRPF, such that planners continue to gain new knowledge about city vulnerabilities and potential interventions from both local and global sources; engage and build awareness among the public, sector leaders, and decision makers; and evaluate and reevaluate priority areas for taking action.

CHAPTER 8

SUMMARY AND CONCLUSIONS

Stephen Tyler and Marcus Moench

SUMMARIZING LESSONS FROM ACCCRN PHASE 2

The notion of urban climate resilience was an abstract one at the outset of Phase 2 of ACCCRN in 2009, and the tools needed to define and achieve it were in nascent form. Since then, the activities of the program have generated a wide range of experience with these emerging concepts, as documented in this volume, and have helped to refine the tools through practice. Climate resilience strategies created by local partners over this short period are now being used in Phase 3 to select and guide a broad spectrum of actual implementation activities. In total, across all ten ACCCRN cities this work represents a significant and unique contribution — mostly achieved by the cities themselves and their supporting national partners — to the rapidly evolving body of practical experience in responding to climate change. The ACCCRN program takes place at an important time: globally most attention to climate change has focused on mitigation — that is, the reduction of greenhouse gas emissions. Adaptation, though increasingly recognized as essential, has received far less attention. In this context of limited adaptation analysis and practice, the second phase of ACCCRN serves as an early example of what can be achieved with relatively modest levels of investment across a diverse array of cities and governance contexts.

ACCCRN's urban focus also makes the resilience planning experience reported in this volume particularly significant. Work on climate vulnerability and adaptation has focused on rural areas because they are perceived to have lower adaptive capacity and because climate change is likely to have immediate impacts on ecosystems that directly affect agriculture and water resources. In an increasingly urban and interconnected world, however, vulnerability can be a function of a set of complex and geographically distributed systems that are not easily comprehended or managed. And even direct ecosystem-related impacts on rural areas are likely to increase urban vulnerabilities due to migration. While poverty and social marginalization are good indicators of vulnerability, they do not capture the wider sources of risk or the wider opportunities for response present in urban areas. As outlined in the Urban Climate Resilience Planning Framework (UCRPF) in chapter 2, these risks are high when fragile systems — and the people who depend on them — are exposed to the impacts of climate change and when institutional factors, social marginalization, or lack of capacity constrain responses to these risks. By looking at broader sources of risk and opportunities for building resilience from the perspective of the evolving framework for urban resilience planning, ACCCRN offers meaningful innovations in both conceptual synthesis and informed practice at local to global levels.

Conceptually, the UCRPF that has evolved on the basis of experience in the ACCCRN program (see chapter 2) provides a robust basis for both understanding vulnerability and identifying practical points of entry for building resilience. The framework, which was developed in parallel with other activities, provides a road map for analysis of issues related to system fragility, social marginalization and capacity, institutions, and, for each, their exposure to climate change. By first analyzing each issue separately and then integrating them, the framework provides a systematic basis for analyzing specific sources of vulnerability. It also assists in disentangling complex interrelationships and enables incorporation of insights and courses of action emerging from different sectors. In this way, the UCRPF allows strategic approaches that are more comprehensive and integrated than any individual intervention could ever be on its own.

In practice, faced with high uncertainty about climate projections, limited familiarity with climate change impacts, and fragmented jurisdictions and responsibilities for planning, ACCCRN cities and their technical partners prepared vulnerability assessments that integrated key factors from the framework as it was being developed. In the process, they created a common local platform for building shared understanding about the issues of climate vulnerability across multiple agencies and actors, through studies, SLDs, and planning discussions. This iterative and interactive process of shared learning enabled partners to jointly identify how key systems, agent capacities, and institutions could be strengthened to build resilience. As the quality of scientific information on the impacts of climate change improves and partners gain experience, future iterations of vulnerability assessment can build on the UCRPF platform to refine the vulnerability assessments, deepen their technical and analytical sophistication, and potentially identify new sources of vulnerability. The UCRPF is, in fact, designed to be used iteratively to support an evolving understanding of vulnerability over time.

ISET has summarized the lessons shared by other ACCCRN partners in this publication. Many of these lessons are of fundamental importance to cities around the world, in both developed and developing countries, as they consider how best to respond to the challenges of climate change.

Climate projections should be more accessible to users

For most of the ACCCRN countries, regional climate projections proved to be difficult to obtain. In India and Thailand, data used by some partners turned out to be either incorrect or fragmentary. And in Indonesia and Vietnam, both countries with strong climate science communities, the range of climate projections available was extremely limited, so users were unable to discern the scope of uncertainty involved in estimates of future conditions. Global scientific knowledge is rapidly evolving, and restricted access to the latest information represents a severe limitation to developing appropriate responses to climate change. Overall, considering the growing level of interest in climate adaptation at the policy level and among local planners, ACCCRN partners had much more difficulty and spent more time gaining a coherent picture of local climate futures and their uncertainties than they should have (see chapter 3). This is a significant barrier to replication of ACCCRN experience and a cautionary tale for both producers and users of climate science information.

Communicating climate information is not straightforward

But even when climate data is made more accessible, communicating its implications is a major challenge. There is little consensus among climate scientists and those engaged in adaptation work on the exact role of climate information in planning for adaptation, including on what types of information are needed and how they should be presented and used in the planning process. Confusion about the role of climate information makes it difficult for climate scientists to communicate the information they have available to potential users, and it means that planners are not sure what information they need. Even when planners can clearly specify their climate information needs, the challenges of communicating climate data and its uncertainties are frequently underestimated (see chapter 3). Climate scientists and lay people often understand terminology differently, even in English, so in ACCCRN, trying to explain climate terms in Thailand or Indonesia, where the languages do not easily allow the same distinctions in meaning, was confusing and time consuming.

While some climate uncertainties may change with improved data and better modeling, others are irresolvable. Because climate uncertainties are new and unfamiliar, it is not easy to communicate them to decision makers in a meaningful way, even when these same people deal with uncertainty in other decisions on a regular basis. This difficulty meant that in Chiang Rai, for example, each shared learning dialogue was held twice: the first time for the climate working group alone to understand the issues and then again for a larger multi-stakeholder group (see chapter 6). Communicating climate information requires considerable time for clarification and translation of concepts, and skilled facilitators and translators to provide leadership.

The format of climate data typically does not match planners' needs

The types of data that climate scientists use to describe climate change (typically small changes in monthly means) often do not convey much useful information to local decision makers, engineers, or other actors. In Quy Nhon, for example, where there is a large local aquaculture industry, the number of consecutive days with temperatures consistently above 36° C has more significance than monthly means, because of the impact on shrimp mortality. Similarly, mean sea level rise was of less concern in Da Nang than the combined effects of sea level and storm surge from stronger typhoons. And monthly precipitation projections are less valuable for planning flood protection measures in Hat Yai than are maximum 24-hour precipitation amounts. The function of climate extension services or technical communications support designed to bridge the gap between available data and planning needs will grow in importance as resilience planning becomes more widespread.

Cities can take action in spite of uncertainty

The ACCCRN experience with resilience strategies shows that in spite of the challenges of understanding climate vulnerability, local partners can integrate a wide range of information to develop prioritized resilience interventions. The Urban Climate Resilience Planning Framework can help cities identify points of entry for reducing vulnerability to climate change, by directing attention to marginality and capacity of agents, or to system fragility, rather than focusing on specific, but highly uncertain, climate impacts. Even in developing countries with very limited climate information and high uncertainties about future development conditions or climate impacts, it is still practical to start planning and action towards adaptation.

Many ways to take action despite uncertainty are included in the city resilience strategies (see chapter 7). Some of the initial resilience strategies included "no-regrets" measures such as efforts to augment water supply (rainwater harvesting in Semarang; water management in Indore), or to improve neighborhood drainage (Gorakhpur). Often, cities proposed technical studies as initial actions to gather more information and reduce uncertainties in decision making (such as hydrological studies in Quy Nhon and Da Nang).

In ACCCRN cities where future climate or urban development conditions are particularly uncertain, it was also practical to focus on current vulnerabilities, starting with climate challenges that local people are already facing regularly (e.g., in Da Nang, Can Tho, Gorakhpur, Indore, Surat, Semarang). Where uncertainty might have kept planners from being able to identify useful actions, using scenarios to think about future options in the context of strategic choice sometimes helped local leaders recognize a climate risk they had not considered before: in Chiang Rai, scenario development revealed the potential economic impacts of climate change, and in Surat, it revealed that the negative impacts of climate could constrain socioeconomic development (see chapters 5 and 6).

In addition to the more immediate practical benefits to taking action even under conditions of uncertainty is the fact that action is an important way to foster learning and build early returns. Pilot activities in ACCCRN encouraged partners to struggle with practical concepts and concrete issues even while they were still poorly defined (see chapter 5). Tangible measures to address immediate problems while supporting long term climate resilience provided a sense of legitimacy to climate resilience planning. And results, even at a small scale, were often immediately beneficial to communities. In Da Nang, a locally designed and built boat winch helps to quickly haul small fishing boats out of the sea and high onto the beach as storms approach. Quy Nhon was able to pilot an innovative and participatory approach to mangrove restoration that may be scaled up to rebuild natural climate buffers along a low-lying coastline. In Gorakhpur, solid waste management efforts have demonstrated the link between improved waste management and maintenance of drainage channels. And in Surat, a flood-proof housing design competition resulted in innovative designs that have generated widespread interest and are likely to be adopted by local housing authorities. None of these efforts was particularly costly, and none required elaborate technical analysis. But they have provided important and broadly recognized lessons about climate risks, demonstrated tangible measures to reduce climate vulnerabilities, and helped build early local engagement and commitment to the program.

The process is important

Climate impacts and future urban conditions are highly uncertain and difficult to predict. Building resilience involves developing the capacity to diagnose and strategically address the weaknesses across a network of linked systems, actors, and institutions. Any resilience strategy is inevitably an ephemeral document, one that needs to be updated to account for new information and to engage new stakeholders. Therefore, the process of engaging diverse public and private sector partners, of building a shared understanding of climate risk and urban vulnerability, of developing joint and separate intervention priorities, and of building a shared platform for ongoing learning from experience is all more valuable to the resilience building effort than any strategy itself.

A crucial component of the planning process in ACCCRN has been the use of shared learning dialogues to integrate new scientific knowledge with local experience and to foster public deliberation on key issues (see chapter 4). Local partners in ACCCRN report consistently that the SLD process for resilience planning has been innovative and valuable in addressing complex local issues. Stakeholders in Quy Nhon, Da Nang, Semarang, Bandar Lampung, Hat Yai and Gorakhpur have recognized the creation of a platform for interaction that focuses on clarifying knowledge and on building shared understanding among diverse participants, from different levels and organizations as a key accomplishment. In Surat and Indore, the work of the climate advisory committees has contributed to building a new and broadly shared vision for economic development of the city. The iterative engagement of multiple stakeholders to build shared learning has helped promote transparency, build new partnerships, and move the planning process forward.

Challenges of engaging vulnerable groups

But while the SLDs have been effective for engaging diverse groups who would not otherwise interact (such as NGOs and local government in Bandar Lampung; or ward level leaders and national technical experts in Da Nang), it has proved challenging everywhere to engage vulnerable groups in a meaningful and systematic way in the deliberations (see chapter 4). Partners were usually sensitive to the need for separate focus group discussions with marginalized groups, or for special attention to their inputs in vulnerability assessment or pilot projects, such as with the HCVA focus groups in Vietnamese cities. In many contexts, practical barriers linked to power differences limit the direct participation of marginalized social groups in multi-stakeholder deliberation, so parallel and supportive processes also need to be applied.

Climate resilience planning must be local and contextual

Throughout the second phase of ACCCRN, as this volume documents, local partners modified a broad conceptual and procedural framework in response to their own contextual requirements. Partners altered timelines and products as technical materials required more time for translation and explanation, cultivated new partnerships with local governments, forged links to ongoing local planning processes, and adapted focal themes to recognize diverse geographical and socioeconomic conditions. The ACCCRN resilience planning process followed loose guidelines, but was not straitjacketed into standardized checklists or templates. A variety of approaches, sometimes in the same city, enabled the process to reach a broader audience and to remain relevant under very different political and socioeconomic conditions (see chapters 5 and 6). In Indian cities, different groups led slightly different shared learning dialogues, while in the other countries the SLDs were mostly large multi-stakeholder workshops. Indore and Surat conducted a wide range of sector studies that shed light on many aspects of urban infrastructure vulnerability, while Can Tho chose to focus its efforts on the resettlement needs of a single remote community.

This diversity in the specifics of the ACCCRN process in each city is an asset of the program. It demonstrates the extent of local engagement and ownership, which greatly strengthens learning and capacity building among multiple local stakeholders, as well as the sustainability of resilience planning efforts after the end of ACCCRN. As a report by NISTPASS in Vietnam commented: "…mobilizing multiple stakeholders, enabling a shared learning environment, engaging them to work with experts in project activities, and giving them the leadership role may be the most effective way to build their capacity" (NISTPASS 2011, p.31).

At the same time, while the local and contextual nature of resilience planning imparts many benefits to the process outcomes, in cities with strong participatory planning approaches, such as Gorakhpur, the ACCCRN resilience planning experience demonstrated the need to engage more specifically with senior government authorities who are able to take direct action to strengthen weaknesses in local systems or institutions.

Climate resilience requires a strategic approach

There are no silver bullets in building climate resilience. Many individual activities and projects, large and small, are needed to contribute in an ongoing process that strengthens systems, builds capacities of actors, and supports enabling institutions. This requires the engagement of multiple types of stakeholders with diverse interests in a common strategic approach. But without a conceptual framework that provides broad direction and overall intent, the practice of climate adaptation remains ad hoc. The Urban Climate Resilience Planning Framework provides that conceptual framework, and informs and directs the process of resilience planning as well as showing how the different substantive elements of climate resilience are inter-related.

ACCCRN cities have demonstrated their recognition and adoption of the UCRPF through the content of their resilience strategies. They have prioritized both technical systems solutions (drainage in Semarang or Gorakhpur, flood warning in Surat, mangrove ecosystem buffers in Quy Nhon) as well as capacity building (training programs for local government officials in Can Tho or awareness raising for vulnerable community groups in Bandar Lampung). In Vietnam, cities took advantage of a favorable policy environment to introduce new Climate Change Coordination Offices to manage a growing number of climate interventions and planning requirements. And in Gorakhpur, ward-level planning processes were introduced to better enable community-based responses to climate vulnerability. City-level partners proposed resilience interventions across the spectrum of fragile systems, low capacity agents, and weak institutions in strategies that addressed both short-term and long-term climate resilience issues (see chapter 7).

Resilience planning needs effective local leadership

While the concepts, methods, and tools for urban climate resilience planning initially came from external resource persons, the role of local leadership was essential to the success of the ACCCRN enterprise. Senior local government officials played a key role in lending personal support to climate resilience planning in Can Tho, Da Nang, Chiang Rai, Semarang, and Surat. This was often essential to obtaining the collaboration and engagement of multiple government agencies. In the case of Gorakhpur, the role of GEAG as a respected and well-connected non-governmental organization proved essential in establishing multi-sectoral links in the absence of effective local government leadership. These "champions" of the climate resilience planning process provided political support and direction for multi-sectoral engagement.

In all cases, a core multi-agency working group or advisory committee, which often included civil society or academic members, guided the local planning process. This committee proved essential to maintain continuity in cases in which senior government officials changed (e.g., Semarang and Indore). In some cities (e.g., Surat), the private sector played a prominent role in the working group. The working group was the foundation for shared learning; its key role was coordination: it served as a repository of knowledge and of data, ensured connection of multiple planning activities that were often taking place at the same time, arranged for data collection and sharing, reached out to engage key local agencies, and built new partnerships for analysis and planning (see chapter 6). In Semarang, the working group members collaborated closely with the Development Planning Board in order to contribute directly to the city's midterm development plans. Ideally, the members of the working group served as representatives of other organizations, taking back to their home organizations lessons on climate vulnerability, impacts, and resilience. In this sense, the best organizations to include in the working group were those who had an identifiable mandate that was likely to be directly affected by climate change. However, the key skills needed to move resilience planning forward at the local level turned out not to be technical skills, but rather coordination skills: the ability to engage, support, and collaborate in an open manner with diverse professional, technical, and civil society groups.

But even when member organizations identified their own strategic interest in climate impacts and adaptation, the demands of other work and the challenges of engaging in collaboration on climate resilience planning often constrained the amount of time their staff could put into ACCCRN activities. It became clear during the course of Phase 2 that local leadership and coordination benefited both from consistent participation by the core group and from the assignment of a significant amount of staff time by various organizations. The consistent engagement of dedicated local staff imposed resource demands on local organizations that they were not always prepared for (see chapter 6). In India and Thailand, national partner organizations bore much of the planning effort, but in Vietnam and Indonesia, local government, NGOs, and academics contributed substantial time.

Novelty and learning take time

When ACCCRN began, there were no practical templates for building local climate resilience in cities. The program allowed a very short timeline to engage with new partners, explain concepts, and build local capacity and ownership of precedent-setting resilience strategies. In response, partners worked to flesh out details from experience and to assemble a coherent conceptual framework along the way. This approach was messy and initially confusing for many local partners, who expected to be presented with a set of proven concepts and methods produced by "experts." But the core framework that evolved in practice ultimately led to stronger engagement and more robust learning on the part of local partners, who were obliged to grapple with and refine concepts in order to implement them sensibly in their own context.

This process provides critical lessons, so shortcutting it in order to meet project timelines is difficult and often unproductive. Local partners are challenged by limited resources and by shifting priorities. Trainings, resource materials, and guidelines need to be translated into local languages. In order to share results for feedback or cross-fertilization across the network, products must be translated into English. Trying to sort out the meanings of unfamiliar concepts for which there were no local language equivalents, and then to put these concepts into practice, inevitably involved trial and error. Iterative processes were essential to build greater understanding from experience. Efforts to speed up these processes often led to miscommunication, misunderstanding, and frustration. Semarang and Bandar Lampung were forced to revisit their vulnerability assessments when expert analysis did not match local experience. In most cases, compressing the process meant that the coherent and logical sequence of planning steps was lost, which limited the learning from sequential planning steps. Many city-level partners complained that it was only after they finished most of the work that they finally got a clear picture of what they were supposed to be doing. While some of this is inevitable in introducing novel planning processes, planners should be aware of the lessons the process can provide, anticipate the time demands, and manage expectations accordingly.

While the introduction of climate resilience planning has been fraught with conceptual difficulties, data challenges, communication frustrations, and deadline pressures across a wide range of heterogeneous city-level conditions, local ACCCRN partners have managed to demonstrate the viability of the conceptual framework and the effectiveness of the key tools and methods through their dedicated efforts. The planning processes, coordination structures, and resilience priorities varied across the partner cities because of their very diversity. This variability was a strength of the ACCCRN planning process, which was not driven by external templates or checklists, but instead built organically from local partnerships and contextual priorities.

The lessons summarized above point the way to further application of a conceptual framework that seems to be readily grasped by local partners, and to the refinement and replication of key tools for shared learning, vulnerability assessment, and intervention analysis based on this experience. These mechanisms will continue to emphasize the strengths of the ACCCRN toolkit: improving access to and understanding of climate data; assessing vulnerability broadly from the perspective of systems, agents, and institutions; identifying practical courses of local action through shared learning from diverse sources of knowledge and experience; ensuring that planning is locally led and tied both to the experience of those groups most vulnerable to climate impacts as well as to other ongoing local planning processes.

THE WAY AHEAD — OPPORTUNITIES FOR CONTINUED LEARNING FROM IMPLEMENTATION OF RESILIENCE INTERVENTIONS

The experiences documented above demonstrate the major advances that the ACCCRN program has achieved with respect to climate resilience planning. ACCCRN is now entering Phase 3, the implementation phase, which will generate additional insights and practical experience in resilience-building activities. It is important to recognize, however, that the experiences generated by the ACCCRN program are at best initial steps. Resilience is a characteristic of systems, agents, and institutions that are alive and evolve dynamically over time. As a result, it can't be "achieved" through a time-bound program. It must be internalized as a core objective that governments and other agents strive for as an integral part of on-going activities. Furthermore, even in the short-term, experiences from the ACCCRN program raise basic questions that are essential to address in order to advance understanding of urban adaptation and resilience to climate change.

Looking forward, we can identify several key issues where better understanding would improve both strategy and practice of climate resilience. These are sequentially ordered below with immediate issues central to building climate resilience practice presented first, followed by more fundamental issues related to basic concepts of adaptation and resilience.

Documenting resilience initiatives in urban areas

ACCCRN and other urban adaptation and resilience planning initiatives are generating a wealth of practical experience. Such initiatives, however, stand little chance of building common understanding and practice unless they are well documented and the results they generate are analyzed and disseminated across a range of policy, practitioner, and scientific audiences. Current frameworks for documentation, coordination, and learning are fragile and often under resourced.

Accounting for investment in climate resilience

Given the tremendous financial pressures currently facing national and local governments, international organizations, and other actors, sustained investment in climate resilience is unlikely unless the benefits and costs can be clearly demonstrated. Substantial work on the costs and benefits of investments is an immediate need.

Addressing the needs of the poor and other socially or economically marginalized communities

International investment in climate resilience is primarily justified where it addresses the impacts of climate change on the poor and other socially marginalized communities — groups that are among the most affected by climate change and that have contributed least to its cause. The ACCCRN program demonstrated both successes and the challenges of involving such communities in the development of strategies for building climate resilience. More effort and innovation are needed to strengthen the voice and participation of marginalized people in building climate resilience.

Focusing resilience and adaptation on key thematic and sector-specific arenas

In ACCCRN and other programs focused on climate resilience in urban areas, common issues related to water, disaster risk management, health, food security, and other targeted issue areas frequently emerge. Responses that focus narrowly on such issues are of tremendous importance to both developing practical strategies for building resilience and to engaging the communities of actors that work within sectors and depend on the services they provide. As a result, while integrated approaches to urban climate resilience are essential at a planning and policy level, activities that focus on specific sectors and work with sector specific organizations are equally important.

Understanding and analyzing vulnerability

The Urban Climate Resilience Planning Framework is a unique foundation that could be used to refine and move forward understanding of vulnerability in ways that are different from the dominant "social vulnerability" dialogue. Implementing and testing the framework in diverse contexts could substantially advance both understanding and practice.

Reshaping disciplines — climate data and its application

Many disciplines, such as engineering, have developed based on the assumption that historical climate records are an accurate sampling that can, in a statistical sense, be used to predict future probabilities as climate varies around a stationary mean. With climate change, the core assumption of stationarity in climate is no longer valid (if it ever was). Furthermore, while some uncertainties in climate models may decline as the underlying science improves, many are fundamental to the nature of climate systems (see details in chapter 3). This has major practical implications. Engineers can no longer use historical probabilities regarding basic parameters, such as wind-speed and precipitation rates, for structural designs and assume they will be safe under future climate conditions. Instead, disciplines may need to shift and develop design principles that do not depend on those types of data. The challenge may be to design structures that are effective despite uncertainty in future conditions rather than to attempt to project those future conditions and use that as a basis for standard design approaches. Overall, substantial research and experimentation is required to understand the implications of climate change for key disciplines and to reshape the practice of those disciplines in ways that better address fundamental climate uncertainties.

Understanding the links between the resilience of systems and the adaptive capacity of societies

Most of the attention in ACCCRN and other initiatives to build urban resilience to climate change focuses on planned strategies. Much, if not most, of the social responses to climate change will, however, involve autonomous behavior by individuals, households, communities, businesses, and other agents as they respond to the opportunities and constraints they face in daily life. Understanding the links between planned interventions and autonomous behavior is, as a result, essential to drive forward global understanding of risks and points of entry at different levels for building adaptive capacity and resilience.

Facing the potential of 4°C

Can emerging strategies for building resilience address the impacts that new projections of climate change indicate are likely? Recent scientific information suggests the world is now destined for an

> increase of over 4°C. Major questions exist, however, regarding whether or not current courses of action or those that are likely to result from on-going work will be sufficient to respond this degree of change. Evaluating whether or not these strategies are likely to be sufficient is essential to determining if more transformative action is necessary.

These points highlight the importance of knowledge in key areas. Why knowledge? Responses to climate change will be inevitable, regardless of the efforts of any single program. But it will be much more cost-effective and benefit many more people if those responses occur in a manner that is well informed and that avoids reinventing the wheel. Adaptation to climate change *is going to happen*, either in a planned or spontaneous manner. Urban areas *are going to grow* and with them the networks of systems, agents, and institutions that shape resilience to climate change. Global concern over climate change and specific investments in resilience and adaptation *are going to occur*. In all of these cases *knowledge*, the essential foundation for understanding and improved practice, is the most fundamental issue. Communication and the building of practice are also important but unless documentation of resilience building initiatives occurs and research is undertaken in key areas, progress will be limited. ACCCRN demonstrates how new concepts of urban climate resilience can be put into practice and tested. The next challenge is to build from this experience, and others, a critical and robust knowledge base that can catalyze change at scale.

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Climate change and dynamic urbanization processes present new and unfamiliar planning challenges for cities globally. Nowhere is this more apparent than in the developing world, where the challenges of urbanization and climate are compounded by poverty and social marginalization. Since most attention to climate change has focused on reductions in greenhouse gas emissions, far less has addressed the equally essential question of adaptation. As a result, the body of analysis and practice regarding adaptation is limited. "Catalyzing Urban Climate Resilience: Applying Resilience Concepts to Planning Practice in the ACCCRN Program (2009-2011)" reports on the results of an innovative initiative supported by the Rockefeller Foundation—the Asian Cities Climate Change Resilience Network (ACCCRN) program—to assess and respond to the interaction between urbanization and climate change and the impacts on particularly vulnerable communities in ten medium-sized cities in India, Indonesia, Thailand, and Vietnam.

"Catalyzing Urban Climate Resilience" describes the experiences of ACCCRN cities with assessing climate vulnerability and applying emerging concepts of urban climate resilience. It presents an innovative resilience-planning framework that offers multiple entry points for local resilience-building interventions. The framework introduces an iterative shared learning process to engage diverse forms of knowledge and build joint understanding and commitment to adaptation actions among diverse stakeholders. The framework looks at broad sources of risk and opportunities for building resilience and helps to identify specifically who might do what to build climate resilience. It also helps to identify specific vulnerabilities and practical interventions for the urban poor and other socially marginalized communities.

While the framework is firmly grounded in emerging scientific knowledge, it is at the same time a practical base for planning and action at the local level and for building the knowledge and capacity necessary to respond effectively as climatic conditions evolve. The climate resilience strategies that cities have developed as part of the second phase of ACCCRN serve as early examples of what can be achieved with relatively modest levels of investment across a diverse array of urban conditions and governance contexts. The ACCCRN experience described in this publication offers meaningful innovations in both conceptual synthesis and informed practice at local to global levels. It provides the key tools for shared learning, vulnerability assessment, and intervention analysis for replication in other cities around the globe.