

ENHANCING URBAN CLIMATE CHANGE RESILIENCE SEVEN ENTRY POINTS FOR ACTION

Aditya Bahadur, Thomas Tanner, and Florence Pichon

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Enhancing Urban Climate Change Resilience: Seven Entry Points for Action

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and Florence Pichon

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ABBREVIATIONS

ACCCRN	Asian Cities Climate Change Resilience Network
ADB	Asian Development Bank
CSO	civil society organization
CRVA	climate risk and vulnerability assessment
PPP	public–private partnership
UCCR	urban climate change resilience
UCCRTF	Urban Climate Change Resilience Trust Fund

EXECUTIVE SUMMARY

Most of the world's population now lives in towns and cities that are disproportionately located along coasts and rivers, and therefore faces substantial risks posed by hydrometeorological shocks and stresses. Moreover, with rapid unplanned growth, urban areas in many cases retain high socioeconomic vulnerability, such as urban poverty, informal settlements, lack of municipal services, land tenure issues, etc., which are exacerbated by the exposure to climate-related shocks and stresses. This has given rise to a growing interest in the concept of urban climate change resilience (UCCR), which recognizes the complexity of rapid urbanization and uncertainties associated with climate change.

Many development agencies are working closely with their member countries and partners and have developed UCCR frameworks. These frameworks highlight that while technology and infrastructure are integral to enhancing UCCR, engaging with a wide range of issues (institutional, financial, spatial, and social) is equally essential. Meanwhile, development organizations and researchers are starting to look into practical areas of action to enhance UCCR. Looking across a vast body of literature on urban resilience and examples of practice reveals seven entry points for action that, in contextually specific combinations, can strengthen UCCR:

- (i) Generating, sharing, and regularly updating data, information, and knowledge on how urban growth interacts or will interact with potential impacts of climate change is a first step for enhancing a city's ability to strengthen UCCR. This includes data on climate change variables, information on exposure of people (specially vulnerable households), assets and livelihoods, and information on socioeconomic vulnerability, covering household income, gender, education, access to basic services, access to financial services, migration flows, and demographic trends. Much of these data can be collected and updated as part of regular urban development processes.
- (ii) Forward-looking urban planning tools, such as land use planning and development planning that allow adopting integrated, inclusive, and reflective approaches, provide a comprehensive and sustainable route to enhancing UCCR. Actions would include adopting climate risk-sensitive spatial growth policies for the city, limiting development in high-risk areas through the use of development control instruments, and reducing physical vulnerability of assets by strict enforcement of building control. Utilizing urban planning as an entry point for enhancing UCCR draws on existing planning processes, technical capacity, and resources.
- (iii) Development processes associated with urban infrastructure and services, including water and sanitation, energy, transport and telecommunications, ecosystems, built environment, and health and social services, can strengthen UCCR by instituting new processes to ensure their organizational systems support resilience and recognize the interconnections among sectors. Combining structural and nonstructural changes builds in robustness, redundancy, and flexibility to cope with shocks and stresses. With large investments in urban infrastructure and services expected over the next several decades in Asia, opportunities for enhancing UCCR remain plenty.
- (iv) Individuals and institutions within city governments often know the city intimately, and building their capacity is critical for bringing UCCR to life. Capacity building is needed to better understand the exposure and vulnerability of the population and assets to the potential impacts of climate change, as well as to strengthen skills in integrated planning,

prioritizing actions, implementation, operations and maintenance, and interdepartmental coordination, all with the ultimate objective of introducing behavioral change.

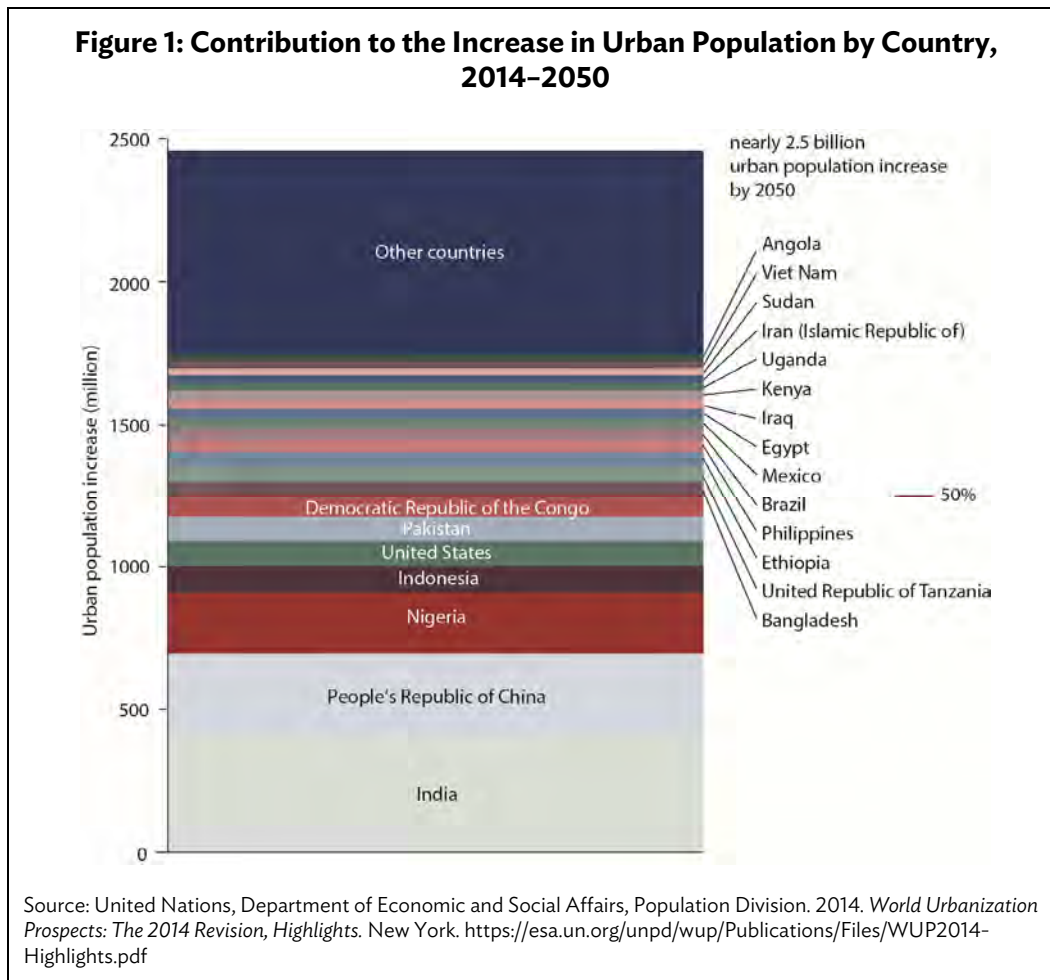
- (v) Community development processes that allow capturing diverse perspectives of communities, especially the perspectives of the most vulnerable, are essential for enhancing UCCR. Community-level resilience planning can enhance the capacity of marginalized urban communities to understand the drivers of risk and vulnerability and to determine local actions for strengthening resilience.
- (vi) There are huge needs for and potential gains from involving the private sector in enhancing UCCR. While governments can influence private investment decisions through planning, incentives, regulation, sharing, and partnerships, the private sector can implement actions to ensure business continuity and protect supply chains from climate-related shocks and stresses. Companies may also invest in resilience building to stabilize existing markets and develop new ones. They may also help develop multistakeholder partnerships to tackle resilience.
- (vii) Catalyzing finance is key to the success of UCCR and includes finances available from different scales of governance: microfinance and local development funds; taxes, levies, and fines at the city level; earmarked and non-earmarked funding from provincial and national governments; and multilateral, bilateral, and philanthropic funding. Catalytic action from a range of actors is essential for ensuring that this available finance is gainfully deployed to enhance resilience.

These seven entry points need to come together in contextually relevant combinations to strengthen UCCR instead of being treated as isolated sectors of activity. Certain cities may have made more progress on some entry points than on others, revealing the need for customized solutions based on local factors. Over time, and with experience, the entry points may be refined and new ones added.

However, some important challenges remain in maximizing the use of these entry points to enhance UCCR. These include challenges related to broader urban governance; understanding the political economy context, navigating the power structures, and dealing with drivers or barriers to change; and engaging with the complexities of treating cities as systems. Overcoming such challenges requires regular feedbacks between urban systems, the need for action at different scales of governance, and the critical bearing of areas outside the political boundaries of the city. This in turn can influence outcomes of UCCR initiatives.

I. INTRODUCTION

By 2050, the percentage of the world's population living in cities and towns will grow from 50% to 70%, with middle-income countries in Asia accounting for much of this growth. For example, India is expected to add over 400 million urban dwellers while the People's Republic of China will increase the global urban population by 290 million residents by 2050.¹ Megacities of 10 million inhabitants or more nearly tripled from 10 to 28 during 1990–2014, with 14 in the People's Republic of China and India alone (footnote 1). Despite this, close to half of the world's urban dwellers reside in centers with fewer than 500,000 inhabitants. Furthermore, small (500,000–1 million are inhabitants) and medium-sized (1 million–5 million) cities in Asia are growing the fastest (footnote 1).



Meanwhile, many of the cities and towns are located along coasts and rivers.² Historically, this was to facilitate trade, but in the context of climate change, this leads to heightened exposure of people and their assets and livelihoods to hydrometeorological shocks and stresses. Potential impacts of climate

¹ United Nations, Department of Economic and Social Affairs, Population Division. 2014. *World Urbanization Prospects: The 2014 Revision, Highlights*. New York. <https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Highlights.pdf>

² D. Dodman and D. Satterthwaite. 2008. Institutional Capacity, Climate Change Adaptation and the Urban Poor. *IDS Bulletin*. 39 (4). pp. 67–74.

change on cities and towns include rising sea levels, extreme weather events, and increase in mean temperatures of up to 4°C, which can lead to flooding, sewage overflows, and a rise in health problems.³ Urban areas also retain high socioeconomic vulnerability, such as urban poverty, informal settlements, lack of municipal services, land tenure issues, etc., which is exacerbated by the exposure to shocks and stresses. Globally, almost 1 billion people live in informal settlements, and this number is expected to grow by nearly 500 million from 2013 to 2020.⁴ Informal settlements have few livelihood opportunities, scant basic services, fractured law and order, and improper planning; these factors combined amplify the vulnerability of urban areas.

With the expected growth in urban population and the volume of investments that will flow into urban development in the coming decades, management of climate change risks will be a critical determinant of how urban areas will thrive. These factors have given rise to interest in the concept of urban climate change resilience (UCCR). This discourse on resilience, which emerged during 2001-2010, was primarily considered an approach to respond to specific shocks (primarily earthquakes; then, in the wake of 9/11, security-related shocks).⁵ The end of the decade 2001-2010 saw the launch of a number of climate change resilience-building initiatives, including the Climate Investment Funds' Pilot Program for Climate Resilience (which includes urban components), Strengthening Climate Resilience Initiative funded by the Department for International Development of the United Kingdom, and the Rockefeller Foundation's Asian Cities Climate Change Resilience Network (ACCCRN). More recently, other major initiatives such as the Rockefeller Foundation's 100 Resilient Cities and the Urban Climate Change Resilience Trust Fund (UCCRTF) of the Asian Development Bank (ADB) have also gone live. As such, the discourse is now paying greater attention to studying pathways for building resilience to climate change-induced shocks and stresses in urban areas.

This growing interest in resilience has led to the consolidation of a certain amount of knowledge on enhancing UCCR. This paper synthesizes existing knowledge on UCCR to identify entry points for action in order to help ADB's developing member countries, ADB project officers and partners, and the wider urban development community gain a general understanding on entry points for enhancing UCCR. It is expected that ADB's UCCRTF and other similar initiatives in the Asian region will benefit from the entry points discussed in this paper, and, over time, will refine the existing entry points and add new ones based on experiences.

II. KEY CONCEPTS

This section provides a brief overview of the theoretical and analytical concepts that frame the idea of UCCR. It first describes the terms that are commonly used to denote the ability to engage with climate change-induced shocks and stresses, and then introduces the key principles and qualities of UCCR.

A. What Is Urban Climate Change Resilience?

In the context of work on climate change, development, and natural hazards, resilience is generally understood to mean the ability of systems to “absorb disturbance and reorganize while undergoing

³ ICLEI-Local Governments for Sustainability. 2014. *Climate Change: Implications for Cities*.

⁴ World Bank and International Monetary Fund. 2013. *Global Monitoring Report 2013. Rural-Urban Dynamics and the Millennium Development Goals*. Washington, DC: World Bank.

⁵ L. Bull-Kamanga et al. 2003. From Everyday Hazards to Disasters: The Accumulation of Risk in Urban Areas. *Environment & Urbanization*. 15 (1). pp. 193-204; T. Swanstrom. 2008. Regional Resilience: A Critical Examination of the Ecological Framework. Working paper for the Urban Affairs Association Annual Meeting. Baltimore, Maryland. 25 April.

change so as to still retain essentially the same function, structure, identity, and feedbacks.”⁶ It is this definition that serves as the launch pad for inquiry into UCCR.

There are numerous definitions of urban resilience. Some argue that “a resilient city is one that can adapt to... changing conditions and withstand shocks while still providing essential services to its residents.”⁷ Others attempt to shift the rather conservative implications of this definition to argue for a vision of resilience that includes ideas of taking advantage of opportunities and bouncing back better.”⁸ For example, “Urban resilience is the capacity of cities to function, so that the people living and working in cities—particularly the poor and vulnerable—survive and thrive no matter what stresses or shocks they encounter.”⁹

These definitions of urban resilience further branch out into an understanding of UCCR, which adds specificity to the nature of shocks and stresses and includes those that have hydrometeorological origins. UCCR embraces climate change adaptation, climate change mitigation, and disaster risk management, while recognizing the complexity of rapidly growing urban areas and uncertainty associated with climate change.¹⁰

“This approach places greater emphasis on considering cities as dynamic systems capable of evolving and adapting to survive and even thrive in the face of volatile shocks and stresses” (footnote 9). Systems thinking helps in working across sectoral silos and engaging with multiple and evolving risks simultaneously.¹¹ This is important because climate change is increasing the frequency and intensity with which climate shocks and stresses occur, rendering historical records alone less effective in predicting the future. Crucially, the resilience of a city depends on the overall performance and capacity of its systems, not solely on its ability to manage disaster risk, reduce greenhouse gas emissions, or adapt to the impacts of climate change. In fact, UCCR describes a city that is resilient on three levels (footnote 8):

- (i) The city’s systems survive climate-related shocks and stresses.
- (ii) The people and organizations are able to accommodate climate-related shocks and stresses into their daily decisions.
- (iii) The city’s institutional structures continue to support the capacity of people and organizations to fulfill their aims.

⁶ C. Folke. 2006. Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses. *Global Environmental Change*. 16 (3). p. 259.

⁷ World Bank. 2014. *Can Tho, Vietnam: Enhancing Urban Resilience*. Washington, DC.

⁸ D. Satterthwaite et al. 2007. Building Climate Change Resilience in Urban Areas and among Urban Populations in Low- and Middle-income Nations. Background paper for the Rockefeller Foundation’s Global Urban Summit Innovations for an Urban World. Bellagio. July; J. da Silva, S. Kernaghan, and A. Luque. 2012. A Systems Approach to Meeting the Challenges of Urban Climate Change. *International Journal of Urban Sustainable Development*. 4 (2). pp. 125–145.

⁹ ADB. 2014. *Urban Climate Change Resilience: A Synopsis*. Manila.

¹⁰ J. da Silva, personal communication, 24 August 2015.

¹¹ B. Walker and D. Salt. 2006. *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington, DC: Island Press; L. H. Gunderson and C. S. Holling. 2001. *Panarchy: Understanding Transformations in Human and Natural Systems*. Washington, DC: Island Press.

B. Key Frameworks for Urban Climate Change Resilience

A number of frameworks set out the pillars of UCCR (Box 1). While these frameworks spring from different organizations operating in different contexts, there is a high degree of convergence on the fact that UCCR results from engaging with a wide range of issues. Each of the frameworks also highlights that, while technology and infrastructure are integral to enhancing UCCR, engagement with organizational, financial, spatial, social, and institutional issues is equally essential. This acknowledges that “cities are complex systems; and, like all systems, a city depends on the smooth functioning of its constituent elements and the larger organization in which it is nested. A city’s resilience is therefore affected by the resilience of those smaller and larger systems” (footnote 7).

Box 1: Key Frameworks for Urban Climate Change Resilience

A. City Resilience Framework, Arup

Arup’s City Resilience Framework, developed in partnership with the Rockefeller Foundation, presents a view of what a resilient city looks like and represents an outcome-oriented framework, with 12 outcomes across four different categories (health and well-being, economy and society, infrastructure and environment, and leadership and strategy) and seven additional qualities of resilience (integrated, inclusive, resourceful, flexible, redundant, robust, and reflective).^a The entry point of this framework is the study of cities, and, while the authors view resilience as a response to climate change and disasters, they feel the concept can be deployed against a wide range of shocks and stresses. Therefore, in this framework, “resilience” implies an enhancement to city systems’ capacity to function in the face of multiple hazards.

B. City Resilience Framework, Asian Cities Climate Change Resilience Network

The framework developed for the Asian Cities Climate Change Resilience Network, pioneered by the Rockefeller Foundation, hinges on viewing the city as a sum of interconnected parts that share dynamic relationships and argues that urban systems, vulnerable groups, and climate change combine to determine the resilience of a city.^b This means that anyone designing or deploying actions to build resilience should consider three key questions:

- (i) How does the city work?
- (ii) What are the direct and indirect impacts of climate change?
- (iii) Who is least able to respond to climate-related shocks and stresses?

A key feature of this approach is that this is specifically about engaging with the direct and indirect risks posed by climate change.

C. Urban Climate Change Resilience Framework, Institute for Social and Environmental Transition

The Institute for Social and Environmental Transition approach to conceptualizing urban climate change resilience highlights similar sets of issues by arguing that urban resilience results from the dynamic interaction of three elements:^c

- (i) Systems: infrastructure, ecosystems, water and food supply, energy, transport, shelter, and communications
- (ii) Agents: individuals, households, and private and public sector organizations
- (iii) Institutions: social rules or conventions that structure human behavior and exchanges in social and economic interactions, including rights and entitlements, decision-making processes (particularly in relation to urban development), and access to information and knowledge

As such, this approach argues “resilience is high where robust and flexible systems can be accessed by high-capacity agents and where that access is enabled by supportive institutions.” (footnote c)

Source: Authors.

^a Arup. 2014. *City Resilience Framework*. New York.

^b J. da Silva, S. Kernaghan, and A. Luque. 2012. A Systems Approach to Meeting the Challenges of Urban Climate Change. *International Journal of Urban Sustainable Development*. 4 (2). pp. 125–145.

^c S. Tyler and M. Moench. 2012. A Framework for Urban Climate Resilience. *Climate and Development*. 4 (4). pp. 311–326.

Complex systems thinking acknowledges the intrinsic interconnection between the different elements of a system while also understanding that change within is shaped by feedback processes that are nonlinear and unpredictable.¹² The implications of systems thinking for enhancing UCCR are complex and diverse, but an analysis of key conceptual frameworks reveals three main clusters of overlapping issues:

- (i) At its very base, systems thinking pushes those designing and deploying UCCR programs to break out of narrow sector compartments and analyzes the relationships, feedbacks, and interconnections between different sectors. Frameworks carry different prescriptions on how to achieve this, but almost all underline the importance of involving a wide variety of stakeholders, including the urban poor and marginalized, in decision making.
- (ii) UCCR practitioners need to understand that the city's resilience is contingent on higher scales of governance, such as at provincial or national levels. This implies that they need to understand these cross-scalar linkages and then work to leverage their potential for effecting change at the city level.
- (iii) This way of understanding the city also necessitates an acknowledgment of how its resilience is dependent on areas that may lie beyond its administrative boundaries. Cities rely on dynamic flows of vital goods and services from peri-urban areas and the hinterlands that must be factored in when developing a comprehensive approach to enhancing UCCR.

C. Guiding Principles of Urban Climate Change Resilience

Achieving resilient outcomes demand that a series of principles are integrated into any UCCR-related efforts. Based on experiences of cities, these principles include the following (footnote 9):

- **Combining hard and soft measures.** Capacities, networks, and behavior (of individuals, communities, and institutions) are as critical as physical systems during disruption. Soft measures include new regulations, technology and information systems, and social networks.
- **Engaging diverse perspectives through multistakeholder processes.** Given a city's varied socioeconomic groups and economic interests, engaging across different sectors (government, business, civil society, and academia) and different departments within the city government can bring forth transformative changes.
- **Enlisting different geographic and governance scales: beyond city boundaries.** Considering the interconnectedness of markets and economies, it is important to understand how systems (economic, physical, ecological, and political) within and beyond the city affect how it functions. There is also a need to understand how to best enlist stakeholders at different scales.

¹² B. Ramalingam et al. 2008. *Exploring the Science of Complexity: Ideas and Implications for Development and Humanitarian Efforts*. London: Overseas Development Institute.

- **Addressing today’s problems while embedding a long-term vision: The future is now.** The city’s decision makers often find it difficult to look beyond current challenges, particularly when change is unpredictable. Planning processes should begin by addressing the current needs (e.g., water supply or urban drainage). Building on existing issues and analyzing how climate change might affect or increase existing hazard risk is one way to bring future scenarios into current decision making.
- **Tapping into local expertise.** Engaging local technical experts (e.g., researchers and academics) enables dialogues to be held on a sustained basis. For example, external experts may be paired with local technical institutions to bridge the quality engagement trade-off and build long-term adaptive planning capacity.
- **Building leadership and local action.** Efforts to build resilience are most likely to be accelerated and sustained through strong leadership, driving commitment, and accountability with active community engagement to build awareness.
- **Focusing on vulnerable communities: Whose resilience?** The litmus test for a meaningful urban resilience approach is its relevance to the interests of poor or vulnerable households. While resilience measures must be provided at multiple levels, it is important to constantly ask “resilience for whom?” to establish their practical value and to ensure that equity concerns are kept at the heart of the agenda.

D. Qualities of Urban Climate Change Resilience

As resilience has come to inform development programming, attempts have been made to distill key qualities of resilience. The key insights from different experiences have been distilled into seven overarching resilience qualities within Arup’s City Resilience Framework.¹³ These qualities are being used to guide the World Bank’s urban resilience agenda and the Rockefeller Foundation’s 100 Resilient Cities initiative, and have been included in the synopsis of UCCR prepared as part of the ADB’s UCCRTF (footnote 9). These qualities include the following:

- **Reflective.** People and institutions systematically learn from experience, with an adaptive planning mind-set that accepts unpredictable outcomes. They have mechanisms that continuously modify standards based on emerging evidence, rather than seeking permanent solutions based on an assessment of today’s shocks and stresses.
- **Robust.** Robust systems include well-conceived, constructed, and managed physical assets so they can withstand the impacts of hazard events without significant damage or loss of function. Robust design anticipates potential failures in systems, making provision to ensure failure is predictable, safe, and not disproportionate to the cause. Overreliance on a single asset, cascading failure, and design thresholds that might lead to catastrophic collapse if exceeded are actively avoided.
- **Redundant.** Redundancy refers to spare capacity purposely created within systems so they can accommodate disruption, extreme pressures, or surges in demand. It includes diversity, i.e., the presence of multiple ways to achieve a given need or fulfill a particular

¹³ J. da Silva and B. Morera. 2014. *City Resilience Framework*. London: Arup.

function. Examples include distributed infrastructure networks and resource reserves. Redundancies should be intentional, cost-effective, and prioritized at a citywide scale, and should not be an externality of inefficient design.

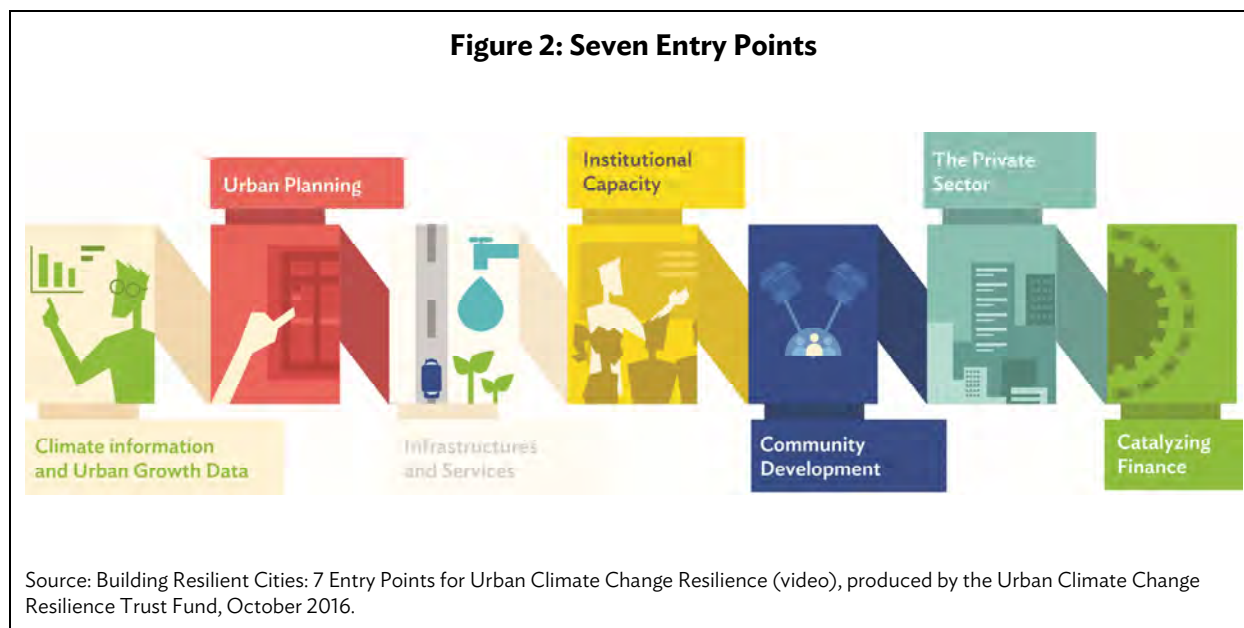
- **Flexible.** Flexibility implies systems can change, evolve, and adapt in response to changing circumstances. This may favor decentralized and modular approaches to infrastructure or ecosystem management. Flexibility can be achieved through the introduction of new knowledge and technologies, as needed. It also means considering and incorporating indigenous or traditional knowledge and practices in new ways.
- **Resourceful.** Resourcefulness implies people and institutions are able to rapidly find different ways to achieve their goals or meet their needs when climate change shocks or stresses arise. This may include investing in capacity to anticipate future conditions, set priorities, and respond, for example, by mobilizing and coordinating wider human, financial, and physical resources. Resourcefulness is instrumental to a city's ability to restore functionality of critical systems, potentially under severely constrained conditions.
- **Inclusive.** Inclusion emphasizes the need for broad consultation and engagement of communities, including the most vulnerable groups. Addressing the shocks or stresses faced by one sector, location, or community in isolation of others is contrary to the notion of resilience. An inclusive approach contributes to a sense of shared ownership or a joint vision to build city resilience.
- **Integrated.** Integration and alignment between city systems promote consistency in decision making and ensures all investments are mutually supportive to a common outcome. Integration is evident within and between resilient systems, and across different scales of their operation. Exchange of information between systems enables them to function collectively and respond rapidly through shorter feedback loops throughout the city.

III. ENTRY POINTS FOR ACTION

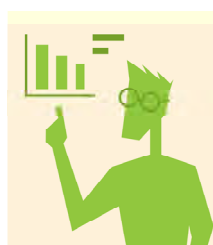
This section discusses seven entry points that have emerged from analysis of the UCCR literature and were validated through interviews with key UCCR experts.¹⁴ It describes and outlines each entry point, the benefits, the range of practical actions to leverage the potential of this entry point for operationalizing pathways to UCCR, and the challenges of using each entry point.

Much of what is considered good development practice—such as strong and equitable economic growth, rights and entitlements, and wide access to basic services—helps build resilience over time. Thus, the entry points identified are part of good urban development processes and, when approached with a resilient qualities lens, provide ample opportunities to translate the concept of UCCR into practice (Figure 2).

¹⁴ Most prominently from Kernaghan and da Silva (who argue that action across four areas is necessary to sustain action on UCCR that includes knowledge (entry point 1), planning and policy making (2 and 3), engaging stakeholders (4, 5, and 6), and enabling finance (7). (S. Kernaghan and J. da Silva. 2014. Initiating and Sustaining Action: Experiences Building Resilience to Climate Change in Asian Cities. *Urban Climate*. 7. pp. 47–63.)



Recognizing that pathways to UCCR are diverse, the sequence of the entry points that follow is not meant to prescribe a tightly bound set of steps that must be adhered to, particularly given the complex and dynamic nature of cities. However, a comprehensive approach to building UCCR may best begin with collecting the right information and knowledge, and move on to planning and policy processes, strengthening capacity, engaging with a variety of stakeholders, and accessing finance. Nevertheless, some cities may have more opportunity or made more progress on one entry point over another, which shows how some actions may be more important than others in different contexts.



A. Entry Point 1: Data, Information, and Knowledge on Urban Growth and Climate Change

Informing UCCR actions requires data, information, and knowledge on natural and physical exposure and social and economic vulnerability of people and assets to climate change-related shocks and stresses. These data cuts across administrative boundaries, sectors, and timescales to include information about past events and performance, current trends, and future projections on climate change and urban growth. Taken together, this information is necessary to determine pathways of UCCR and can largely be collected, shared, and updated as part of regular urban development processes.

Key Points

Opportunities and Benefits

- Urban development processes provide opportunities to collect, share, and update large sets of base data, which are critical for understanding the exposure and vulnerability of people, their assets, and livelihoods to potential impacts of climate change.
- Advancements made in mobile technology and its wide usage, especially in the urban areas, provide opportunity to crowdsource information, thereby capturing resilience-related perspectives of the urban population and making it easier to share and update data.
- Collecting, sharing, and applying exposure and vulnerability-related data provide opportunities to improve intradepartmental coordination and better understanding of interlinkages between sectors, which is a key requirement for urban climate change resilience (UCCR).

Actions and Modalities

- Collect three main streams of data for enhancing UCCR:
 - Climate change data: information on climate variables, their trends, and projections
 - Exposure data: location and nature of physical assets and environmental resources
 - Social and economic vulnerability data: household income, gender, literacy level, access to basic services, access to inclusive financial services, migration flows, demographic trends, etc.
- Use these data in undertaking climate risk and vulnerability assessment, which should inform urban planning, project prioritization, and design of individual UCCR-related investments.

Challenges

- Incorrect interpretations of climate projections that are characterized by uncertainty
- High financial costs in collecting and maintaining exposure and vulnerability data
- Disconnect between data collection, sharing, and evidence-based decision making

1. Opportunities and Benefits

Climate change will have potential impacts on the assets and performance of a wide range of interdependent urban sectors (water and sanitation, electricity, housing, natural resource management, and transportation); delivery of basic urban services; and emergency management-related functions of a city government. If any component which forms part of the larger system in a sector fails, this could have a domino effect. For instance, failure in the power grid due to a tropical cyclone can disrupt water supply and transportation. Moreover, such impacts will be felt differently in various sections of the urban population, with the poor being most at risk because of their preexisting socioeconomic vulnerabilities.

Thus, as a first step, along with information on climate variables (temperature, precipitation, and changing hazard pattern), it is critical to collect information on factors that would contribute to the exposure and vulnerability of the population and assets to the potential impacts of climate change. Such information would include socioeconomic data, geographical characteristics of the area (preferably beyond immediate administrative boundaries), land records, characteristics of various physical assets (e.g., size, shape, occupancy, age, and construction type of public buildings), urban growth pattern, environmental data, and location of vulnerable population.

Large portion of UCCR-relevant data can be collected as part of urban development. A large portion of the information required for strengthening UCCR is typically collected by city governments,

line agencies, private sector, and research organizations for wider urban development purposes, and should be the starting point to strengthen UCCR. Over time, a geographically referenced spatial information platform can be developed to regularly collect, analyze, share, and update data toward increasing collective understanding among different sectors and population on how the exposure and vulnerability of people and assets will interact with current and future climate-related shocks and stresses. Such an approach will improve coordination across agencies and facilitate the development of system-wide resilience-building measures.

Human and intellectual capital present in cities makes data collection and update easier. Apart from data and information available from public sources, cities are also important agglomerations of human and intellectual capital, which can be tapped to generate UCCR-related information. For example, data collection can enlist the support of local communities, particularly those with low adaptive capacity but good knowledge of their own subjective resilience and experience of past climate-related hazards.¹⁵ Involving local communities and institutions also allows for the incorporation of the concerns of more vulnerable groups, which top-down planning processes might not capture. In addition, it builds information networks that can assist municipal governments in targeting resilience-building efforts. By identifying the various ongoing initiatives and organizations working in community-based development, city officials can create an opportunity to mine their accumulated knowledge and extend their capacity for data collection and updating information.

Technological advancements provide new cost-effective opportunities to collect and update data. Advancements in technology, such as mobile technologies which have high usage in urban areas, offer new opportunities to collate local perspectives on climate change resilience in an efficient, economic, and participatory manner (Box 2). For example, communities can be involved by using their mobile phone in collecting geo-referenced data on the location and characteristics of assets, such as public and private schools and hospitals. The engagement of communities has the potential of making them cocreators of data, thereby also supporting the regular update of local level information on vulnerability and exposure.

Box 2: Harnessing Mobile Technology to Crowdfund Resilience Data, Jakarta, Indonesia

Cities are unique for their high mobile phone service penetration and communication infrastructure. Mobile technologies can be used to crowdsource geo-referenced data, in combination with big data streams to support community-based disaster risk reduction initiatives. Because social media data contain geo-located information, crowdsourcing can produce strategies that respond to infrastructure problems that come along with rapid and unplanned development. The United Nations Global Pulse led a SMART Infrastructure Facility project in Jakarta, and looked at what big data could contribute to small, citizen-generated crowdsourced data. The program analyzed information from a combination of citizen-generated projects and Twitter, building a picture of flooding across the city as the monsoon season unfolded. The data are sourced in real time and mapped, and overlaid with “big data” sources that help show connectivity between different infrastructure and how these components react to flooding. The pilot was specifically geared toward flood risk, but the methodology could be applied to urban waste and sewage management. It could also help decision makers understand the unintended social and economic consequences of infrastructure or construction decisions, preventing maladaptation and allowing for iterative learning.

Source: G. Quaghiotto. 2014. Combining “Big” and “Small” Data to Build Urban Resilience in Jakarta. *United Nations Global Pulse*. 9 April. <http://www.unglobalpulse.org/urban-resilience-petajakarta>

¹⁵ L. Jones and T. Tanner. 2015. Measuring “Subjective Resilience”: Using People’s Perceptions to Quantify Household Resilience. *ODI Working Paper*. No. 423. London: Overseas Development Institute.

2. Actions and Modalities

Climate-related shocks occur in cities in tandem with an array of environmental, economic, and political stresses. Assessing how cities will deal with concurrent shocks and stresses requires the following actions:

Collect and analyze climate change-related data. To understand how an urban area could be affected by potential impacts of climate change, data are needed on past patterns and future projections of climate characteristics—temperature, precipitation, intensity and frequency of climate hazards, sea level rise, etc. Collection of such data requires looking beyond immediate urban administrative boundaries, and close collaboration with a wide range of stakeholders with diverse perspectives, including government agencies responsible for climate information, research institutions, universities, and local experts, thereby encouraging an integrated approach. With advancements in technology, it is becoming easier to collect data on climate variables, e.g., remote sensing imagery from satellites can be used to understand past flooding patterns. However, uncertainties are inherent in downscaling climate data, especially when modeling the changes in the magnitude and intensity of extreme weather events. It is important to appreciate that uncertainties exist and to discuss the implications for the results and decision making.¹⁶

Assess exposure of people and assets. In addition to data on climate variables, data on urban characteristics and growth are required—topography, changes in land use, characteristics of the urban population, location and characteristics of formal and informal housing, location and characteristics of public assets, infrastructure and economic activities, location of natural ecosystems, and location of vulnerable communities. The climate data are laid over the data on urban characteristics and growth to analyze which aspects of the city's urban system are most likely to be negatively affected.

Exposure data can support in making crucial decisions on enhancing UCCR by understanding how climate-related shocks and stresses will potentially interact with demographic trends and spatial growth strategies of the urban area. Since the projections are based on uncertain socioeconomic futures, the timing, magnitude of potential impacts, and the locations of the most affected by climate change cannot be determined with high precision.¹⁷ Here, analogue scenarios can be constructed from paleorecords to create plausible scenarios. However, these can only demonstrate futures in which socioeconomic variables remain similar to historic trends.¹⁸

Multiple methods can be used to collect data on exposure: crowdsourced geo-referenced data on flooding extent can be collated from social media; information on location and characteristics of housing and physical assets built in hazard-prone areas can be gathered from land use maps; and stresses within a community can be obtained using participatory techniques such as transect walks¹⁹ (Box 3). Such methods will enable inclusiveness and reflectiveness in approaching UCCR.

¹⁶ ADB. 2016. *Reducing Disaster Risk by Managing Urban Land Use: Guidance Notes for Planners*. Manila.

¹⁷ R. L. Wilby et al. 2009. A Review of Climate Risk Information for Adaptation and Development Planning. *International Journal of Climatology*. 29 (9). pp. 1193–1215.

¹⁸ J. Padgham. 2009. *Agricultural Development under a Changing Climate: Opportunities and Challenges for Adaptation*. Joint Departmental Discussion Paper. (1). Washington, DC: World Bank.

¹⁹ R. Shaw and A. Sharma, eds. 2011. *Climate and Disaster Resilience in Cities. Community, Environment and Disaster Risk Management*. 6. Bingley: Emerald Group Publishing.

Box 3: Adopting Participatory Techniques to Assess Exposure to Climate Change, Battambang, Cambodia

In Battambang, Cambodia, city planners, with the Asian Development Bank, underpinned urban resilience planning with a participatory mapping exercise to track previous extreme floods and regular seasonal flooding. Information was overlaid on maps with climate change projections for the city based on modeling results. These maps were used to develop risk priorities and decide on zoning boundaries. Where specific infrastructure was particularly exposed, officials created composite vulnerability scores using data on exposure, sensitivity, impacts, and adaptive capacity to allow planners to prioritize infrastructural upgrading.

Source: ADB. 2015. *Building Urban Resilience in Battambang, Cambodia, Volume 5 of the Resource Kit for Building Resilience and Sustainability in Mekong Towns, Prepared by ICEM – International Centre for Environmental Management for the Asian Development Bank and Nordic Development Fund.* Manila (TA 8186).

Assess socioeconomic vulnerability. The factors that determine socioeconomic vulnerability include household income, livelihoods, gender, age, race, ethnicity, literacy, education, access to basic services, access to financial services, and migration. Combined with scientific information on climate change variables and exposure data, vulnerability information can convey various facets of different groups' capacity. Robust climate risk and vulnerability assessments (CRVAs) require wide consultations with different population groups in order to capture local knowledge and capacities to adapt, thereby encouraging an inclusive approach (Box 4).

Box 4: Collecting Vulnerability Data, Hyderabad, India

In Hyderabad, India, the city's hazard exposure, infrastructure, governance, socioeconomic variables (HIGS) framework combines information on population density, percentage of population living in slums, and percentage of population living in areas subject to regular flooding.^a Priority actions were drawn up for authorities, including on improving access to services in informal settlements. HIGS is a relatively simple way of creating an initial dataset for assessment in areas where data may be sparse. It can also be used to raise awareness on a wider scale through civil society organizations, academics, and community groups.^b

Sources:

^a J. Parikh, G. Sandal, and P. Jindal. 2014. *Vulnerability Profiling of Cities: A Framework for Climate-Resilient Urban Development in India. IIED Working Paper Series.* No. 8. London: International Institute for Environment and Development.

^b S. Cutter, B. Boruff, and W. L. Shirley. 2003. Social Vulnerability to Environmental Hazards. *Social Science Quarterly.* 84 (2). pp. 242–261.

Combine information on climate change variables, exposure, and vulnerability. Combine information collected on climate change variables, exposure, and vulnerability of people and assets to undertake CRVA. Such assessment should conceptualize cities as complex systems with their reach beyond administrative boundaries, and demonstrate the importance of sharing information collected from different sectors for enhancing overall resilience. One approach is to establish a common information platform (preferably geographical information-based systems) accessible to all relevant city stakeholders so as to enable sharing, using, and updating of information across sectors for integrated planning and defining priority investments (Box 5).

Box 5: City Information Base

The World Bank's *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters* advocates collating the data into a city information base accessible to all within the urban development process and the city's organizational structure. This would include annotated maps that overlay a socioeconomic profile, physical infrastructure, a hazard risk profile, and a future growth map that generates a "vision" of how the city will grow with different kinds of investments, indicating the capital outlay and capacity-building efforts required to achieve this. Where there is limited knowledge on the most effective resilience policies, the city information base can guide implementation of efficient solutions that will have multi-sector effects, adjusting them as environmental and social factors evolve over time.

Source: N. Prasad et al. 2009. *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters*. Washington, DC: World Bank.

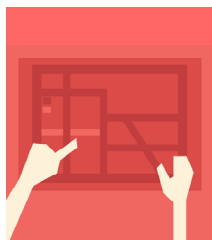
3. Challenges

Uncertainties associated with climate change. Climate data and climate projections in particular are still characterized by uncertainty. UCCR-related planning and investment decisions may at times require highly downscaled projections, yet high levels of detail in climate projections do not translate to high levels of confidence in that detail: estimations are based on different socioeconomic futures, so creating projections with a granular level of geographic detail is near impossible.²⁰ Thus, it is important to appreciate that uncertainties exist and to understand the implication of using such information. This requires close collaboration between climate science specialists and urban planners and decision makers. Furthermore, detailed downscaled data may not always be necessary, and resilience actions can be built using regional-level climate predictions without compromising the validity of the method.

High levels of investments in collecting and updating exposure and vulnerability data. Another challenge is the high levels of investment required in collecting and updating exposure and vulnerability data. House-to-house surveys can cover small areas only, and the method is both time-consuming and expensive. However, new methods have harnessed geospatial data to simplify and cut costs for exposure and vulnerability mapping. Also, updated land use maps can determine to a significant degree the types of buildings, key economic activities, and population density in a particular area. For instance, urban residential, commercial, and industrial zones will display different characteristics in terms of building structure, occupancy, and value. Thus, the costs of traditional methods of exposure and vulnerability mapping can be offset by using advanced technology and creatively incorporating such data into a larger database.

Using results of climate risk and vulnerability assessments in decision making. Translating data on climate risk and vulnerability into policy, planning, and investment-related decision making remains a challenge, particularly for UCCR, an area in which a broad range of information is needed. Helping decision makers visualize what change means across a variety of climate change and urban growth scenarios and discussing adoption of no-regret or low-regret local actions are a good way of overcoming this challenge.

²⁰ S. Dessai et al. 2009. *Climate Prediction: A Limit to Adaptation*. In W. N. Adger, ed. *Adapting to Climate Change: Thresholds, Values, Governance*. Cambridge: Cambridge University Press.



B. Entry Point 2: Tools and Approaches Used for Urban Planning

Urban planning regimes establish the “planning guidelines, policies, development code and space requirements for various socio-economic activities”²¹ and influence “the way we plan the physical layout, or land use.”²² This entry point examines the value of urban planning processes, such as land use planning and city development planning, for enhancing UCCR.

Key Points

Opportunities and Benefits

- The long-term outlook and integrated nature of land use planning provide an opportunity to consider longer-term concerns such as climate change resilience, and facilitate an understanding on interlinkages between different sectors in the context of climate change.
- The spatial nature of land use planning allows a demonstration of the locational constraints posed by climate change and helps reduce exposure and vulnerability by adopting climate-sensitive spatial growth policies. City development plans can prioritize a combination of hard and soft investments to enhance urban climate change resilience (UCCR).

Actions and Modalities

- Institute climate-sensitive locational and design controls through land use planning and development controls, and prioritize resilient investments through city development plans.
- Ensure that urban planning processes follow comprehensive approaches (integrated, inclusive, and reflective).

Challenges

- Paucity of adequate information on exposure and socioeconomic vulnerability of people and assets to potential impacts of climate change needs to be addressed.
- The vast presence of informal sector economy in cities limits the potential of urban planning to effect change.
- Building consensus among different stakeholders and, in particular, gaining the support of decision makers to adopt policies and investments prioritizing climate resilience are another challenge.

1. Opportunities and Benefits

Urban planning regimes aim to provide a comprehensive and longer-term approach to development and guide the spatial, social, economic, and cultural development of the city. Therefore, integrating the principles of UCCR within urban planning regimes can potentially ensure various streams of urban development are taken into account and contribute to enhancing climate change resilience. Also, using land use planning and city development plans as entry points for enhancing UCCR

²¹ Delhi Development Authority. Master Plans. http://www.dda.org.in/planning/master_plans.htm

²² N. Pace. 2013. *Resilient Coastal Development through Land Use Planning: Tools and Management Techniques in the Gulf of Mexico*. http://seagrant.noaa.gov/Portals/0/Documents/what_we_do/social_science/ss_tools_reports/resilient-planning_web.pdf

leverages existing planning systems and draws on established processes, technical capacity, and resources, instead of new approaches (footnote 16).

Long-term outlook of land use planning provides opportunities to factor longer-term concerns such as climate change. The long-term outlook of land use planning (e.g., 10–20-year time frame of land use plans) provides an opportunity to factor in longer-term risk considerations, such as climate change. This is particularly important to protect critical infrastructure and public utilities, which typically have a longer design life (footnote 16).

Urban planning can help reduce or limit exposure and vulnerability. The spatial nature of land use plans allows a demonstration of the locational constraints posed by climate change on existing and future developments of a city, and guides the adoption of climate-sensitive spatial growth policies. For example, the land use planning process can identify environmental resources and sensitive areas (e.g., wetlands, sand dunes, and coastal vegetation) and adopt relevant development control measures (such as conservation zoning, and buffers), thus helping to maintain the health of ecosystems that provide basic services, strengthen livelihoods, and enhance social capital, all of which in turn reduce vulnerability. At the same time, the city development plans can reduce socioeconomic vulnerability by targeting investments in vulnerable communities, thereby enhancing their resilience. For example, city development plans can prioritize hard and soft investments to enable equal access to education, health, and financial services, and to strengthen capacity and institutions.

2. Actions and Modalities

The approaches for embedding UCCR principles and qualities in urban planning processes can be as follows:

Factor climate change considerations in different stages of land use planning. The different stages of the land use planning process—situation analysis, visioning, goal setting, and development scenario analysis—should incorporate scientific and local knowledge of the potential impacts of climate change and guide the development of climate-resilient policies and investments. The situation analysis process, which provides an understanding on current land usage and information about likely future occupancy and city expansion rates, should undertake analyses on how the potential impacts of climate change will affect the development suitability of the area (inside and outside the administrative boundaries) and demand for land, housing, infrastructure, transportation, employment, recreation, waste management, etc. Also, the city visioning process, which allows developing consensus among a wide range of stakeholders on the strategic priorities of the city, should be within a defined time frame. Further, it should analyze how current and future climate considerations will affect the realization of the city’s vision and the need to develop explicit climate-resilient land use goals, where needed. Such climate-sensitive analysis undertaken during the land use plan formulation process will guide the development of a package of policy and hard and soft investment measures and thereby contribute to resilience qualities (integrated, inclusive, and resourceful) (footnote 16).

Use development control instruments to strengthen resilience to climate change. A key component of land use planning is zoning, a regulatory tool used for controlling the type of land use permitted (e.g., residential or commercial). Zoning can be an effective tool to regulate urban development in locations that are at risk from climate-related shocks and stresses. Zoning can restrict development in high-risk and environmentally sensitive areas, and can introduce measures to support development in a risk-sensitive manner. For example, large parts of Mildura, Australia, are at risk of flooding. An urban flood zone was created within the land use plan, which permitted development but

only after compliance with certain safeguards to reduce flood risk, such as setback distances and permeability requirements on plots.²³

However, successful implementation of zoning as a tool to enhance UCCR will depend on the flexibility in design and implementation (especially with the uncertainties associated with climate change); synergy in enforcement with other development control tools used in surrounding areas, thereby promoting integrated approaches; and being reflective through regular updates of zoning regulations in order to capture changing nature of exposure and vulnerability.

Reduce physical vulnerability through building controls. When it comes to design and building controls, regulations for the built environment can act as a way of driving UCCR through reduced exposure and vulnerability. This includes stipulating specifications for building sites and could involve mandated plinth heights as a way of reducing exposure to floods²⁴ and the use of extra-strong fasteners to keep roofs securely fastened during high winds.²⁵ Regulations on building enclosure are the third pillar; these could include cool roofs (to reduce urban heat island effects), enhanced insulation (to reduce exposure to extreme temperatures), and installation of a range of devices to fend off shocks and stresses, such as power, climate control, veneers, cladding, overs, and braces (footnote 23). These design controls help ensure buildings can respond to changing conditions, thereby being flexible and factoring redundancy. However, successful implementation of design and building controls requires adaptation of design codes to capture locally relevant risks, capacity to design and enforce, and incentives to encourage applications. It also requires establishing a culture of compliance.

Adopt principles of good urban planning: integrated, reflective, and inclusive. There is also a growing understanding that planning processes to enhance UCCR needs to be integrated, i.e., arrived at through collaboration and deliberation between a variety of different stakeholders (footnote 9). This ensures that planners can spot interconnections, trade-offs, and other relationships between levels of risk, functions and/or departments of the city, and priorities of different stakeholders. While many existing urban planning regimes entail such processes of collaboration, these are typically open to a limited set of experts and the scope of discussion is narrow. This often leads to a model of technocratic consultation as opposed to genuine integration.

Closely linked to this is the importance of inclusion. There is a strong need to institute consultation with different urban stakeholders—elected and appointed officials, government staff, civil society organizations (CSOs), the business community, and the vulnerable population—to develop consensus on how current and future shocks and stresses will impact the city’s vision and strategic development priorities, and what types of policies, investments, and practices are required to address the shocks and stresses (footnote 16). More specifically, poor and marginalized populations must participate in such consultations as, more often than not, they are highly exposed (e.g., they reside in hazard-prone land in poor-quality shelters) and highly vulnerable (e.g., they have low levels of education, savings, and health) to the impacts of climate change.²⁶

²³ ADB. 2015. *Urban Planning for Building Resilient Mekong Towns, Volume 3 of the Resource Kit for Building Resilience and Sustainability in Mekong Towns*. Prepared by International Centre for Environment Management for ADB and the Nordic Development Fund. Manila (TA 8186).

²⁴ J. Newman, S. Slaughter, and A. Wilson. 2013. *Building Resilience in Boston: “Best Practices” for Climate Change Adaptation and Resilience for Existing Buildings*. http://www.massport.com/media/266311/2013-July_Building-Resilience-in-Boston.pdf

²⁵ ADB. 2013. *Moving from Risk to Resilience: Sustainable Urban Development in the Pacific*. Manila.

²⁶ M. Pelling and D. Manuel-Navarrate. 2011. From Resilience to Transformation: the Adaptive Cycle in Two Mexican Urban Centers. *Ecology and Society*. 16 (2). p. 11.

Urban planning also needs to be informed by empirical or scientific knowledge on exposure and vulnerability.²⁷ Although the balance is difficult to achieve, viable pathways to enhancing resilience start to emerge when “top-down” scientific information, whether through climate projections or risk models, is integrated with “bottom-up” perspectives of exposure and vulnerability. Finally, decision-making processes that inform planning for climate change resilience must be reflective, and decisions made must be revisited at regular intervals, so the course of planning can be corrected if necessary (footnote 9). This is to be able to accommodate multiple, evolving risks and rising uncertainty owing to climate change within planning regimes for enhanced UCCR. Reflection is also vital to breathe life into the idea of flexibility enshrined within the concept of resilience, as it is key to cities developing the ability to adopt alternative strategies in response to changing circumstances or sudden crises.

These qualities (integrated, inclusive, and reflective), while not new to urban planning processes, are further gaining importance because of the benefits they bring to enhancing UCCR.

3. Challenges

Paucity of adequate data and information. First, there is a paucity of adequate information on exposure and vulnerability of people and assets to potential impact of climate change, and the lack of capacity to use such information for decision-making purposes. Actions discussed in entry point 1 can help fill this gap.

High degree of informality limits the potential of effectiveness of formal planning. Second, there is a high degree of urban informality in developing countries: 33% of all urban residents live in informal settlements that do not fall squarely within the purview of planning systems.²⁸ This means that the levers of urbanization and development are usually not with those who are mandated to develop plans, such as city governments, but rather with private builders, businesses, slum-dweller federations, and residents’ welfare associations, for example. To overcome these challenges, urban planning processes should reconcile the priorities of different groups and develop a shared vision for UCCR, include bottom-up approaches to community resilience planning (entry point 5), and engage with the private sector (entry point 6).

Gaining support of decision makers. Third, gaining the support of decision makers to adopt climate-resilient land use policies and investments may prove difficult, because the policies may place additional economic and regulatory requirements on interest groups such as land developers and property owners, and, in some instances, reduce the value of their land and assets. Thus, as a first step, it will be important to gain the consent of the city leader or other higher authorities in the government to factor climate change considerations in urban planning processes. The city leader needs to be informed of all the relevant issues pertaining to factoring in climate change considerations, both for and against, so that informed decisions can be made regarding identification and prioritization of investments, allocation of financial and regulatory resources, and plan implementation. Needless to mention, the effectiveness of planning is limited if the plans are not operationalized.

²⁷ S. O. Reed. 2013. “Shared Learning” for Building Urban Climate Resilience – Experiences from Asian Cities. *Environment & Urbanization*. 25 (2). pp. 393–412.

²⁸ PWC. 2011. Cities and Urban Poverty. 11 July. <http://pwc.blogs.com/sustainability/2011/07/cities-and-urban-poverty.html>



C. **Entry Point 3: Development Processes Associated with Urban Infrastructure and Services**

This entry point looks at how urban infrastructure and services can strengthen climate change resilience. Discussion here is based on six critical urban sectors identified by the Fifth Assessment Report of the Intergovernmental Panel on Climate Change: water and sanitation, energy supply, transport and telecommunications, built environment, ecosystems, and health and social services.²⁹ For each, the section demonstrates how it can continue to provide undisrupted services through shocks and stresses, recover, and contribute to the resilience of the city as a whole.

Key Points

Opportunities and Benefits

- Good-quality urban infrastructure and services enhance the ability of urban areas to survive and thrive in the face of shocks and stresses related to climate change.
- Utilizing existing processes associated with infrastructure sector development provides a sustainable route to urban climate change resilience (UCCR).

Actions and Modalities

- Enhance UCCR across vital urban sectors and services: water and sanitation, energy, transport and telecommunications, ecosystems, built environment, and health and social services.
- Adopt a systematic and systemic approach to enhance UCCR in urban sectors or systems as opposed to a piecemeal approach.

Challenges

- Limited political will to make infrastructure resilient
- Lack of fiscal decentralization to make policy shifts and investments needed to mainstream resilience in development processes associated with urban infrastructure and services

1. Opportunities and Benefits

Infrastructure, such as water supply and sanitation, transport, and energy, is critical for the social, environmental, and economic sustainability of urban areas. With the rapid growth of urban areas in Asia, large investments in infrastructure and services are expected over the next several decades. Such infrastructure has a long design life, requires a long-term planning horizon and operation and maintenance commitments, and locks in investments for decades. Moreover, such infrastructure comprises large and diverse networks made up of many different interdependent components, crossing diverse geologic conditions, and interruption caused in any part may result in interrupting the

²⁹ A., Revi et al. 2014. Urban Areas. In C. B. Field et al., eds. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY: Cambridge University Press. pp. 535-612.

performance of the entire system. Thus, it is important to plan such infrastructure in a robust manner to ensure that climate-related shocks and stresses are factored in the planning, design, construction, and maintenance processes associated with the infrastructure.

Good-quality and functioning infrastructure can reduce vulnerability. A growing body of evidence demonstrates how regular provision of basic services can reduce socioeconomic vulnerability and thus enhance the ability of a system to function in times of shocks and deal with stresses. For example, making sure water and sanitation systems have redundant capacity—i.e., the collapse of one section of the system does not lead to complete breakdown—or building energy systems using the principle of flexibility so neighborhoods have decentralized grids will help urban residents continue to receive life-supporting services during times of upheaval.

Existing infrastructure sector development processes provide a sustainable route to enhance UCCR. Cities are expanding rapidly and face major resource (financial and capacity) constraints. Those responsible with managing these cities are overwhelmed when trying to meet the everyday needs of urban residents. Thus, existing infrastructure sector development and urban service provision systems should be leveraged to enhance UCCR as opposed to establishing parallel approaches. This would then also help ensure local efforts to enhance UCCR endure, as these services are ultimately overseen and funded by city governments.

2. Actions and Modalities

Actions can be undertaken across sectors to strengthen resilience to potential impacts of climate change, which in turn will enhance the overall resilience of a city.

Water and sanitation. Climate change will affect water supply and demand in cities. Rising temperatures and erratic rainfall will exacerbate the depletion of groundwater sources through increased use and the degradation of watersheds (32% of the population in Asia and the Pacific is groundwater dependent).³⁰ Rising sea levels and storm surges will potentially increase salt water intrusion. Urban heat island effects will contribute to greater evaporation from tanks and reservoirs. The rising intensity of rainfall will overwhelm storm-water management systems and increase turbidity and sedimentation, leading to reduced availability of quality water³¹; and extreme events will damage infrastructure.

Several actions can make urban water and sanitation services more resilient to climate change. Currently, most water supply systems assume a certain degree of fluctuation in supply, based on historical data and observed risks, but the high degree of uncertainty induced by climate change renders these calculations less effective.³² To engage with high levels of fluctuation in water quantity and quality, water supply systems must have a greater degree of flexibility built in through both water management and structural measures (footnote 29). Flexible water management will entail diversifying water sources, reducing demand, and working with water user groups (footnote 31). Structural flexibility can result from decentralizing distribution through some engineering techniques, including the strategic use of valves that can de-network one part of a system from another that may be malfunctioning, and by laying pipes that can be moved and changed to accommodate various

³⁰ Wellowner.org. Ground Water Supply & Use. <http://www.wellowner.org/groundwater/groundwater-supply-use/>

³¹ J. Cromwell, J. Smith, and R. Raucher. 2007. *Implications of Climate Change for Urban Water Utilities*. Washington, DC: Association of Metropolitan Water Agencies.

³² A. Loftus. 2011. *Adapting Urban Water Systems to Climate Change: A Handbook for Decision Makers at the Local Level*. Washington, DC: ICLEI.

exigencies.³³ All these interventions can be part of an “integrated urban water management” approach that considers the entire water cycle comprehensively.³⁴ More specifically, this approach underlines the need to consider a wide range of water sources, take the catchment into view (as opposed to being limited to the city boundaries), and involve all stakeholders in decision making.³⁵ Strengthening climate change resilience of water and sanitation systems can result in enhanced overall resilience in many ways, including through the improvement of health, which in turn would reduce human vulnerability to climate change impacts.

Energy. Climate change is set to affect energy supply and demand in cities. In terms of supply, hydroelectric power generation will be less because of the depleting volume of water in rivers, and there will be more erratic supply from thermal power plants which are dependent on large volumes of water for cooling.³⁶ Gradual climatic changes such as sea level rise and extreme weather events could destroy infrastructure—e.g., oil refineries, as a large percentage of the world’s oil refineries are located at sea. On the demand side, extreme temperatures will exacerbate urban heat island effects, leading to increased demand for air-conditioning, and shortages in regular water supply will need to be met through the use of pump sets.

Actions that can be undertaken to make energy systems more climate-resilient fall broadly into the categories of management and technical solutions. Management solutions can help manage demand by, for instance, spreading awareness of low-technology solutions to deal with heat waves or through pricing plans that make electricity use very expensive after certain thresholds are crossed. Technical solutions that can improve supply are aimed mainly at enhancing “intelligence” (e.g., predictive tools to determine the location, nature, and extent of a potential fault so appropriate action can be taken);³⁷ increasing redundancy (e.g., having the option of drawing on multiple different sources of energy and switching between these should either one fail);³⁸ or improving the ability of energy systems to couple and decouple from networks (central grids can expand access to different sources of energy, but decoupling is important to avoid complete collapse should one part of the grid fail).³⁹

Transport and telecommunications. Potential direct impacts here could include damage to infrastructure from extreme weather events. Across the world, vital transportation systems are concentrated in cities, most of which are in highly exposed locations. Also, storms and high-speed winds could damage above-ground transmission cables, soil erosion due to rising sea levels could expose major telecommunication cables and trunk routes and telecommunication exchanges, and base stations could overheat because of extreme temperatures, etc.⁴⁰ Potential indirect effects are the overburdening of transport infrastructure owing to climate-induced migration, higher energy costs for

³³ S. A. 2013. Tsegaye. Flexible Urban Water Distribution Systems. PhD diss., University of South Florida. <http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=5794&context=etd>

³⁴ Global Water Partnership. 2012. Integrated Urban Water Management. Briefing Note. Stockholm; Arup. 2010. C40 Workshop. Ho Chi Minh City.

³⁵ ADB. 2012. Water Supply and Sanitation. *Sector Briefing on Climate Change Impacts and Adaptation*. Manila.

³⁶ United States Environmental Protection Agency. Climate Impacts on Energy. <http://www3.epa.gov/climatechange/impacts-adaptation-renamed/energy.html>

³⁷ P. Evans and P. Fox-Penner. 2014. Resilient and Sustainable Infrastructure for Urban Energy Systems. *Solutions*. 5 (5). pp. 48–54.

³⁸ D. Walton. 2014. Improving the Resilience of Energy Systems. 8 December. www.leonardo-energy.org/blog/improving-resilience-energy-systems

³⁹ ADB. 2013. *Guidelines for Climate Proofing Investment in the Energy Sector*. Manila.

⁴⁰ Maunsell. 2008. *Impact of Climate Change on Australia’s Telecommunications System*. Canberra.

transport facility operators, increased costs of insurance, and reduced efficiency of inland waterways because of declining water levels.⁴¹

Transport and telecommunications systems can be made more resilient by using technical solutions as well as management processes that support robustness, redundancy, and flexibility. For example, railway lines could undergo stressing to permit them to function under higher temperatures; spare equipment (engines and carriages) could be distributed throughout a network; exposed or sensitive points in the network could be identified; and alternative routes could be designated. At the same time, a range of management processes could ensure the system can deal with climate impacts, including emergency planning and awareness raising on safety procedures and precautionary measures.⁴² These systems must also have the ability to recover swiftly should they fail. Transport and telecommunications can enhance urban resilience by allowing urban populations to be evacuated and emergency services to operate during disasters.

Ecosystems. Changes in temperature and rainfall patterns, evaporation, humidity, soil moisture levels, vegetation growth rates, water tables and aquifer levels, and air quality will affect ecosystems. Urbanization processes degrade ecosystems as urban expansion usually takes place in peri-urban areas and the hinterlands, which play critical ecological roles. Furthermore, areas of ecological importance within cities are ignored or encroached on as the value of ecosystems and the role they play is not adequately recognized or understood.⁴³ At the same time, there is now enough evidence on the vital provisioning (e.g., supply of fresh water) and regulating (e.g., reducing urban heat island effects, and flood control) roles ecosystems play for urban residents.⁴⁴

The resilience of ecosystems can be enhanced through conservation by means of development controls in areas of ecological importance (as discussed in entry point 2). Apart from locational controls on development, structural or design aspects of the built environment could enhance resilience through the promotion of “green infrastructure” that is less disruptive to ecological cycles. This type of infrastructure could include the use of a pervious surface to ensure watershed health;⁴⁵ green roofs (that enable rainfall infiltration and evapotranspiration, and regulate temperature); green corridors; and urban drainage systems that manage storm water sustainably.⁴⁶ Strong and healthy ecosystems carry the capacity to reduce vulnerability (by providing quality water and food) and would also help buffer the impact of climate extremes (by absorbing excess runoff, binding soils, and allowing rivers to flood safely).

Built environment. Buildings in all contexts will face degradation, but informal settlements that are poorly constructed on exposed land are even more susceptible to the impacts of a changing climate.⁴⁷ Extreme climate events can destroy buildings, and the slower-onset impacts of climate change (e.g., increasing salination) can weaken them over time.

⁴¹ Volpe. 2014. *Transportation System Resilience, Extreme Weather and Climate Change*. Washington, DC: United States Department of Transportation.

⁴² U. Eichhorst. 2009. Adapting Urban Transport to Climate Change. *Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities*. Module 5f. Bonn: GTZ

⁴³ J. da Silva, personal communication, 17 September 2015.

⁴⁴ E. Carabine et al. 2014. *The Contribution of Ecosystem Services to Human Resilience: A Rapid Review*. London: Overseas Development Institute.

⁴⁵ European Union. 2013. *Building a Green Infrastructure for Europe*. Brussels.

⁴⁶ ADB. 2012. *Green Cities*. Manila.

⁴⁷ UN-Habitat. 2012. *State of the World's Cities 2012/2013*. New York.

Locational controls built into urban plans can ensure that construction does not take place on hazard-prone land (as discussed in entry point 2), and structural controls undertaken in consultation with and with inputs from local communities can ensure it is adapted to current and future local risks.⁴⁸ Building resilience into sunk infrastructure by retrofitting and remodeling (often through low-cost localized actions) can make buildings more resilient (e.g., fastening roofs to main structures more tightly, using stronger materials). Most of these actions aim at enhancing robustness and redundancy. Use of information technology and sensors can enhance flexibility, through automated climate control that can open and close vents and turn the air-conditioning up or down to adjust to temperatures or switch power sources based on disruptions.⁴⁹

Health and social services. The impacts of climate change could destroy or degrade health and social service provision infrastructure. In addition, extreme climate events will result in demand spikes and will overwhelm these two key sectors. Meanwhile, the sectors will be unable to fulfill their mandate, given the shifting disease patterns and new health risks that have not been accounted for.

Resilience to health services will need to be dealt with using management and technical solutions, but adequate health planning can help build resilience to demand spikes and develop solutions to new health risks. There are many examples of how city governments have achieved this comprehensively (Box 6).

Box 6: Transforming the Health System for Enhancing Resilience, Paris, France

When the heat wave of 2003 had a high human and financial impact on Paris, the city administration recognized the need to transform the health care system in order to better deal with emergencies of this nature. The city invested substantial funds in equipping the system in a short span of time, setting up risk registers across the city, providing training to health-care workers, upgrading hospital facilities, developing response plans and protocols, establishing better early warning systems, and creating improved risk communication methods.

Source: T. Tanner and A. Bahadur. 2013. Distilling the Characteristics of Transformational Change in a Changing Climate. In University of Oslo. Proceedings of Transformation in a Changing Climate. Oslo. 19–21 June.

Action in these sectors need to be taken systematically, which would entail gaining the right information, engaging the right stakeholders (including marginalized urban residents) in planning actions, and then prioritizing these based on a number of criteria, including costs and benefits. A strategic approach that recognizes the interconnections among sectors can yield very positive results.

3. Challenges

While there is immense potential to enhance UCCR through urban infrastructure and services, a number of challenges remain.

⁴⁸ Cassidy Johnson, interview, 7 September 2015.

⁴⁹ J. Ruiz, C. Nesler, and K. Managan. 2014. *Intelligent Efficiency: Improvement Measures and Investment Analysis Framework*. Washington, DC: Johnson Controls.

Limitations related to wider urban governance. Effectively mainstreaming resilience qualities in urban infrastructure and services requires additional technical capacity and, often, financial resources (which may not produce revenue streams) as well as amendments to sector policies, regulations, cost norms, and institutional mandates. Fractured processes of decentralization often mean city governments are not empowered to make changes in how key urban sectors and services are prioritized, funded, implemented, and operated, as the provincial and national levels retain this mandate. Clearly, those spearheading enterprises to enhance UCCR need to operate at multiple levels of governance.

Lack of awareness on benefits of strengthening UCCR. The lack of awareness on climate-related shocks and stresses and the burden of day-to-day responsibilities deter the effective mainstreaming of resilience within urban infrastructure and services. This shows that there is a clear need to demonstrate the co-benefits of enhancing UCCR.

Weak political support. In the case of climate shocks (such as extreme weather events), many city administrations are concerned more with reacting to these shocks than with managing the potential risks.⁵⁰ There are political reasons for this: city politicians are not motivated to invest time and resources in building resilience to avert losses that may occur only after the next election.⁵¹ There are also administrative reasons: often, central and/or local governments are mandated to allocate reserves for responding to calamities (including climate-related shocks), but preemptive actions for strengthening resilience need to be financed from national or sector or city development budgets (with competing priorities and with limited positive revenue flows).



D. Entry Point 4: Institutional Capacity for Urban Development

Cities will be able to enhance UCCR only when the individuals and institutions charged with managing cities have the right capacities to do so. This entry point explores the need for strengthening capacity of city government and various other key stakeholders. It discusses methods and approaches which would allow identifying and understanding the potential impacts of climate change on achieving development priorities of the city, factoring climate risk considerations in inclusive development policies and investments, and effective operational and maintenance of assets and services.

⁵⁰ A. Bahadur and H. Thornton. 2015. Analysing Urban Resilience: A Reality Check for a Fledgling Canon. *International Journal of Urban Sustainable Development*. 7 (2). pp. 196–212.

⁵¹ A. Bahadur and T. Tanner. 2014. Policy Climates and Climate Policies: Analysing the Politics of Building Urban Climate Change Resilience. *Urban Climate*. 7. pp. 20–32.

Key Points

Opportunities and Benefits

- Individuals working within city governments often know the city intimately, and building their capacity on understanding climate-related shocks and stresses in the context of urban development can help bring urban climate change resilience (UCCR) to life.
- Working with mid-ranking and junior officials will help ensure that UCCR initiatives are sustainable.

Actions and Modalities

- Build the capacity of those managing city departments in understanding climate change risks and vulnerability, and in planning, prioritizing, designing, and deploying actions to build resilience of the city.
- Give attention to the methods and modalities of capacity building, along with the content, with a long-term objective of behavioral change.

Challenges

- Incentivizing city officials to participate in capacity building can be challenging because of their existing commitments and lack of awareness.
- Language can pose a barrier in trainings on UCCR.

1. Opportunities and Benefits

Achieving and sustaining an agenda for UCCR requires champions to push the agenda, a heightened awareness and capacity among various stakeholders, and a commitment to translate awareness into individual and collective actions. In many cases, urban local bodies have limited capacity, hence there is a strong need to work with city government officials to enhance knowledge, skills, and technical expertise. Such increased local capacity can deliver a number of benefits in terms of enhancing UCCR.

Local experts have in-depth understanding of how cities function. The individuals involved in different city departments have local knowledge and understand the complex ways in which cities operate. They often have a great deal of experience of how their departments and their services have handled issues in the past. They are also likely to understand the changes required to enhance UCCR. Therefore, putting the right knowledge in their hands through a variety of capacity-building interventions is likely to yield rich dividends.⁵²

Focusing capacity building initiatives on mid- and junior-level professionals ensures sustainability. Senior civil servants are frequently transferred out of the city as and when changes in political leadership occur at the city, provincial, or national levels.⁵³ This means that vital institutional knowledge is not retained. In contrast, those in junior positions within urban departments tend to remain in their posts longer. Moreover, even if policies are formulated at higher levels of governance, it is the “street-level bureaucrats” or middle and junior actors who are charged with their implementation.⁵⁴ Thus, the functionaries working within city departments are key in their day-to-day

⁵² D. Sharma, R. Singh, and R. Singh. 2015. Building Urban Climate Resilience: Learning from the ACCCRN Experience in India. *International Journal of Urban Sustainable Development*. 6 (2). pp. 133–153.

⁵³ A. Bahadur. Policy Climates and Climate Policies: Analysing the Politics of Building Resilience to Climate Change. PhD thesis, University of Sussex. 2014. http://sro.sussex.ac.uk/48873/1/Bahadur,_Aditya_Vansh.pdf; Steve Gawler, interview, 16 September 2015.

⁵⁴ M. Lipsky. 1980. *Street-Level Bureaucracy: Dilemmas of the Individual in Public Services*. New York: Russell Sage Foundation.

operations to capture different perspectives and to bring the vision of UCCR to life. As such, enhancing the knowledge and capacity of these functionaries could ensure a sustainable approach to enhancing UCCR. However, considering that application of urban resilience qualities may result in increase in costs and regulatory changes, advocacy should be directed at senior functionaries to ensure a mandate for UCCR, capacity building, and skills development for staff of municipal corporations.⁵⁵

2. Actions and Modalities

The approaches for embedding UCCR principles and qualities in institutional capacities can be as follows:

Strengthen capacity to understand risks and deploy actions to build resilience. Content should be focused on understanding how the exposure and vulnerability of the city and its constituent systems to climate change is affected by urban growth. Capacity building should also be focused on approaches for designing and deploying inclusive policies with hard and soft actions that will result in enhanced UCCR. While it is not the task of city officials to downscale climate models and undertake CRVAs, they should be working in close partnership with climate change and risk assessment specialists to understand what the data climate models generate, the potential implications of climate risk, and how to use such information for urban development-related decision making. This would require having a good understanding on the potential impacts of climate-related shocks and stresses; gauging the assets, skills, local knowledge, and social relations available to reduce their impact; and looking at the levels of risk among different groups of people in order to prioritize action.⁵⁶

Capacity building should focus on approaches for carrying out integrated and inclusive planning to enhance UCCR (as described in entry point 2). More specifically, it should involve the development of a shared understanding of the nature and location of institutional responsibility—which includes institutions at higher levels of administration, and may extend beyond administrative boundaries—for enhancing climate change resilience; of how different city systems can contribute to UCCR (see entry point 3); and of the types of financing mechanisms available to a city for implementing resilience-building measures (see entry point 7).

Select appropriate methods and mechanisms to strengthen capacity. The methods and mechanisms used to achieve this knowledge transfer are equally important and can encourage reflective thinking and integrated approach toward decision making. For example, the shared learning dialogue approach in the ACCCRN initiative entails iterative, structured, multistakeholder dialogues to understand how different components of a city (officials, academics, civil society, representatives of vulnerable communities, and the private sector) function, and to determine roles, responsibilities, and plans of action for enhancing resilience.⁵⁷ Peer-to-peer learning is also crucial to enhance UCCR.⁵⁸ This is because UCCR is a novel concept, and, while city government functionaries may sometimes struggle to see its value when approached by experts or academics, they are far more convinced when their peers in other cities explain its importance (footnote 55). Peer-to-peer learning between functionaries from cities with similar governance contexts, resources, and risk profiles permits a more effective examination of common challenges and methods to overcome those challenges (footnote 55). Alternatively, learning between cities with major differences in terms of levels of resilience can help

⁵⁵ Divya Sharma, interview, 25 August 2015.

⁵⁶ Asian Disaster Preparedness Center. 2010. *Risk Assessment in Cities*. Bangkok. Report for United States Agency for International Development.

⁵⁷ For more on shared learning dialogues, see footnote 26

⁵⁸ Cities Development Initiative for Asia. <http://cdia.asia>

transfer lessons between two individuals with similar roles but differential engagement with UCCR. For instance, under its Climate Change Resilient Development Project, the United States Agency for International Development (USAID) facilitated peer-to-peer learning between eight cities facing common climatic and non-climatic stressors. The attending city teams were at different stages of dealing with these stressors and brought different approaches and solutions to the table.⁵⁹

Different cities and even the departments within a city will have varying perspectives on climate change-related risks and will have different requirements in relation to capacity building. Thus, it is important to conduct a rapid needs assessment in advance of any interventions, for example through short semi-structured interviews with a subset of the target cohort. Also, although it is impossible to prescribe a set format for capacity building sessions, generally it is vital to first talk about climate impacts (past, present, and future) before going into institutional arrangements and resilience-building measures.

3. Challenges

Incentivizing officials to participate in capacity building initiatives. This relates to incentivizing the participation of officials who are constantly dealing with pressing issues, which means pausing to learn, reflect, and imbibe new information is sometimes a luxury (footnote 49). Moreover, building resilience currently does not appear in their job descriptions and terms of references. The Energy and Resources Institute and the Asia-Pacific Network for Global Change Research target cities that have faced disasters in the recent past and thus are more receptive to the idea of enhancing resilience, lobby senior civil servants at provincial level to mandate participation, and project these sessions as valuable professional development opportunities (footnote 55).

Use of terminologies that are not common in the local language. Another important challenge entails the use of language. Terms such as “resilience” are notoriously difficult to translate into local dialects, which means grasping novel ideas associated with these becomes much more difficult. The Institute for Social and Environmental Transition in India uses objects and activities to explain certain points. For instance, a rubber band was used to explain the idea of building flexibility into city systems and a Swiss Army knife to explain redundancy (footnote 51). Other solutions include the formation of smaller cohorts based on linguistic preferences and the preparation of bespoke training materials well in advance. More generally, protocols, mandates, rules, and legislation that provide an imperative for functionaries to participate in capacity-building activities are scant, thus organizations arranging training sessions will have to deploy creative approaches to incentivizing participation.

⁵⁹ A. Casey. 2014. *Promoting Resilient Infrastructure through Peer Learning*. http://icma.org/en/cl/blogs/blogpost/2315/Promoting_Resilient_Infrastructure_through_Peer_Learning_in_Santo_Domingo.



E. Entry Point 5: Community Development Processes in Urban Areas

Definitions of “community” in the context of climate change, development, and urbanization proliferate. ADB associates three primary stakeholder groups with the term: the general public, civil society, and the local private sector.⁶⁰ This entry point is limited to the first two stakeholder groups, and other entry points explore the private sector and government’s roles in relation to urbanization and climate change resilience.

Key Points
<p>Opportunities and Benefits</p> <ul style="list-style-type: none"> • Community-based organizations can support the delivery of basic services, thereby reducing vulnerability and enhancing resilience. • Community engagement can help capture different perceptions of risks, identify and prioritize investments that benefit the most vulnerable, and ensure that investments made for strengthening resilience bring wider development gains. • Involvement of communities is vital for managing residual risks that cannot be reduced due to uncertainties associated with risk information and low cost-effectiveness.
<p>Actions and Modalities</p> <ul style="list-style-type: none"> • Enhance understanding of the communities on climate change, the underlying factors contributing to climate change risks, and determining pathways of resilience. • Undertake community-level resilience planning that entails using top-down climate information and bottom-up participatory methods to identify exposure and vulnerability, and identifying and prioritizing resilience actions.
<p>Challenges</p> <ul style="list-style-type: none"> • Working with communities is complex and takes time. • Engaging communities will entail the management of trade-offs (where actions to enhance resilience for one group may exacerbate vulnerability for another). • Successful community engagement requires support from higher levels of government.

1. Opportunities and Benefits

A mounting body of evidence supports the benefits of engagement of communities in program design and execution.⁶¹ This is because beneficiaries need to “buy into” the initiative if the objectives are to be met. Local knowledge also helps minimize dissonance between the priorities of those funding or

⁶⁰ Sasank Vemuri, personal communication, 10 August 2015.

⁶¹ R. Chambers. 1997. *Whose Reality Counts?: Putting the First Last*. London: Intermediate Technology Publications; D. Dodman. 2008. *Building Resilience: How the Urban Poor Can Drive Climate Adaptation*. London: IIED; M. Pelling, D. Manuel-Navarrete, and M Redclift, eds. 2012. *Climate Change and the Crisis of Capitalism: A Chance to Reclaim Self, Society and Nature*. London: Routledge.

initiating development projects and the realities of the context in which they are deployed. Both these propositions hold in the context of UCCR.

Community-based organizations can support delivery of basic services, thereby reducing vulnerability. Engaging and organizing communities from within can add to their capacity to improve basic services that enhance resilience. Services such as water, transportation, education, and energy increase communities' adaptive capacity to a range of risks, and not just risk from intensive shocks (footnote 29). The World Bank's *World Development Report 2004: Making Services Work for Poor People* also emphasizes how community engagement can enhance the quality of service provision not only by increasing the pressures of accountability on urban governments to provide services, but also by pooling local resources to bridge deficits in service provision.⁶²

Community engagement can capture different perceptions of risk and target inclusive measures to strengthen resilience. The community engagement process can help local governments understand how different populations within a community perceive risk differently and the varying roles in shaping risk. Such understanding can help in identifying investments targeting the most vulnerable, those that bring wider development gains in the immediate term, and those that at same time are flexible enough to accommodate uncertainties arising from climate change.

Involvement of communities is vital for managing residual risks. An added value to engaging with communities in the context of UCCR pertains to tackling residual risk.⁶³ Residual risk is the risk that remains despite structural interventions to mitigate the adverse impact of shocks and stresses.⁶⁴ The increasing intensity and uncertainty of extreme weather events and their potential impacts in urban areas mean that appropriate measures must be put in place to ensure that the communities, especially the most vulnerable, are prepared and can effectively respond when existing mechanisms for risk reduction are overwhelmed.⁶⁵ Measures to manage the residual risk would include enhancing the inherent capacity within exposed and vulnerable communities to organize, mobilize, and coordinate in order to deal more effectively with exigent situations. This is crucial in resource-scarce governance settings; more often than not, communities are the first responders when existing systems fail.

2. Actions and Modalities

Communities can undertake a wide range of actions to enhance UCCR, but all of these require two fundamental steps: (i) enhancing understanding of the drivers of climate-related shocks and stresses; and (ii) determining and prioritizing pathways of resilience through community-level planning, implementation, and operations.

Adopt participatory methods to assess climate risks. Typically, facilitation of community-level action to strengthen resilience is undertaken by CSOs and community-based organizations. It entails the use of participatory methods whereby different members of the community are collectively engaged in identifying changing patterns of climate characteristics and factors contributing to exposure and vulnerability, and through dialogues coming to a conclusion about risk. Sometimes, scientific information is inserted into discussions to improve the quality of the data used. This process

⁶² World Bank. 2003. *World Development Report 2004: Making Services Work for Poor People*. Washington, DC.

⁶³ Sasank Vemuri, interview, 3 September 2015.

⁶⁴ United Nations Office for Disaster Risk Reduction. Residual Risk. <http://preventionweb.net/go/7827> (accessed 8 October 2015).

⁶⁵ Intergovernmental Panel on Climate Change. 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Special Report. Cambridge, UK: Cambridge University Press.

usually takes place alongside surveys, questionnaires, and group discussions to identify community vulnerability. Results of such assessments should be communicated clearly to all stakeholders, allowing them to make informed decisions regarding investments at the individual, household, and community level. Such participatory processes contribute to inclusiveness and are reflective in capturing the experiences of the community.

Undertake community-based planning. Once shocks and stresses are mapped, communities are engaged in discussions to determine a set of local actions based on available opportunities and resources, thereby contributing to resourcefulness. These actions can range from hard solutions such as building protective infrastructure (to reduce exposure to extreme weather events) to softer measures such as awareness of the health impacts of particular weather extremes and measures to tackle these (to reduce vulnerability); and from strengthening early warning capacities to managing the residual disaster risk. Box 7 details one well-recorded case that took place as part of the ACCCRN initiative.⁶⁶

Box 7: Microresilience Planning Initiative, Gorakhpur, India

The microresilience planning initiative in India was run by the Gorakhpur Environmental Action Group (a civil society organization) and entailed surveys and shared learning dialogues to determine risks using local knowledge and climate models. Shared learning dialogues centered on finding solutions to low-intensity, high-frequency flooding, also known as waterlogging.^a This was followed up by participatory exercises to determine actions to reduce risk and build resilience. These included community organizations through the formation of residents' committees and appointing community resilience volunteers. These institutions were used to improve basic service provision both by demanding better services from the city government (e.g., more regular outreach clinics by government doctors to deal with waterborne diseases and activation of a disused water tank in the neighborhood for better water supply) and by pooling community resources (e.g., upgrade and maintenance of an elevated communal toilet through local funds). Protective infrastructure was also developed through the widening and reinforcement of drains, through the construction of a model elevated house and a flood-resilient school.^b Residents' committees were then charged with maintaining this infrastructure. Finally, to strengthen sources of income, training was held on flood-resilient agriculture and diversification of income streams. These activities at the local level were linked to city-level institutional structures through a "city advisory group" composed of prominent citizens and experts that mediated communication between the community and the city government.

Meanwhile, a more subtle and somewhat serendipitous process enabled these communities to dismantle pernicious and risk-inducing political structures. Building awareness, collectivism, and mobilization for the purposes of planning also permitted the community to challenge political interests that were undermining their resilience. For instance, residents' committees led by volunteers were now better able to demand improved services from the local municipal councilor, who was forced to take action for fear of facing defeat in the upcoming election.^c Similarly, improved community organization also facilitated the institutionalization of a community-led solid waste management scheme that shed light on the inadequacy of existing arrangements put in place by the councilor, which were also allegedly a source of kickbacks. This underlines how navigating complex governance challenges is key to enhancing urban climate change resilience.

Sources:

- ^a S. O. Reed et al. 2013. "Shared Learning" for Building Urban Climate Resilience – Experiences from Asian Cities. *Environment & Urbanization*. 25 (2). pp. 393–412. <http://eau.sagepub.com/content/25/2/393.full>
- ^b A. Bahadur. Policy Climates and Climate Policies: Analysing the Politics of Building Resilience to Climate Change. PhD thesis, University of Sussex. 2014. http://sro.sussex.ac.uk/48873/1/Bahadur,_Aaditya_Vansh.pdf
- ^c A. Bahadur and H. Thornton. 2015. Analysing Urban Resilience: A Reality Check for a Fledgling Canon. *International Journal of Urban Sustainable Development*. 7 (3). pp. 196 –212.

⁶⁶ N. Mani and S. Wajih. 2014. A Participatory Approach to Microresilience Planning by Community Institutions: The Case of Mahewa Ward in Gorakhpur City. Working Paper. London: International Institute for Environment and Development.

At the same time, sensitizing, mobilizing, and organizing communities is vital to ensure that investments in strengthening resilience have the desired impact. For instance, there is little point in widening drainage networks to absorb excess runoff only for these to get clogged with solid waste that has been disposed of improperly because of lack of awareness or ownership. As such, the participatory operation and maintenance of infrastructure can improve the quality of service delivery. This, in the long term, increases adaptive capacity, which is a key component of resilience.⁶⁷ Improvements in levels of social and political capital are also key to enhancing adaptive capacity, and, as Box 7 shows, community-level planning to enhance resilience carries the potential to support both.

3. Challenges

Community engagement is complex and time-consuming. First, genuine engagement with communities on resilience is fraught with complexity. Far from being a cohesive entity, a community contains social, political, and economic fault lines.⁶⁸ Many perspectives need to be reconciled in any decision-making process. This is partly to manage any trade-offs (see next paragraph) but also to ensure that as wide a range of community members as possible take ownership. Participatory adaptive management initiates regular dialogue between multiple groups within a particular geographic context prior to taking action, as well as after action has been undertaken to review impact and make changes.⁶⁹

Building community resilience entails trade-offs. Second, key to the discussion on complexity is the growing understanding that building resilience necessarily entails trade-offs: the reduction of risk and vulnerability for one group or individual can lead to an increase in the same for another.⁷⁰ This was also seen when one group of vulnerable people in Gorakhpur, India decided that boundary walls around their houses were one way to reduce flooding risk. This ended in the increased inundation of another, less affluent group downstream that could not afford boundary walls.⁷¹ One clear strategy to overcome such a situation is to ensure that any climate-resilient community development program entails genuine participatory spaces where traditionally marginalized groups are given an equal voice. This point is highlighted very clearly in ADB's guidelines on participation: "All people are valued equally, opportunities for participation are adequately communicated and offered fairly, and barriers that stop particular groups getting involved are challenged."⁷²

Successful community engagement requires support from higher levels of government. Third, vulnerable communities in resource-scarce cities are, more often than not, economically and socially marginalized. This means that mobilizing them is important but can never replace broader enterprises of resilience building at higher levels of governance. Thus, it is critical to ensure that any action at community level is complemented by activity at the city, provincial, and, where needed, the national levels.⁷³

⁶⁷ A. Bahadur et al. 2015. *The 3As: Tracking Resilience across BRACED*. London: Overseas Development Institute.

⁶⁸ Richard Friend, interview, 2 September 2015.

⁶⁹ Ashvin Dayal, interview, 2 September 2015.

⁷⁰ M. Leach, ed. 2008. Re-framing Resilience: a Symposium Report. *STEPS Working Paper*. No. 13. Brighton: STEPS Centre.

⁷¹ T. Tanner and A. Bahadur. 2013. Distilling the Characteristics of Transformational Change in a Changing Climate. In University of Oslo. Proceedings of Transformation in a Changing Climate. Oslo. 19–21 June.

⁷² ADB. 2012. *Strengthening Participation for Development Results: An Asian Development Bank Guide to Participation*. Manila. <http://www.adb.org/sites/default/files/institutional-document/33349/files/strengthening-participation-development-results.pdf>

⁷³ David Dodman, interview, 3 September 2015.

These challenges show us how initiatives need to be tailored to context. This is also why questions remain on the degree to which the type of initiatives described in this entry point can be scaled up. That said, entry point 7 highlights how action at the community level can be scaled (through “federations” of CSOs engaged in urban resilience across cities), as well as the growing understanding of how climate-resilient community development can be one solution in a suite of UCCR approaches.⁷⁴



F. Entry Point 6: Tapping the Private Sector in Urban Areas

The private sector is one of the main engines of economic growth and a driver of wealth creation and physical expansion in urban areas in recent decades. As such, there are huge potential gains from involving the private sector in UCCR, both for the profitability of businesses themselves and for the wider resilience of the urban area. Governments can influence investment-related decisions through planning, incentives, regulation, and knowledge sharing, but, given the significant resource and capacity constraints, the private sector plays a key entry point for enhancing UCCR, especially in terms of engaging the informal economy, where enforcement and compliance with formal planning and regulations is usually much weaker.

Key Points
<p>Opportunities and Benefits</p> <ul style="list-style-type: none"> • Economic impacts of climate change are borne primarily by businesses, directly, indirectly, and via the wider economy, and thus the private partnerships are likely to play a major role in securing finance to build resilience. • Incentives to invest in resilience building extend beyond economic benefits to include new market opportunities and other co-benefits.
<p>Actions and Modalities</p> <ul style="list-style-type: none"> • Strengthen business continuity and protect supply chains. • Explore business opportunities by stabilizing existing markets and developing new markets. • Strengthen engagement of businesses with multistakeholder partnerships, including public-private partnerships (PPPs) or corporate social responsibility ventures. • Provide incentives to strengthen private sector engagement
<p>Challenges</p> <ul style="list-style-type: none"> • Weak governance and poor fiscal decentralization, often resulting in poor regulatory environments for resilience, leading to poor private sector compliance with measures such as land use plans and building codes • Low knowledge and awareness of climate and disaster risks to businesses, lack of access to data, complicated regulatory frameworks, and lack of practical experience in building resilience into business practice

⁷⁴ B. Smith, D. Brown, and D. Dodman. 2014. Reconfiguring Urban Adaptation Finance. *IIED Working Paper*. London: International Institute for Environment and Development.

1. Opportunities and Benefits

The private sector is expected to face a major brunt of the potential impacts of climate change, including destruction of property and equipment, damage to stocks, loss of revenue due to business interruption, increases in operational cost, and other unexpected expenses due to climate-related shocks and stresses. Although the magnitude of these impacts will depend on a range of factors, including the location of the private sector operations and the nature, size, and ownership of the business, typically there are opportunities to strengthen the private sector's climate change resilience.

Private sector absorbs a large share of climate-related impacts and will play an increasing role in investing in resilience. Climate-related shocks have a combination of direct, indirect, and wider macroeconomic impacts on businesses. Direct impacts are centered on damage or destruction of assets such as physical infrastructure and human resources. While these impacts often receive the greatest attention, economic losses are often exceeded by indirect impacts on flows of goods and services.⁷⁵ Flooding in Bangladesh's capital Dhaka, for example, cut production in the garment factories that underpin the country's export-led growth. Floods affected the factories directly but also prevented staff, who often live in the city's inundated low-lying areas, from accessing their workplace, driving production losses.⁷⁶ Wider macroeconomic impacts on factors such as overall gross domestic product, employment, consumption, or inflation will also affect businesses through reduced sales and increased production costs.⁷⁷ Thus, the private sector needs to invest in resilience-building measures. Moreover, public-private partnerships (PPPs) can help bridge the gap of capacity and financial constraints in the public sector, as well as link businesses with the policy support and incentives they need for resilient investment. Such PPPs can also help businesses develop market niches and learn the value of building resilience into wider operations.

Incentives for the private sector to invest in resilience extend beyond benefits of avoiding losses. Growing awareness of the impacts of climate change has already prompted some larger and multinational corporations to pay increased attention to strengthening climate change resilience.⁷⁸ Incentives for businesses to enhance UCCR extend beyond economic benefits to also encompass legal compliance and social or environment responsibilities.⁷⁹ Economic incentives include those related to protecting business losses from potential impacts of climate change through climate-informed investment decisions. Another set of incentives stems from social and environmental responsibility, including the duty of care to employees to prevent injury or loss of human life, as well as from a broader responsibility to mitigate the adverse impacts of extreme events on societal welfare. There is also a growing acknowledgement that investments in resilience building can yield co-benefits. This "resilience dividend" can include benefits to the businesses undertaking the investments, such as

⁷⁵ A. Rose. 2014. Economic Resilience and the Sustainability of Cities in the Face of Climate Change: An Ecological Economics Framework. In D. Mazmanian and H. Blanco, eds. *Elgar Companion to Sustainable Cities: Strategies, Methods and Outlook*. Cheltenham: Edward Elgar.

⁷⁶ M. Alam and G. Rabbani. 2007. Vulnerabilities and Responses to Climate Change for Dhaka. *Environment & Urbanization*. 19 (1). pp. 81–97.

⁷⁷ Asian Disaster Preparedness Center, United Nations Economic and Social Commission for Asia and the Pacific, and R3ADY Asia-Pacific. 2015. Resilient Business for Resilient Nations and Communities. Working Paper for World Conference on Disaster Risk Reduction. Bangkok: UNESCAP.

⁷⁸ M. Crawford and S. Seidel 2013. *Weathering the Storm: Building Business Resilience to Climate Change*. Arlington: Center for Climate and Energy Solutions.

⁷⁹ J. Rodin. 2014. *The Resilience Dividend: Being Strong in a World Where Things Go Wrong*. Washington, DC: Public Affairs; T. Tanner and J. Rentschler. 2015. Unlocking the "Triple Dividend" of Resilience: Why Investing in Disaster Risk Management Pays Off. Interim Policy Note. Washington, DC: Global Facility for Disaster Reduction and Recovery and London: Overseas Development Institute

improved image or credit ratings, and to other businesses, through increased supply chain stability and business continuity planning to face a wider range of potential shocks (footnote 79). Box 8 gives an example of deriving a resilience dividend.

Box 8: Resilience Dividends of Flood Risk Management, Tabasco State, Mexico

A study of flood defense investment in Tabasco found a benefit-cost ratio of 3:1, contributing to avoided damages and losses when floods occurred in 2010 equivalent to \$3 billion, or 7% of Tabasco's gross domestic product (or four times its public works budget in 2014). This figure does not capture the full dividends of the investment at the state, city, and household levels. Qualitative evidence suggests that, in reducing background risk in the area, these investments stimulated development dividends that included continued investment by oil companies in the region that were otherwise leaving, private investment in housing in previously flood-prone areas, and public investment in improved drainage and electricity networks in areas where floods had previously deterred. Investments also stimulated co-benefits for society and the environment. The local government has improved parks and street paving in areas once neglected because of regular flooding, and tree planting has begun on riverbanks to prevent landslides.

Source: T. Tanner and J. Rentschler. 2015. Unlocking the "Triple Dividend" of Resilience: Why Investing in Disaster Risk Management Pays Off. Interim Policy Note. Washington, DC: Global Facility for Disaster Reduction and Recovery and London: Overseas Development Institute.

2. Actions and Modalities

A wide range of potential actions can be identified for private sector engagement in enhancing UCCR. Many sectors can be pinpointed for engagement,⁸⁰ with three modes distinguished.

Strengthen business continuity. As companies become more engaged in global value chains, there are increasing needs to protect physical assets through robust structural measures, and to incorporate redundancy in supply chains, which would enable business continuity in the face of external shocks. While such actions are primarily to safeguard the company's own interests, it can also support other, often smaller, companies in the value chain. Small businesses, formal and informal, may also look to local chambers of commerce and/or business associations to educate them on climate change risks. They can then jointly identify measures, including providing risk information, incentives, and capacity building to better protect small businesses from these (footnote 80).

Explore business opportunity. Provision of urban lifeline utilities such as communications, energy, transport, water, and wastewater systems is often contracted out to private sector firms. Business engagement with resilience building may help stabilize existing markets or develop new opportunities, such as supplying robust urban infrastructure, providing risk information, or developing new hard and soft technologies. Local governments in at-risk locations may enter into mutual aid agreements with such firms to formalize support that may be needed in the event of a disaster. Outreach to small-scale local construction-related service providers can be particularly important, as much of the building work in informal settlements and urban slums often takes place outside of formal regulatory systems.

Consider business as a stakeholder. PPPs are likely to become more common, given that many cities lack the financial resources to respond to the challenges of enhancing climate change resilience. These could span activities such as delivering service contracts for public sector suppliers as well as full-scale

⁸⁰ A. Khattri, D. Parameshwar, and S. Pellech. 2010. *Opportunities for Private Sector Engagement in Urban Climate Change Resilience Building*. Hyderabad: Intellectual Capital Advisory Services; A. Jha, T. Miner, and Z. Stanton-Geddes, eds. 2013. *Building Urban Resilience: Principles, Tools, and Practice*. Washington, DC: World Bank.

joint ventures and privatization. International finance also plays a key catalytic role in developing UCCR programs and drawing in private sector actors. Local nongovernment organizations and CSOs can support firms to attain some of their corporate social responsibility goals, including through collaboration with finance and insurance companies on risk transfer mechanisms for urban communities. Businesses themselves may also be central in developing collaborative initiatives, as the Southern Gujarat Chamber of Commerce & Industry illustrated through the formation of the Surat Climate Change Trust in India, which draws in stakeholders to plan and tackle climate change to increase the resilience of vulnerable sectors and communities to the adverse impacts of urbanization and climate change.⁸¹

Provide incentives for engaging the private sector. In addition, city authorities are increasingly exploring financial incentives for engaging the private sector in UCCR-related initiatives. These include supportive changes to business, sales, and property taxes; rebates to promote installation of design features that incorporate robustness, redundancy, and flexibility, such as flood-proofing or information technology backup systems; subsidies, grants, and soft loans; and financial aid following a disaster itself (footnote 80). There may also be incentives from fulfilling explicit contractual requirements with partners, particularly in hazard-prone locations with a history of disaster-related events. These partners include government bodies as part of PPPs as well as other businesses or clients, and requirements may relate to business continuity plans and insurance provisions.

3. Challenges

Weak governance resulting in poor compliance to resilience-building regulations. The key challenges to effective engagement of the private sector in UCCR relate to governance, finance, knowledge, data, and business planning. Governance is a crucial determinant of effective resilience building and remains a major challenge in many cities, with physical and population growth often outpacing government capacity.⁸² This leads to absence or weak enforcement of a suitable regulatory environment to incentivize resilience, for example through land use plan or building codes.

Lack of awareness, especially among small and medium-sized businesses. Businesses may not be fully aware of the concept of UCCR, nor of how risks may change in a changing climate. This is likely to be more pronounced for small and medium-sized and informal enterprises. Even where awareness exists, there may be challenges to investments in resilience, given the pressures for short-term returns, the uncertainties and long return periods associated with climate change, and the need to weigh the costs of building flexibility or redundancy into delivering value to shareholders. The growing emphasis on resilience dividends is helping challenge this, but this evidence based practice is only just beginning to develop (footnotes 79). The inclusion of business stakeholders in enhancing UCCR, particularly through chambers of commerce or CSOs representing businesses, will be vital to raise awareness, build consensus for action, and understand gaps in data and knowledge.

⁸¹ weADAPT. Surat Climate Change Trust. <https://www.weadapt.org/organisation/surat-climate-change-trust-sccct>

⁸² T. Tanner et al. 2009. Urban Governance for Adaptation: Assessing Climate Change Resilience in Ten Asian Cities. *IDS Working Paper*. No. 315. Brighton: Institute of Development Studies.



G. Entry Point 7: Catalyzing Finances

Operationalizing the preceding six entry points will inevitably require financial resources. Enhancing the ability of urban areas to access and absorb streams of funding to implement actions of enhancing resilience to climate change is the final entry point that requires close examination.

Key Points
<p>Opportunities and Benefits</p> <ul style="list-style-type: none"> • Basic financial management infrastructure exists in most cities, and existing funding streams should be taken advantage of to support novel actions to enhance urban climate change resilience (UCCR).
<p>Actions and Modalities</p> <ul style="list-style-type: none"> • Catalyze action to ensure that finances available from various levels of governance are deployed to enhance UCCR. These include the following: <ul style="list-style-type: none"> – Local: microfinance and local development funds – City: private sector and city-level funds – Provincial and national: earmarked (e.g., funds for urban development) and non-earmarked (e.g., budget support for city governments) – International: multilateral, bilateral, and philanthropic funding
<p>Challenges</p> <ul style="list-style-type: none"> • Poor understanding of costs and benefits of enhancing UCCR • Lack of financial absorptive capacity in cities • Challenges with scaling up • Lack of clarity on methodologies for outlining additionality of finance for UCCR

1. Opportunities and Benefits

Infrastructure for financial management exists and can be creatively used to enhance UCCR. In most cities, the basic structures for managing streams of funding for UCCR exist. Cities have the fiduciary infrastructure to generate local funds, receive funds from provincial and national governments, program funds (e.g., by allocating them to different departments), and account for receipts and expenditures. These systems may be weak and fractured, but financial management infrastructure (protocols and personnel) to build on is usually present. It may be a case of taking advantage of existing funding opportunities as opposed to the generation of fresh, exclusive streams of funding. Many rapidly urbanizing countries have a large amount of funding (national or provincial) earmarked for urban development. For instance, two of India’s nodal urban development programs

have an outlay of \$10 billion each. Creatively deploying even a small percentage of these funds could lead to substantial gains for UCCR.⁸³

2. Actions and Modalities

The options and instruments for generating finance for UCCR fall broadly into public and private sources at the local, city, national, and international scales.

Tap localized sources of finance in support of UCCR. Highly localized sources of finance, including bottom-up financing mechanisms, such as microcredit, microinsurance, and microsavings, can enhance resilience. Microcredit “can support entrepreneurial undertakings by those unable to get bank loans, help diversify local economies and empower women in particular, which can in turn contribute to adaptive capacity in a local context” (footnote 29: 38). Informal or semiformal savings groups also play an important role in reducing risk in urban areas, as they provide quick access to emergency loans, especially in informal settlements with transient populations whose access to formal banking mechanisms is limited. Microinsurance can also enhance UCCR. For example, hazard-indexed microinsurance for small urban businesses can enable local markets to recover faster from climate-related shocks. Early indications from one such initiative being piloted by CSOs with 5,000 small businesses in Guwahati, India are positive.⁸⁴ Of course, challenges exist around regulating microfinance institutions to prevent exploitative lending, and there is a lack of clarity on how it can be deployed to make collective investments (e.g., to improve drainage). Despite this, there is evidence that “locally controlled funds managed directly by organizations of low-income urban residents have shown their ability to reduce risk and vulnerability” (footnote 74: 1), and they contribute significantly to inclusiveness.

Utilize local development funds to support resilience-building measures. Countries with a degree of political devolution may provide public funding earmarked for local development. This includes funds made available to locally elected political leaders to undertake development activity in their constituencies. In Gorakhpur, India, community activism on urban resilience in one municipal ward has led to some of these funds being deployed to enhance resilience (improving drainage to deal with low-intensity, high-frequency flooding).⁸⁵ Community mobilization of the type discussed in entry point 5 can ensure more such funds go into building resilience and thereby contribute to resourcefulness. Sometimes these funds are based on performance criteria which could include direct or indirect criteria, leading to enhancing UCCR. For example, in Nepal, local governments can access block grants under the national Minimum Conditions Performance Criteria program. Some of these criteria, such as “following building regulations,” can directly contribute to reducing risks from extreme climate events.

Leveraging city’s own financial resources. Funds for resilience can also come from a city’s own financial sources. The main sources of municipal revenue include some form of taxes on income, corporate revenues, property, goods, and services; excise; intergovernmental resource transfers; and institutional grants.⁸⁶ The revenue is then plowed into a range of expenditure streams, including the

⁸³ Government of India, Prime Minister’s Office.. 2015. Union Cabinet Approves Atal Mission for Rejuvenation and Urban Transformation and Smart Cities Mission to Drive Economic Growth and Foster Inclusive Urban Development. 29 April. http://pmindia.gov.in/en/news_updates/union-cabinet-approves-atal-mission-for-rejuvenation-and-urban-transformation-and-smart-cities-mission-to-drive-economic-growth-and-foster-inclusive-urban-development/

⁸⁴ K. Gupta. 2015. Risk Insurance and Adaptation: Managing Urban Risks. southasiadisasters.net. 130. May.

⁸⁵ A. Bahadur and M. Chaturvedi. 2014. *Micro Resilience Planning in Mahewa, Gorakhpur: An Evaluative Commentary*. London: Overseas Development Institute.

⁸⁶ UN-Habitat. 2009. *Guide to Municipal Finance*. Nairobi.

financing of activities across the sectors and systems described in entry point 3. Therefore, ensuring that resilience principles are effectively mainstreamed into sector plans increases the chance of some of these resources enhancing UCCR. City revenues may also be devoted to “bespoke” activities. These could include a range of actions from building infrastructure to reduce exposure to hazards, to developing institutional mechanisms to deal with climate change impacts and raising awareness on drivers of risk and pathways of resilience. Cities are taking a growing number of actions to enhance UCCR by using their own resources. For example, the Ahmedabad Municipal Corporation has developed a plan to enhance resilience against heat waves by investing in early warning infrastructure, designating responsibility for taking action to officials, building the capacity of health care professionals, and financing awareness-raising initiatives.⁸⁷

Tap finances available with the private sector. Finance from the private sector can also play a key role, including through investments in the provision of risk transfer mechanisms or insurance, climate-proofing supply chains, and business continuity that ensures urban economies continue to flourish in the face of disturbance. Deutsche Post DHL (the world’s largest courier company) is investing human and financial resources in working with airports in cities across Bangladesh, El Salvador, Indonesia, Lebanon, Nepal, and Turkey to ensure, through training and contingency planning, that they continue to function when disasters occur.⁸⁸

Explore financing available from higher levels of government. More often than not, provincial and national levels streams of funding are those that are vital for enhancing UCCR. Many countries suffer from fractured processes of decentralization, whereby political and administrative functions are devolved but fiscal power is retained at higher levels of governance.⁸⁹ Revenue transfers from federal and state governments to cities could be earmarked for specific development works or take the form of non-earmarked budget support in line with the city’s priorities. Both could be used to enhance UCCR. Some of the non-earmarked funds will go into sector plans (of the type discussed in entry point 3); mainstreaming resilience qualities into these will ensure that provincial or national streams of finance are deployed to enhance UCCR. These streams could also enhance resilience through the imposition of “conditionalities” in return for access. It is possible for legislation or protocols to stipulate the release of funds to cities only after they have met a set of conditions that enhance resilience. In Brazil, the state of Paraná deploys criteria such as improvements in physical and biological quality (fauna and flora), quality of water resources, and quality of planning to determine the share of resources certain municipalities get (footnote 29).

When it comes to earmarked funds of the type that come attached to urban development programs for enhancing upgrade in information technology infrastructure, transport systems, roads, and drainage, it is a matter of city-level officials using these creatively to also deliver a resilience benefit. For this, those charged with requesting and programming these funds must understand how resilience can be beneficial (entry point 4). Alternatively, these funds could also be conditional (Box 9). A small number of developing countries are also starting to develop national funds to provide financing for risk reduction, adaptation, and resilience. The Bangladesh Climate Change Trust Fund (\$100 million per year) offers city governments access to finance for specific projects.

⁸⁷ A. Jaiswal. 2014. *Ahmedabad Heat Action Plan: South Asia’s First Climate Adaptation and Early Warning System for Extreme Heat*. London: Climate & Development Knowledge Network.

⁸⁸ Meister Consultants Group. 2013. *Resilience in Action: Lessons from Public-Private Collaborations Around the World*. Summary for Policy Makers. London: Climate & Development Knowledge Network.

⁸⁹ Maria Angelica Sotomayor, interview, 22 November 2015; K. Chamaraj. 2009. *Parastatals and Task Forces: The New Decision-Makers*. <http://www.indiatogether.org/2009/feb/gov-parastate.htm>

Box 9: Conditionality to Enhance Resilience, India

India's flagship national urban renewal program, the Jawaharlal Nehru Urban Renewal Mission, lacked clarity on using funds (\$10 billion) to reduce risk and build resilience.^a Therefore, the program that replaced it, i.e., the Atal Mission for Rejuvenation and Urban Transformation (\$10 billion), outlines that projects financed by this national fund will support urban resilience by mandating that “disaster-secure engineering” and “structural norms” for risk reduction are built into plans from the very beginning.^b Cities applying have to explain how risk and resilience are factored into the plans for which they seek funding.

Sources:

^a The Energy and Resources Institute. 2012. *Climate-Resilient and Sustainable Urban Development*. London and New Delhi.

^b Government of India, Ministry of Urban Development. 2015. *Atal Mission for Rejuvenation and Urban Transformation: Mission Statement & Guidelines*. New Delhi. <http://amrut.gov.in/writereaddata/AMRUT%20Guidelines%20.pdf>

Leverage international sources of climate finance. In international sources, multilateral and bilateral climate finance mechanisms are proliferating, and some of these are focusing increasingly on urban areas, with some of their financing being employed to enhance resilience. A recent analysis reveals that \$77 million was given to urban resilience projects from 2010 to 2012 in the form of multilateral funding.⁹⁰ These projects focused on resilient infrastructure, improving institutional capacity and planning, and ecosystem-based approaches to enhancing resilience. Of course, this is only a tiny fraction of the amount needed for UCCR, but it demonstrates that there is potential to expand the amount of finance flowing from these funds toward resilience projects. Bilateral aid for urban adaptation and resilience totaled \$720 million per year during 2010–2012, mostly going to cities in Asia,⁹¹ although there are questions on the degree to which this is different from “business as usual” development funding (footnote 90). Other international sources of climate finance include targeted flows from philanthropic ventures and charities such as the Rockefeller Foundation’s ACCCRN and the 100 Resilient Cities initiative.

Finally, it is only through catalytic action from a diverse array of agents that sources of finance can be used to enhance UCCR. A pilot CSO project in Guwahati, India provided hazard-indexed microinsurance and mobilized community members to demand the allocation of local funds for resilience. There is also a need for advocacy and capacity building to ensure public expenditure at the city level supports UCCR. While the Ahmedabad Municipal Corporation led the heat action planning process, it received technical support from a consortium of international and national nongovernment organizations. Even in the case of the Deutsche Post DHL initiative, the United Nations Development Programme created an enabling environment. Similarly, there is a need to build adequate capacity at the different levels of governance to ensure that international climate finance can be usefully deployed to enhance resilience.

While the exact nature of these catalytic activities will vary, they are all aimed at generating demand for the supply of funds. International actors including multilateral banks can play this catalytic role in developing tools and methodologies to enhance financial absorptive capacity and bringing key stakeholders together to facilitate financial flows.⁹²

⁹⁰ S. Barnard. 2015. *Climate Finance for Cities*. ODI Working Paper. No. 419. London: Overseas Development Institute.

⁹¹ Organisation for Economic Co-operation and Development. Development Assistance Committee. 2014. *Aid to Urban Climate Change Adaptation*. Paris.

⁹² Michael Gruber, interview, 23 September 2015.

3. Challenges

Challenges are ample and include the following:

Inadequate understanding of financial benefits of investing in resilience. First, even though much progress has been made in terms of understanding the financial benefits of investing in resilience, this remains an inexact science at best. Even where such analysis has been done, it has not always been successful in mobilizing investment, as just avoiding loss is not seen as adequate motivation for politicians to sanction resources for resilience.⁹³ A growing interest in methodologies to calculate a “resilience dividend,” which would permit the analysis of additional benefits (such as cities with resilient infrastructure being perceived as attractive investment destinations), seems to offer a way around this.

Lack of capacity to absorb and program funds for UCCR. Second, capacity to usefully absorb and program funds for urban resilience is deficient. This is why a recent review of multilateral urban climate finance underlines an urgent need to build absorptive and technical capacities at the local level. Strengthening the capacity of cities to receive climate finance by, for instance, having plans for a feasible set of resilience projects is an “area of untapped potential” for those looking to sustainably support UCCR (footnote 90). Other actions would include improving fiduciary management processes in urban governments, so they comply with national and international standards expected of fund recipients (Box 10).

Box 10: World Bank City Creditworthiness Initiative

The World Bank’s City Creditworthiness Initiative helps cities improve their financial performance to increase their ability to secure and effectively program finances for delivering climate-smart infrastructure and services. Hands-on learning programs teach city leaders the fundamentals of creditworthiness and municipal finance, including issues determined by the enabling environment and options for financing, revenue management and enhancement, expenditure control and asset maintenance, capital investment planning, debt management, and scoping out options for financing. This is one example of how the demand for any kind of development finance, including that for enhancing urban climate change resilience, can be strengthened.

Source: World Bank. 2015. *City Creditworthiness Initiative: A Partnership to Deliver Municipal Finance*. Washington, DC.

Challenges with scaling up. Third, while local or bottom-up financing for resilience has been quite effective in isolated pockets, there remain challenges around scaling this up for greater impact and sustainability. This is primarily because local contextual factors play a major role in defining the dynamics of these funds, and there is no homogenous formula that can be applied uniformly to unlock local sources of climate finance across a large number of cities. The fostering of “federations” of local finance mechanisms can help overcome this. Urban Poor Fund International capitalizes on local funds established by its 33 national federations across 464 cities to combine the collective savings of residents with donor (and sometimes state) funds, and sends this money to local stakeholders via member federations (footnote 74). Since its foundation, Urban Poor Fund International has channeled \$20 million for a range of actions, including some aimed at UCCR.

⁹³ Michael Rattinger, interview, 4 September 2015.

Lack of methodological clarity in calculating additionality. Finally, greater scrutiny of financial streams is needed to ensure that funds being made available or deployed for “development as usual” are not packaged as resilience. ADB highlights this issue by noting that, “Clearly, development and addressing climate change (mitigation and/or adaptation) are not the same. Development projects may, or may not be modified so that they, contribute to mitigation and/or adaptation... Conceptually it can be difficult to classify a project as being development or as combatting climate change.”⁹⁴ Outlining the “additionality” climate finance brings is easier in the context of mitigation (as abated emissions can be measured); amendments or alterations made to projects to accommodate the risk of climate impacts are difficult to quantify. This is because the changes needed for resilience are extremely context-specific, and because being “adapted” to risks is key anyway to the success of the initiative rather than being an “addition.”

IV. KNOWLEDGE GAPS

A review of the opportunities, actions, and challenges in each of the seven entry points suggests that they need to come together in contextually relevant combinations to deliver UCCR instead of being treated as isolated sectors of activity. This relates back to the importance of understanding the city as a complex system (discussed in section II.B). For example, the right data need to be inserted (entry point 1) into comprehensive urban resilience planning processes (entry point 2) to mainstream resilience into key urban infrastructure systems (entry point 3) through inclusive processes that engage a variety of stakeholders (entry points 4, 5, and 6) using appropriate finance (entry point 7) to enhance UCCR. Certain cities may have made more progress on some entry points (e.g., they may have adequate data or information) more than on others (e.g., the private sector may not be aware of the need for UCCR), necessitating a different emphasis on each of the entry points based on local contextual factors.

Challenges for each entry point are identified above, but some broader gaps in knowledge on UCCR cut across the entry points, including the following:

- (i) It is impossible to enhance UCCR without engaging with key governance challenges. Fractured processes of decentralization across low- and middle-income countries in Asia and the Pacific mean that city governments usually cannot mandate the shifts in policy and planning required to build resilience. Those building UCCR need not only bring technical expertise but also act as savvy policy entrepreneurs so they can exploit windows of opportunity in policy and planning processes that may accompany changes in political leadership at the right moment. Overall, good governance through rights, entitlements, and accountability is vital, because it results in improved delivery of basic services, which can tangibly enhance people’s resilience to a range of climate-related shocks and stresses.
- (ii) Enhancing UCCR also entails navigating tricky issues around politics and power. The preceding sections have discussed how the large amount of informality and lack of regulation in urban areas mean that extra-governmental actors such as private builders, federations of slum residents, and community-based CSOs need to be part of any process to enhance UCCR. Wide, deep, and iterative consultations with a range of

⁹⁴ E. Haites. 2014. *Aligning Climate Finance and Development Finance for Asia and the Pacific: Potential and Prospects*. ADB Sustainable Development Working Paper Series. No. 33. Manila: ADB. pp. 42–43.

stakeholders can also be used to navigate any trade-offs in building resilience between these groups. Key to this engagement is mapping incentives for participation. For instance, explaining to builders that construction in low-lying areas is a risky investment could be more effective than more altruistic appeals. Understanding the incentives of legislators and city politicians is also crucial: arguments that demonstrate how enhancing UCCR can deliver benefits today while also helping the city prepare for an uncertain future are clearly needed. A techno-managerial approach that is not alive to political realities and the functioning of power is unlikely to result in major gains for UCCR.⁹⁵

- (iii) Finally, engaging with complexity is key to building UCCR. Indeed, the very structure of this paper and the seven entry points further emphasize the need to engage with the city as a complex system. Understanding the spatial, temporal, and sector relationships that make a city tick is vital. Those spearheading UCCR initiatives can positively engage with this complexity by garnering the viewpoints of those with a keen understanding of different parts of the city system. As such, the literature on UCCR repeatedly highlights the need for platforms where diverse constituencies can jointly deliberate and determine pathways of resilience. Inclusive and iterative processes of engagement can help make progress on this count.⁹⁶

Leveraging the potential of the entry points presented in this paper, while paying attention to the issues highlighted in this section, will help ensure that UCCR initiatives can support rapidly growing and densifying urban areas to not only function but also flourish in the face of dangers posed by a changing climate.

⁹⁵ Saleem UI Haq, interview, 9 September 2015.

⁹⁶ Astrid Wigstrom, interview, 22 September 2015.

GLOSSARY OF KEY TERMS

Climate change	A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2012).
Climate change adaptation	In human systems, the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate (IPCC 2012).
Disaster risk reduction	Denotes both a policy goal or objective, and the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard, or vulnerability; and improving resilience (IPCC 2012).
Exposure	The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected (IPCC 2012).
Hazard	The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources (IPCC 2012).
Resilience	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC 2012).
Shocks	Sudden, sharp events that threaten a city. In this document, shocks refer to the ones that are hydrometeorological in nature, e.g., floods and tropical cyclones (adapted from 100 Resilient Cities webpage).
Stresses	Factors that weaken the fabric of a city on a daily or cyclical basis. In this document, stresses refer to the ones that have origin in hydrometeorology, e.g., chronic and water shortage (adapted from 100 Resilient Cities webpage).
Urban climate change resilience	The capacity of cities to function so that the people living and working in cities, particularly the poor and vulnerable, survive and thrive in the face of shocks and stresses related to climate change (ADB 2014).
Urban resilience	The capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience (100 Resilient Cities webpage).
Urban systems	Include infrastructure, services, and functions (e.g., water supply and wastewater treatment systems, solid waste management, roads, power lines, food distribution,

health, education, and finance) and ecosystems (e.g., agricultural land, parks, wetlands, and fishing grounds). Systems are designed and managed by people, but their performance depends on a multitude of factors that are difficult to manage, including human behavior and institutional context, which often lead to unintended side effects such as pollution. Systems are fragile if they are easily disrupted or broken, though their basic functioning may look very stable. Systems are linked and dependent on each other. The strengths or weakness of the links between systems can enhance adaptive capacity or increase the vulnerability of other systems (adapted from ISET-International 2012).

Vulnerability The propensity or predisposition to be adversely affected (IPCC 2012).

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Enhancing Urban Climate Change Resilience

Seven Entry Points for Action

This working paper synthesizes existing knowledge on urban climate change resilience to identify seven entry points for actions. It is expected that the proposed entry points will benefit ADB's developing member countries, development partners, staffs and projects under the Urban Climate Change Resilience Trust Fund to take actions for strengthening urban resilience.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to a large share of the world's poor. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

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



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