PREPARED COMMUNITIES

Implementing the Urban Community Resilience Assessment in Vulnerable Neighborhoods of Three Cities

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ACKNOWLEDGMENTS

We are pleased to acknowledge our institutional strategic partners, who provide core funding to WRI: Netherlands Ministry of Foreign Affairs, Royal Danish Ministry of Foreign Affairs, and Swedish International Development Cooperation Agency.

This project is an outcome of the knowledge, expertise, and efforts of many individuals and organizations. We would like to express our gratitude to the families and individuals who participated in the UCRA process in Rio de Janeiro, Surat, and Semarang, who graciously let us into their homes; shared their knowledge and personal stories, often over tea and food; and had faith in our intentions.

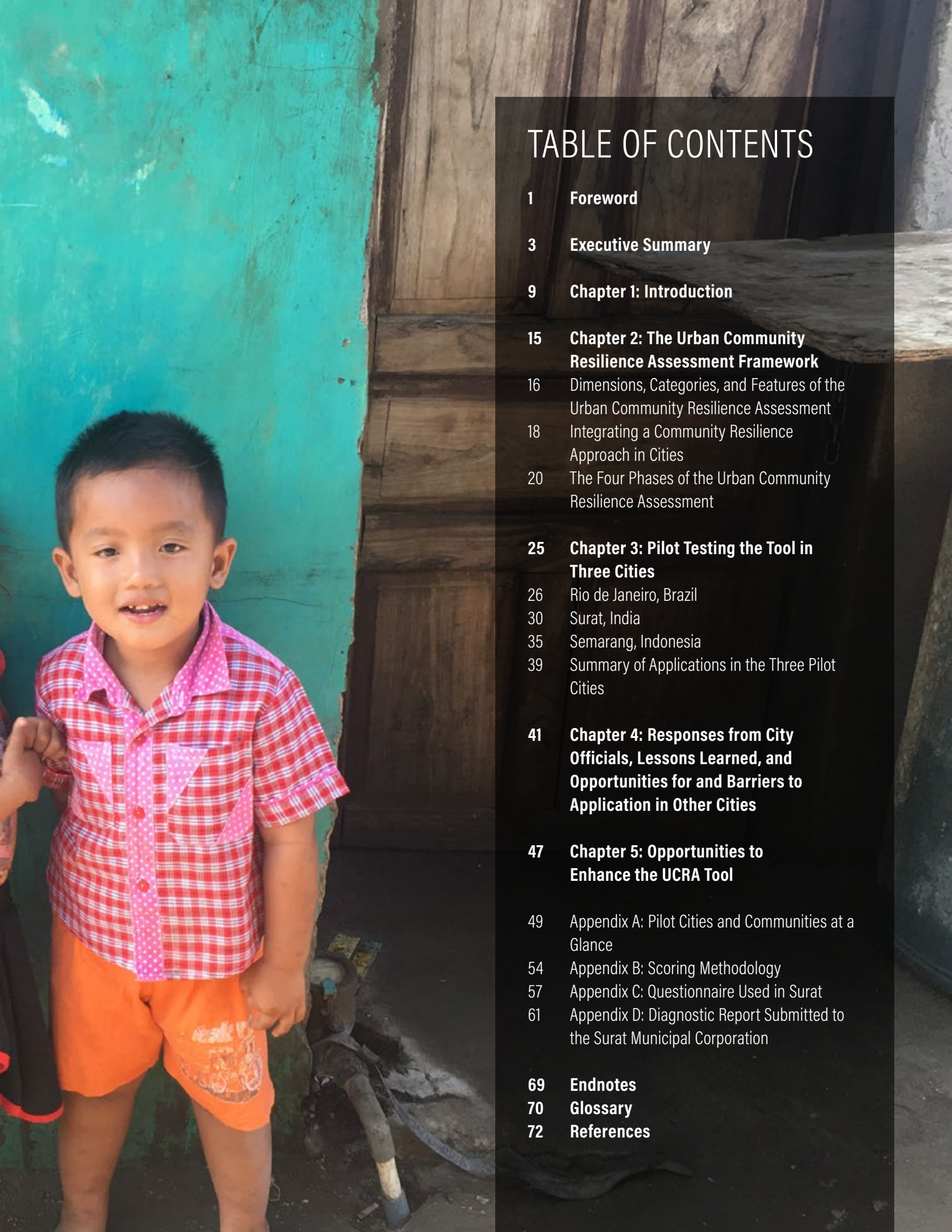
Our work would not have been possible without the support of and guidance from our institutional partners. They included the Municipal Government and Civil Defense in Rio; the Surat Municipal Corporation and the Urban Health and Climate Resilience Centre for Excellence (UHCRCE), under the leadership of Dr. Vikas Desai, in Surat; and the Initiative for Urban Climate Change and the Environment (IUCCE), under the leadership of Mr. Purnomo Dwi Sasongko, in Semarang.

We are grateful for the strong international, regional, and local partnerships of members of the Cities Alliance Joint Work Program and the 100 Resilient Cities network, which were integral to the initial framing and strategic development of this project. Insightful comments from reviewers improved the quality of this report. Internal reviewers included Christina Chan, Laura Malaguzzi, Luiza Oliveira, Madhav Pai, Nambi Appadurai, and Robin King. External reviewers included Ajay Dhiraj Suri (Cities Alliance), David Dodman (International Institute for Environment and Development), Ratri Sutarto (Mercy Corps Indonesia), and Sharon Gil (UN Environment).

The hard work and efforts of several colleagues and interns who supported the evolution of the UCRA tool over the past two years is deeply appreciated. We thank Daniela Cassel, Daniely Votto, Fabricio Pietrobelli, and Magdala Arioli for their work on Brazil and Alex Linz, Manasi Nanavati, Praveen Yadav, and Sonia Suresh for their work on India.

We express special appreciation to our WRI colleagues. Heather McGray, who is now the Director of the Climate Justice Resilience Fund, and Ayesha Dinshaw, who provided support and critical guidance in conceptualizing the UCRA indicators for application in Brazil. Renata Marson, Maria Hart, and Laura Malaguzzi provided endless patience and guidance throughout the review and publication process. Carni Klirs and Romain Warnault supported the publication design and layout. Emily Matthews and Barbara Karni provided valuable assistance with the editorial process. Schuyler Null, Marlena Chertock, Sarah Parsons, and Talia Rubnitz helped with messaging and outreach.

We are indebted to the Cities Alliance Joint Work Program for funding this work and to the WRI Ross Center for Sustainable Cities for additional financial support.



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FOREWORD

Cities are key players in the global movement to address the threats posed by climate change. They invest in climate-resilient infrastructure, information management systems, and risk-reduction programs. But poor urban residents who live in risk-prone areas are often left out of the planning and implementation process, leaving them more vulnerable to extreme climate-related events.

The new Urban Community Resilience Assessment (UCRA) tool described in this report aims to address this critical omission. This resilience planning process can help link local knowledge from cities, neighborhoods, and individuals with planning priorities. The report describes the pilot application of the approach in three cities—Rio de Janeiro, Brazil; Surat, India; and Semarang, Indonesia—and presents the tool's potential for future applications in other cities.

The people who stand to suffer the most from climate change live in poor and vulnerable communities. Infrastructure and urban services in these communities are often inadequate, and housing is often located in precarious settings, such as steep slopes, flood plains, or hazardous industrial areas. Homes are often self-constructed and unable to withstand extreme climate events. Lack of access to early warning systems heightens the risk for these communities.

Lack of skills, knowledge, and social capital exacerbates the risks vulnerable people face. The social connections and support networks among neighbors, their political engagement, and their access to information or financial resources can increase their collective and individual potential to respond to risks.

This report can guide mayors, city officials, and elected representatives in designing resilience policies and projects that better address the needs of vulnerable people. It can be used by the disaster preparedness departments to improve emergency and preparatory action in poor communities. Community leaders and civil society advocates can use this report and the UCRA tool to adopt a participatory planning process that is collaborative—one in which stakeholders from diverse fields, institutions, and socioeconomic spheres develop resilience strategies together.

Climate resilience planning is complex. It requires city officials to step outside their departmental silos, address multiple aspects of vulnerability and resilience, engage with poor communities, and develop plans that go beyond engineered solutions. By engaging poor and vulnerable citizens in the process of resilience planning, communities can learn to respond to risks, reorganize to maintain their essential functions, and adopt a culture of continuous learning and adaptation.

Andrew Steer
President
World Resources Institute

EXECUTIVE SUMMARY

Urban resilience is receiving more global attention than ever before. The SDGs and the Paris Agreement make clear commitments to prioritize the lives and well-being of vulnerable communities living in cities. The Urban Community Resilience Assessment tool is well positioned to help cities leverage this international momentum to strengthen social resilience while achieving resilience goals.

HIGHLIGHTS

- Cities around the world are experiencing increases in the frequency and intensity of climate-induced natural disasters. Such disasters are severely affecting communities in underserved and underdeveloped urban areas.
- The Urban Community Resilience Assessment (UCRA) tool, developed by the World Resources Institute (WRI), proposes a bottom-up resilience planning process that aims to link local knowledge with top-down planning priorities. This report describes the UCRA framework and discusses the limitations and opportunities of pilot testing it in three cities: Rio de Janeiro, Brazil; Surat, India; and Semarang, Indonesia.
- Applying the UCRA in the three cities revealed that the perceptions of climate-related risks differ by city, gender, and the effectiveness of information and communication systems. The share of respondents that perceived climate-induced hazards as life threats ranged markedly (74 percent in Rio, 65 percent in Surat, and 38 percent in Semarang). Across the three cities, men, who were more politically engaged than women, were more likely to perceive climate change as posing risks.
- The UCRA helps cities measure vulnerabilities, resilience capacities, access to services, information, social networks, and financial resources across neighborhoods.
- If tools like the UCRA can be deployed in a cost-effective, time sensitive, and easy to apply manner, planners can use them to create locally relevant resilience plans that link city-wide social development programs with community resilience priorities.

Context

Partly in response to massive urban growth in the 21st century, countries and international organizations have set global targets for sustainable and climate-resilient development. Poor urban communities are at the center of these global goals for eradicating poverty, boosting shared prosperity, and driving sustainable urban growth. Cities, national governments, and international development agencies are increasingly focusing on the need for inclusion in urban resilience planning to leverage local community knowledge and focus on vulnerable communities (UNFCCC 2018).

Cities are exposed to a multitude of risks, which disproportionately affect poor and vulnerable communities. In 2017 alone, natural disasters displaced millions of people (Galvin 2017) and upended the lives of millions more.

Tailoring the response to resilience requires that cities understand the range of urban risks and develop appropriate resilience responses (Brown et al. 2017). Planning and collecting accurate and detailed risk data, integrating multistakeholder participation involving vulnerable communities, and ensuring interdepartmental coordination will help cities grow along climate-resilient pathways.

About This Report

This report describes the UCRA and its application in poor communities of Rio de Janeiro, Brazil; Surat, India; and Semarang, Indonesia—three coastal cities that are at increased risk of flooding, landslides, land subsidence, and heat stress. It describes lessons learned and the recommended actions co-developed with community members.

The report is intended for city planners, community-based organizations, and international development organizations interested in enhancing resilience in poor and vulnerable communities. Local development organizations, community leaders, and community rights advocacy groups looking to develop resilience diagnostics and engage in participatory planning with community members may also find it valuable.

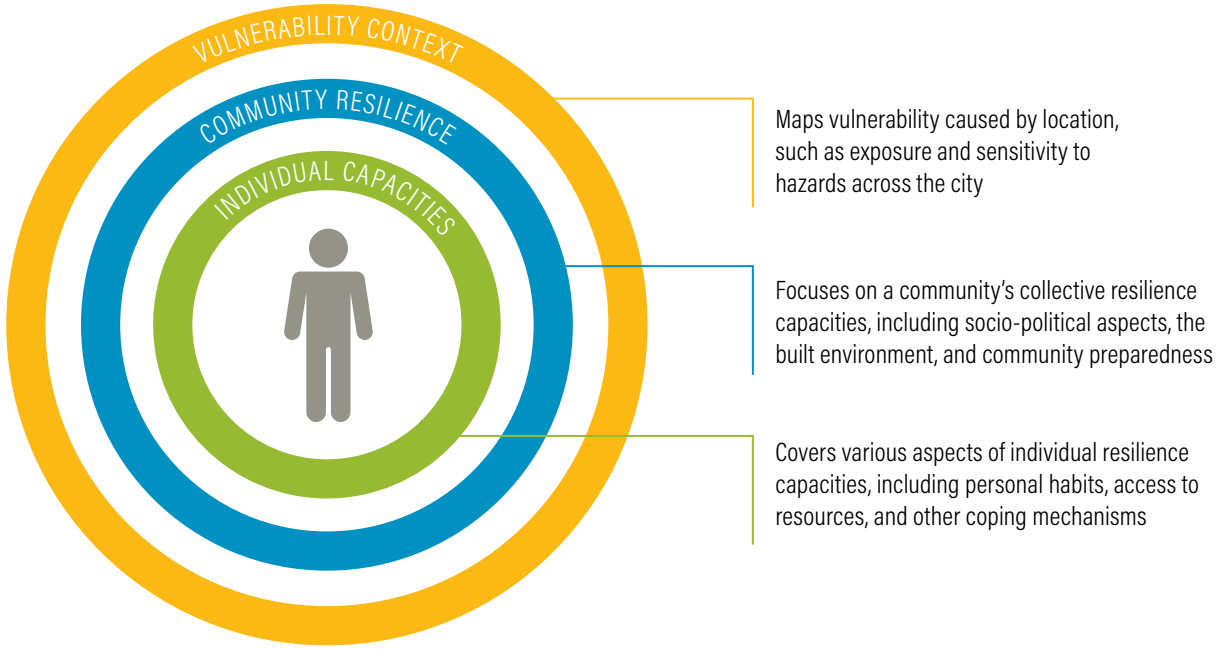
What Is an Urban Community Resilience Assessment?

The UCRA is a bottom-up resilience planning process that links local knowledge with top-down planning priorities. It is inspired by the place-based approach of Cutter et al. (2008), which focuses on a community's social resilience potential as well as infrastructural upgrades, early warning and evacuation communication, and trainings to enhance personal resilience capacities.

The UCRA includes three dimensions, subdivided into 10 categories and up to 60 indicators. The three dimensions (Figure ES.1) include the vulnerability context at the city level, the community resilience potential of the neighborhood, and household capacities to respond to climate disasters. Within each dimension are flexible indicators that can be customized to the local context.

Cities are exposed to a multitude of risks, which disproportionately affect poor and vulnerable communities. In 2017 alone, natural disasters displaced millions of people and upended the lives of millions more.

Figure ES.1 | Three Dimensions of the Urban Community Resilience Assessment



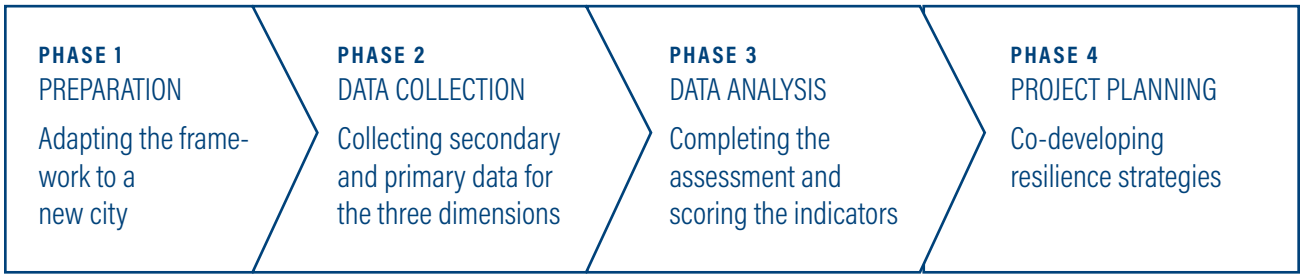
Source: WRI

The UCRA framework allows resilience planners to identify causal relationships across the categories and indicators, leading to resilience actions that can address multiple issues. It provides an opportunity to integrate city-wide vulnerability assessments and resilience strategies with local neighborhood concerns, linking top-down and bottom-up information systems and resilience actions. It aims to use disaster preparedness activities as an entry point for strengthening social networks and building stronger, better-prepared, and more resilient communities.

The UCRA helps cities bring together information on people's resilience capacities, to connect city-level resilience plans with local residents. It provides cities with a baseline, which allows them to target resilience efforts toward specific gaps in the near term and monitor the impacts of these efforts over the long term. It helps city officials explore causal relationships across different UCRA indicators and enhances overall community and individual resilience by engaging residents in surveys, focus group discussions, and planning workshops. Application of the UCRA can inspire participatory planning in other planning sectors in the city, creating a new culture of inclusionary planning.

The UCRA process is carried out in four phases (Figure ES.2), which took six to eight months to complete in the three pilot cities. The process allows cities to customize the indicators, identify a team of experts and community leaders who serve as advisors to the implementing team, administer the data collection and analysis, and co-develop resilience actions with community members. Chapter 2 of this report describes the step-wise implementation methodology, based on the team's experiences in Rio de Janeiro, Surat, and Semarang.

Figure ES.2 | Four Phases of Implementation of the Urban Community Resilience Assessment



Main Findings

Cities can benefit from the UCRA process in several ways. The process helps officials connect resilience actions and policies to vulnerable communities, promotes a culture of inclusive planning, involves multiple stakeholders and participatory activities, and provides cities with a baseline of detailed data at the local level. The city resilience strategy, participatory city-regional visioning workshops, and ward-level consultations represent a platform for mainstreaming resilience thinking and sharing successes and failures across communities in a city.

Pilot implementation of the UCRA revealed three main limitations. First, a lack of political will and leadership to drive the UCRA process lengthens the implementation period and reduces effectiveness. Second, the UCRA methodology is costly and time-intensive. Third, incongruencies in data, information, and language across the city, neighborhood, and individual levels make it difficult to build consensus among city officials and community members.

BOX ES.1 | ABBREVIATIONS

ACCCRN	Asian Cities Climate Change Resilience Network
IUCCE	Initiative for Urban Climate Change and Environment
SDG	Sustainable Development Goal
UCRA	Urban Community Resilience Assessment
WRI	World Resources Institute

The UCRA has the potential to promote peer-to-peer learning between cities. Developing an online community of practice could help promote pro-poor urban climate resilience planning by allowing cities to exchange insights, visually display and share results, and overcome barriers to implementation more rapidly.

The city resilience strategy, participatory city-regional visioning workshops, and ward-level consultations represent a platform for mainstreaming resilience thinking and sharing successes and failures across communities in a city.

CHAPTER I

INTRODUCTION

Climate resilience planning is complex. The Urban Community Resilience Assessment tool is a bottom-up resilience planning process, linking local knowledge with city planning priorities. The UCRA can guide mayors, city officials, and elected representatives in designing policies and projects that build resilience and better address the needs of vulnerable people.

The Global Context

Urban growth in the 21st century has transformed towns and cities. In 1950 just 30 percent of the world's population lived in urban areas. This figure rose to 54 percent in 2014 and is projected to reach 66 percent by 2050, with most of the growth occurring in Africa and Asia (UN-DESA 2015).

Local institutions must accommodate a growing urban population efficiently, equitably, and sustainably. Failure to do so has created a plethora of challenges in most cities of the global South. Increasing inequality and urban sprawl have intensified challenges for city dwellers, making it harder for them to access safe drinking water and affordable transportation and earn a living.

The people most affected by the inability of local institutions to manage the challenges of urbanization are the urban poor, especially poor people living in underserved or underdeveloped neighborhoods. Almost 1 billion people in the world live in urban slums (Satterthwaite et al. 2018). They frequently occupy at-risk areas, such as coastlines, floodplains, hillsides, and underserviced areas. Poor urban communities usually have limited influence over local governments. Even where cities have city-level disaster management plans, their needs tend to be overlooked and neglected, increasing their vulnerability to losses.

What Is Resilience?

Resilience is defined as "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation" (IPCC 2014). In this report, urban climate resilience planning is defined as integrating climate science and risk projections into long-term urban planning and short-term urban development projects. One of its goals is to reduce vulnerability to climate change. To do so, urban resilience plans should address the specific needs of vulnerable communities and ensure that residents participate in planning processes (Satterthwaite et al. 2018).

Various resilience measurement tools, frameworks, and methodologies were developed over the past 20 years to measure urban climate resilience (Bahadur et al. 2015; Beccari 2016; Vaitla et al. 2012). The wealth of tools partly reflects the fact that resilience is being applied to a range of fields, including ecology, psychology, engineering, and urbanism, each of which requires a different approach.

The dynamic and continuous process of creating resilience renders it challenging to measure over time (Frankenberger et al. 2012). Efforts are being made to identify the most effective ways to measure resilience.

The Need for Urban Climate Resilience Planning That Focuses on Individual Preparedness

Urban climate resilience planning has become a priority for global agendas such as the Sustainable Development Goals (SDGs), the New Urban Agenda, the Sendai Framework, and the Paris Agreement. For example, SDG 11 ("make cities and human settlements inclusive, safe, resilient and sustainable") sets targets for cities to adopt and implement "integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, develop and implement in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, and promote a holistic disaster risk management at all levels." The New Urban Agenda—adopted by the UNHabitat at the Habitat III world forum in October 2016—outlines planning activities that can help achieve the SDGs.

The success of these agendas and frameworks relies partly on the extent to which they can be contextualized and implemented at the local level (Tollin 2015). City governments are in a position to link global goals to local communities through public policy, local trainings to build technical and institutional capacities, investments in resilient infrastructure, and increases in access to information at various scales of planning.

Because vulnerability and climate impacts are

unevenly distributed, resilience planning requires measuring the climate resilience of different communities and engaging them as part of the planning process. Doing so helps cities identify and assess differential resilience needs and ensure that locally appropriate plans to climate change are developed. Involving local communities in the planning process is critical for preventing resilience strategies from excluding parts of the population and/or exacerbating vulnerabilities.

Anguelovski et al. (2016) show how urban adaptation initiatives in eight cities increase climate vulnerability in poor communities when the poor are excluded from the planning process. City authorities in Manila blamed poor households for blocking drains (which increases flood risk) and adopted flood mitigation measures that could potentially force the relocation of 100,000 poor households to provincial areas outside the city, where they would continue to be exposed to climate-induced risks. In Medellín, Colombia, the city is proposing a green belt zone to contain urban growth and reduce risks from landslides that would result in the relocation of thousands of poor residents, leaving residents of high-income areas unaffected. Poor residents claim the city is misusing studies and exaggerating risks to make the case for relocating informal settlements.

Purpose of the Urban Community Resilience Assessment

The UCRA helps cities develop vulnerability and resilience assessments at the local level and incorporate the findings into wider city and subcity disaster management and resilience plans. It provides a snapshot of resilience capacities, including social and political networks, collective preparedness mechanisms, and access to economic resources. Each assessment is based partly on focus group discussions, which reveal a local community's willingness to engage in collective resilience actions and integrate them into disaster preparedness and planning.

The UCRA collects data that are disaggregated by gender, age, income, and social profiles, allowing cities to map differential vulnerabilities across neighborhoods and to distinguish the needs of women, children, and vulnerable social groups. The UCRA framework is designed to help cities manage data across various scales and aspects of vulnerability and resilience.

The UCRA approach aims to achieve three main objectives:

- Dismantling conventional silos: Top-down resilience strategies function within conventional departmental silos, with minimal coordination across agencies and departments (Cutter et al. 2013), exacerbating implementation gaps.
- Moving away from engineered solutions: For solutions to be effective, multiple stakeholders must engage in the process. They include city leaders, who seek mechanical, engineered solutions; ecologists, who acknowledge the fragile nature of ecosystems; and social psychologists, who seek to address the emotional needs of the most vulnerable people (Vale 2014).
- Promoting a multistakeholder, community resilience process: Community voices are integral to understanding urban risks, defining vulnerabilities, and co-developing strategies. The UCRA is a multistakeholder planning process that cuts across departmental silos, planning hierarchies, and socioeconomic barriers.

Vulnerability assessments are a method to map exposure and sensitivity to climate-induced hazards in different areas and communities in a city while measuring individuals' capacities to withstand, respond to, and recover from risks. The UCRA is meant to be used collaboratively with existing vulnerability assessments completed at the city level. For example, the vulnerability assessment for Semarang, Indonesia (conducted as part of an Asian Cities Climate Change Resilience Network [ACCCRN] project) was a systematic review of climate-induced hazards and vulnerabilities in the

city using subdistrict-level household surveys. A composite climate hazard index was created, with an assessment of adaptive capacities, access to information, and response mechanisms (ACCCRN and ISET 2010). In Surat, India, the vulnerability assessment was based on a combination of survey data and Geographic Information System (GIS) methods to map high-risk areas and access to infrastructure and services (ACCCRN and IIED 2013). It lacked local information, context-specific indicators, and participatory methods to improve interventions based on the local context (Taru Leading Edge 2010, 23).

The vulnerability assessments as part of the ACCCRN project (ACCCRN and IIED 2013 and ACCCRN and ISET 2010) and the Preliminary Resilience Assessments as part of the 100 Resilient Cities project (2016a; 2016b) provided detailed vulnerability contexts for the UCRA applications in both cities. The UCRA process enabled communities to learn about their resilience capacities (and deficits) and co-develop actions alongside city stakeholders.

Impetus for, Objectives of, and Organization of This Study

The impetus to develop an UCRA arose from conversations between WRI and the city of Rio de Janeiro in Brazil. The city highlighted the need for a comprehensive tool that could help measure the resilience of low-income and vulnerable communities and compare resilience capacities across neighborhoods in the city. WRI developed the UCRA framework for Rio de Janeiro and pilot tested it in two Brazilian cities: Rio de Janeiro and Porto Alegre (both part of the 100 Resilient Cities network). The UCRA is conceptualized as an actionable, locally focused, gender-responsive tool that can help cities measure resilience capacities in poor and vulnerable communities, considering multiple aspects.

With support from the Joint Work Program on Resilient Cities of the Cities Alliance, WRI pilot-tested the UCRA in poor urban communities in Rio de Janeiro, Brazil; Surat, India; and Semarang, Indonesia.[1] The three cities followed the same process, with a few adjustments to accommodate contextual details (e.g., local differences in language, gender-segregated workshops to enhance inclusivity, household versus individual surveys). These differences in process allowed the team to compare steps and reflect on the methodology followed in each city, to better understand the limitations and benefits of the UCRA process.

This report showcases how the UCRA was applied in three cities. It describes the limitations of the process and makes recommendations for improving it. The report provides guidance for cities interested in designing a community resilience planning process that takes account of the differential needs and vulnerabilities of poor urban settlements.

This report is intended for city planners focused on increasing resilience in poor and vulnerable communities. It may also be useful to nongovernmental organizations (NGOs), local development organizations, and community rights advocacy groups looking to developing resilience diagnostics and engage in participatory planning with community members.

The report is organized as follows. Chapter 1 introduces the UCRA and describes the global context of urban climate resilience in which it is being applied. Chapter 2 describes the UCRA framework and the steps taken in applying the tool. Chapter 3 provides insights from pilot implementation of the UCRA in Rio de Janeiro, Surat, and Semarang. Chapter 4 reflects on the UCRA process and shares key lessons. Chapter 5 lists areas for improvement to develop the UCRA as a more cost-efficient and effective tool for community resilience planning.

CHAPTER 2

THE URBAN COMMUNITY RESILIENCE ASSESSMENT FRAMEWORK

This chapter describes the approach and framework of the UCRA and shows how the tool is adapted and implemented.

The UCRA helps cities identify differentiated needs for resilience planning in poor urban communities, based on current and future climate risks. The approach is inspired by the "place-based approach" of Cutter et al. (2008). Place refers to geographic, socioeconomic, institutional, and political factors that need to be defined in order to contextualize differentiated vulnerabilities and resilience capacities in a city. Communities are defined as social systems within a defined geographic space (neighborhood, city, or region). Resilience is defined as the potential outcome (measured by a community's ability to bounce back to its original or a better state with reduced risks) or a process (focusing on improving peoples' adaptive capacities to make informed decisions and better manage disasters). Based on these factors, different communities in a city may respond differently. Understanding communities' differential needs is therefore useful in developing locally relevant resilience plans.

The UCRA encourages cities to shift away from a reactive disaster management approach toward a proactive resilience planning approach. It offers an opportunity for cities to maintain an exhaustive UCRA database of differential vulnerabilities and resilience capacities as a baseline to monitor and evaluate impacts in the long term and, through the process of engagement, enhance communities' resilience capacities in the short term.

Dimensions, Categories, and Features of the Urban Community Resilience Assessment

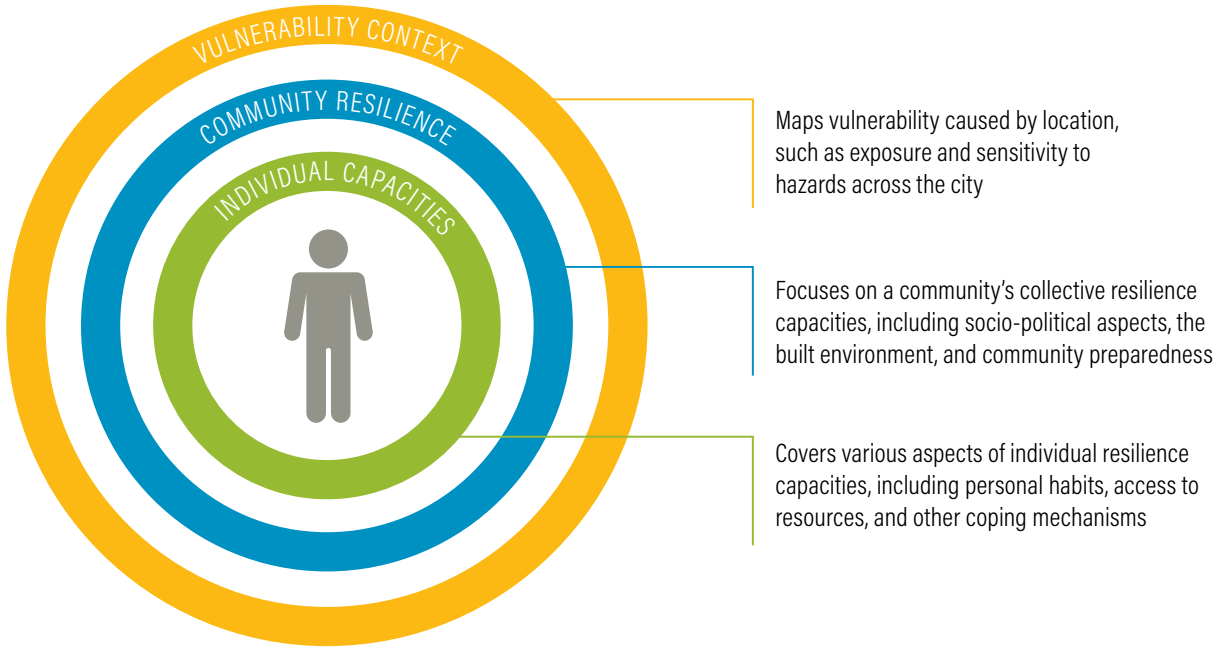
Dimensions

The UCRA is framed by three dimensions:

- mapping the vulnerability context at the city level
- evaluating community resilience potential at the neighborhood scale
- assessing individuals' capacities to respond to climate risks and extreme events.

The three dimensions capture three planning scales (city, local area, and household) for data collection and implementation (Figure 2.1).

Figure 2.1 | Three Dimensions of the Urban Community Resilience Assessment



Vulnerability context

The vulnerability context helps assess the level of exposure and sensitivity to natural disasters and slow-onset events (such as sea level rise, land subsidence, or heat and drought risk) related to climate change. It provides a comparative look across the urban landscapes, based on exposure to climate hazards, social and economic characteristics of the population, and access to and the quality of urban services in an area. Data for the vulnerability context dimension are gathered for the entire city and by subcity delineations (wards, planning units, districts), based on how a city aggregates the data.

Community resilience

Community resilience captures communities' potential to respond to climate-induced natural disasters and learn from, adapt, and transform their essential functions and environments based on experience.[2] Communities' collective responses to climate-induced natural disasters are stronger, better-coordinated, and more effective if members share strong social bonds (Aldrich and Meyer 2015; Baussan 2015; Paton and Johnston 2001) and communities are politically well organized. Community resilience is determined by measuring the complex relation between aspects of social cohesion, political engagement, collaboration during disaster response and recovery efforts, and the state of the built environment. Data for the community resilience dimension are collected using primary surveys, focus group discussions, and workshops.

Individual capacities

Climate risks affect people directly; whatever their capacities, they are expected to respond. Encouraging and enabling a culture of resilience can build individual capacities, help reduce damage, and speed recovery.

This dimension explores the capacities and habits of individuals, including their knowledge and perception of climate-induced risks, preparedness for hazards, access to telecommunications, and access to economic resources. Data for this dimension are collected using primary surveys, the results of which are disaggregated by demographic variables, such as age, sex, and occupation.

Categories

Each dimension comprises three or four categories, and each category comprises up to 6 indicators (on average) (Figure 2.2). All UCRA applications include the 3 dimensions and 10 categories described in this chapter. The indicators are flexible; cities adapt or add new indicators to create an assessment that reflects their local needs (Baussan 2015).

Categories of the vulnerability context

- **Vulnerability of setting** focuses on the exposure to environmental, physical, or climatic hazards. This category of indicators can be detailed; span larger regions (watersheds, floodplains); and include trends across multiple years.
- **Preexisting social vulnerability** focuses on vulnerability arising from socioeconomic factors, such as human development indicators and crime.
- **Access to urban services** focuses on the equity of access to basic public services (such as piped water, solid waste management, electricity, and safe and affordable health services). The measure of access is the percentage of the city that is covered by urban services.

Categories of community resilience

- **Social cohesion** is a characteristic of a community (Laiglesia 2011). Socially cohesive communities respond better to external shocks before, during, and after an event (Baussan 2015).
- **Community preparedness** is based on the premise that access to information increases the likelihood of timely and appropriate action (Swanson et al. 2007). It measures the proactive nature of communities to leverage local knowledge to manage climate-induced risks.
- **Governance and political engagement** focuses on institutional reach and the extent of political participation in a community, through trusted leaders or civil society support. A politically active community is less likely to get sidelined during a disaster (Morrow 2008). Trustworthy leadership increases the resilience potential of a community (Wongbusarakum and Loper 2011).

- **Resilient built environment** acknowledges that the impacts of climate change often increase existing risks in underserved and underdeveloped neighborhoods of the city, reducing a community's coping capacities. This category assesses access to and the quality of urban services, amenities, and critical infrastructure.

Categories of the individual capacities

- **Risk perception** assesses individuals' perceptions of climate risks and their capacities to manage and respond to them.
- **Communication and awareness** explores the importance of communication technologies, such as televisions, mobile phones, Internet access, newspapers, and access to weather alerts, that influence emergency protocols and resilience habits. Technology allows people to alert one another and enhance collective resilience.
- **Economic resources** are resources that help create an economic safety net that can help individuals and communities deal with the disruption caused by natural disasters. Access to financial resources increases the availability of resilience options and allows for informed decision-making. The category includes impacts on livelihoods, access to social security and insurance, and residents' capacities to invest in resilience and save for emergencies.

Features

The following features characterize the UCRA framework and indicators:

- **Inclusive:** Indicators can be disaggregated by age, sex, education, income level, and other demographic variables, to identify the needs of specific individuals and groups.
- **Comprehensive:** UCRA combines official secondary source data with data collected on the ground, including data that capture residents' knowledge, skills, and perceptions of risk.
- **Actionable:** Indicators were designed with officials' and stakeholders' input to help identify resilience weak spots that can be addressed rapidly.
- **Local:** Residents have the best local knowledge, and they are the first affected and the first to respond to climate-induced hazards and disasters. By focusing on them, the UCRA helps cities leverage actors from diverse institutional and social capacities to develop comprehensive and collaborative responses over the short and long term.
- **Multi-aspect:** Unlike many resilience metrics, the UCRA recognizes that resilience is not only a function of macro-level elements (economics, governance, access to services). It captures relationships among individuals, organizations, and urban form.
- **Flexible:** When applying UCRA, cities and other stakeholders can adapt the list of indicators to reflect their local context. Cities can add new indicators or replace indicators that are irrelevant with ones that better reflect the aspects considered under each category. Depending on data availability, some indicators may need adjustment.

Integrating a Community Resilience Approach in Cities

Integrating urban climate resilience in city planning is a challenge in most cities, because of the lack of institutional capacities and effective governance mechanisms to integrate long-term climate risk assessments in urban planning and decision-making (Friend et al. 2014). Climate resilience thinking is based on dynamic and adaptive systems that respond to learning-oriented processes (Friend et al. 2014), but most urban development policy and planning frameworks have long and bureaucratic amendment or review processes. Most of the focus in urban planning is not on removing these obstacles but on infrastructure planning and engineered resilience solutions. Vulnerable communities are often left out of these discussions.

Figure 2.2 | **Dimensions, Categories, and Indicators of the Urban Community Resilience Assessment Framework**

Vulnerability Context

A. Vulnerability of Setting

1. **High-risk areas**
2. **Urban housing for the poor/informal housing**
3. **Summer heat index**
4. **Precipitation anomaly**
5. **Land subsidence**
6. **Sea level rise**
7. **Extreme events**
8. **Evacuation routes**

B. Preexisting Social Vulnerability

1. **High-risk labor profile**
2. **Literacy profile**
3. **Age profile**
4. **Gender profile**
5. **Poverty profile**
6. **Migration profile**
7. **Disability profile**
8. **Social profile (religion/race/caste)**
9. **Crime rate**

C. Access to Urban Services

1. **Access to water distribution network**
2. **Access to sewage treatment network**
3. **Access to electricity grid**
4. **Access to waste collection network**
5. **Access to urban health amenities**
6. **Storm water drainage**
7. **Reliable and affordable mobility**
8. **Green areas and natural infrastructure**
9. **Access to educational facilities**
10. **Fire protection**

Community Resilience

A. Social Cohesion

1. **Size and strength of social networks**
2. **Neighborhood socializing**
3. **Neighborhood preference**
4. **Sense of community identity**
5. **Community-based livelihoods**

B. Community Preparedness

1. **Community-led resilience activities**
2. **Community health awareness camps**
3. **Early warning systems**
4. **Evacuation routes, refuge areas, and shelters**
5. **Access to information centers**

C. Governance and Political Engagement

1. **Political and city engagement**
2. **Voter participation**
3. **Trust in community leader**
4. **Nongovernmental support**

D. Resilient Built Environment

1. **Access to urban amenities**
2. **Mobility**
3. **Access to natural features**
4. **Construction type**
5. **Light and ventilation**
6. **Availability of shade**

Individual capacity

A. Risk Preparedness

1. **Perceived climate risk**
2. **Practice of resilience habits**
3. **Resilience kits**
4. **Resilience training**
5. **Back-up of documents**

B. Communication and Awareness

1. **Cellphone ownership**
2. **Internet access**
3. **Access to local news**
4. **Weather forecast awareness**
5. **Weather health awareness**

C. Economic Resources

1. **Labor and livelihood options**
2. **Emergency savings**
3. **Health and life insurance**
4. **Proof of identity linked to social security**
5. **Willingness to invest in resilience**
6. **Land tenure**

Note: More information on the UCRA indicators and their quantification is provided in Appendices A and B.

Source: Authors.

The UCRA approach is inspired by community-based adaptation practices that focus on increasing individual and collective resilience capacities while strengthening social networks and their abilities to perform essential functions during and after extreme events. The UCRA helps link city planning priorities and community needs, presenting an assessment of differential vulnerabilities and resilience capacities to city officials, thereby shifting the focus of resilience assessments from the city to neighborhoods. It brings diverse stakeholders on a collaborative platform to discuss urban risks, vulnerabilities, and institutional gaps and opportunities to leverage community knowledge. Resilience actions defined by the UCRA tool are linked to existing projects, policies, or programs at the city level, where local knowledge is used to influence urban priorities in the water, transport, housing, and other sectors. In Surat, for example, where community members reported impacts of extreme heat on their health and livelihoods, city officials made recommendations to the city's Heat Action Plan. In Semarang city officials highlighted various resilient infrastructure projects planned in the city that would benefit from community inputs and participation.

The Four Phases of the Urban Community Resilience Assessment

The UCRA process includes four phases (Figure 2.3), detailed in Table 2.1:

This method was tested in Rio de Janeiro and Porto Alegre and then in Surat and Semarang, to assess its replicability, simplicity, and scalability as a globally applicable process. Testing identified some limitations, which are discussed in chapters 4 and 5.

The UCRA process deviated from the process followed in the two Brazilian cities in three ways:

- Focus group discussions were introduced at two stages of the process, to increase community participation and supplement data collected through household surveys. In Rio, community workshops and meetings were held to select the UCRA indicators, but primary data were collected using only surveys of individuals. Focus group discussions in Surat and Semarang allowed field researchers to discuss specific aspects of vulnerability and resilience with community members and encouraged greater participation.

Figure 2.3 | Four Phases of Implementation of the Urban Community Resilience Assessment

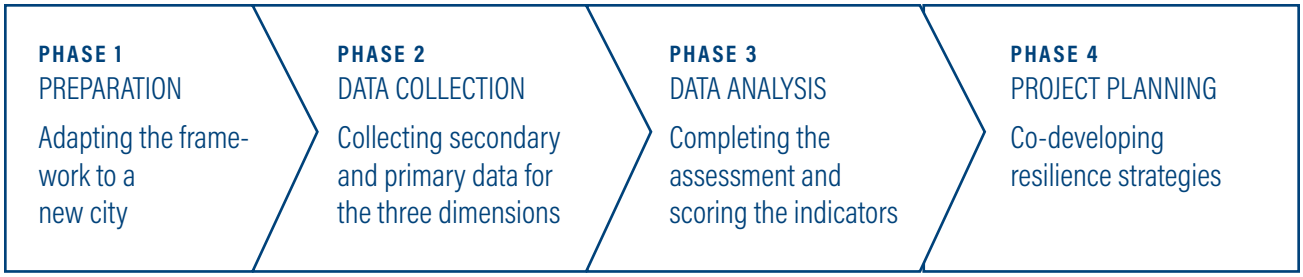


Table 2.1 | Phases and Steps in Implementing the Urban Community Resilience Assessment

PHASE/STEP	DESCRIPTION
Phase 1: Preparation	
Step 1	Implementing agency identifies local partner, team of technical experts, and stakeholders to begin the UCRA implementation process.
Step 2	With support and guidance from the city, local partner conducts preliminary literature review to map hazards, vulnerabilities, and urban challenges in the city. Assessment begins by using city census data, reports, and other secondary data, including GIS data if available. If the city has completed a vulnerability assessment, the UCRA team is encouraged to integrate those indicators and assessments, to enable a comprehensive analysis that builds on past assessments. Doing so reduces data collection costs, increases efficiency, and enhances collaboration across agencies.
Step 3	City organizes a kick-off meeting to launch the UCRA process. A launch can be useful to align the UCRA with any projects or programs the city is about to initiate in an area or priority issues the city wants to take forward at a larger scale.
Step 4	UCRA team identifies communities where the UCRA will be implemented. It can use existing vulnerability assessments to select vulnerable areas, on the basis of challenges in the city. It is important to select communities that have high potential for comparison in order to be able to identify differential risks within a city; doing so increases the potential for scaling UCRA lessons to other communities in the city facing similar challenges. Communities can be selected on the basis of four criteria: (a) level of exposure to climate risks and other hazards; (b) social and economic vulnerability; (c) degree to which the community exemplifies a citywide issue (such as housing type, infrastructure access, or livelihood); and (d) alignment with other political or planning interests (to increase the likelihood of implementation).
Step 5	Implementing agency hosts multistakeholder workshop, inviting UCRA stakeholders to review the UCRA indicators, finalize a survey methodology, and select communities through group exercises in workshop, participants share relevant data sources and suggest sample survey questions. The UCRA team finalizes selection of communities at this workshop.
Step 6	Local partner collates feedback and publishes list of UCRA indicators to be implemented.
Step 7	Local partner facilitates focus group discussions in each community, to develop survey questions for indicators under categories such as social cohesion, community preparedness, and risk preparedness. Discussions are held at community center (preferably segregated by gender). Team should (a) encourage residents from different areas in settlement to attend and (b) direct questions to youth and older people, to ensure that their views are incorporated.
Step 8	Local partner conducts a physical survey of built environment of selected communities, by examining maps and photographs, on the basis of factors determined by the UCRA team.
Step 9	Local partner develops questionnaire and survey methodology, including sampling method, ensuring gender and age segregation (Appendix C includes a sample questionnaire). The survey sample size can be determined on the basis of a statistically significant percentage of the total population (e.g., a 5 percent sample of all households in the selected community) or on the basis of the budget available for data collection. A random sampling method is used to select households for the survey, to achieve unbiased results. To ensure that all living conditions are reflected in the sample size, the sampling can be designed to reflect the built form of the settlement (buildings, single-story homes) and kinds of vulnerability conditions (e.g., living close to a creek, on a dense market street, or in secluded sections of the community).
Step 10	Local partner develops a scoring methodology for all indicators, using primary and secondary data. (Appendix B describes the scoring methodology used in Surat.) Each indicator receives a resilience score on a scale of 1 (not resilient) to 5 (very resilient).

Table 2.1 | Phases and Steps in Implementing the Urban Community Resilience Assessment (continued)

PHASE/STEP	DESCRIPTION
Phase 2: Data collection	
Step 1	Local partner trains survey team to understand UCRA approach, survey questions, and expected answers.
Step 2	Survey team conducts 10 pilot surveys in each community to test questionnaire. Local partner assesses pilot survey results and makes necessary changes to questionnaire.
Step 3	Local partner identifies questions that have answer rates of less than 75 percent or that receive complex answers and includes them in the focus group discussion questionnaire.
Step 4	Survey team executes household survey.
Step 5	Local partner conducts focus group discussions, segregated by gender and age, to address questions that may benefit from in-person interactions. The partner is also expected to collect secondary city-level data to complete the vulnerability context assessment.
Phase 3: Data analysis	
Step 1	Local partner scores indicators.
Step 2	The local partner completes the socioeconomic analysis on the basis of primary data and disaggregated resilience characteristics. Analysis highlights gaps in each community and across communities, revealing differential resilience patterns in the city.
Step 3	The local partner develops a resilience diagnostic report collating the UCRA findings, which is submitted to the implementing agency, along with primary and secondary datasets.
Phase 4: Project planning	
Step 1	Local partner hosts community workshops in each neighborhood, preferably segregated by gender and age, to share UCRA results. Community members are asked to select a priority issue that scored low on the UCRA assessment and co-develop resilience actions to address the related indicators and issue. Residents may also select an indicator that scores high on the UCRA scorecard but remains a concern for them.
Step 2	Using the needs communities identify, local partner comes up with project ideas (e.g., improving access to early warning systems, co-developing postdisaster evacuation maps, improving community infrastructure), which it submits to implementing agency.
Step 3	Implementing agency hosts a multistakeholder project planning workshop to review UCRA findings (presented by local partner) and develop them into operational resilience plans that include identifying opportunities and constraints, relevant stakeholders, roles and responsibilities, and financing ideas if required.
Step 4	Local partner submits workshop summary and operational resilience plans to implementing agency and relevant departments within the city, which then determine next steps. Further engagement with the city to implement resilience actions is subject to specific circumstances.

- In Rio indicators were scored using thresholds developed from the literature and community responses. Other cities may find it difficult to contexualize these thresholds, because thresholds can be subjective even if they are well-referenced, and urban contexts can differ greatly, making this process tedious for cities. Hence a standard scoring method was developed, with all survey questions designed for simple yes/no responses (Appendix B provides guidelines for developing this scoring method for each indicator).
- A new category (resilient built environment) was added to assess the reach and quality of urban services in poor settlements compared with other neighborhoods. It was added because community members expressed dissatisfaction with certain urban services, such as waste collection, that scored high according to city-wide data.

The process took six to eight months to complete in the three pilot cities. In vulnerable communities, it is ideally implemented by city officials, who can then design relevant resilience actions. The tool can also be used by community-based organizations, civil society groups, or private investors interested in adopting a community resilience planning approach to addressing climate-induced risks in vulnerable communities.

CHAPTER 3

PILOT TESTING THE TOOL IN THREE CITIES

This chapter describes the implementation of the UCRA process in the three pilot cities.

The first pilot project was implemented in Rio de Janeiro, with funding from WRI and support from the Chief Resilience Officer of 100 Resilient Cities and the city's Department of Civil Defense. With additional funding from the Cities Alliance, the UCRA approach was broadened and pilot tested in two Asian cities, Surat, India, and Semarang, Indonesia. Both cities belong to the 100 Resilient Cities network and the Asian Cities for Climate Change Resilience Network (ACCCRN).

The UCRA was implemented in collaboration with two local partners, the Urban Health and Climate Resilience Centre for Excellence (UHCRCE) in Surat and the Initiative for Urban Climate Change and Environment (IUCCE) in Semarang. Both were involved with the ACCCRN vulnerability and resilience assessment in Surat and Semarang and the 100 Resilient Cities process. They are affiliated with the city governments in both cities and have experience working in vulnerable communities, making them ideal partners for UCRA implementation. All three pilot cities are coastal cities that are at risk of tidal flooding worsened by heavy rainfall. Because of their topography and climatic context, the cities also face myriad other risks, including landslides, land subsidence, and heat stress. Similarities and differences in climate-induced risks were leveraged in order to learn from the implementation experiences.

All three cities had experience with resilience planning. If the UCRA is to be implemented in cities with no such experience, capacity-building workshops must precede UCRA implementation, to familiarize city officials with the concept of urban resilience.

Rio de Janeiro, Brazil

Rio de Janeiro is home to more than 6 million people (IBGE 2018).[3] More than 700 *favelas* are sprawled across the city, where some 1.4 million (more than 22 percent of Rio's population) live (Cavallieri and Vial 2012). The city is divided into five planning areas, 33 administrative regions, and 161 neighborhoods.

The city's municipal adaptation plan identifies exposure to sea level rise, landslides, urban heat islands, flooding, and prolonged drought as some of the major climate-induced risks (City of Rio de Janeiro 2016). (Table A.1, in Appendix A, describes the vulnerability context of Rio.)

In 2013 Rio was selected as one of the first 32 cities in the 100 Resilient Cities network. As a result, it received technical and financial support to develop a municipal resilience plan.

In partnership with the Rio Resiliente,[4] in 2016 the city applied the UCRA in two poor communities, Morro da Formiga and Morro dos Macacos (Figure 3.1; Table A.2 in Appendix A describes the two communities).

Implementation of the Urban Community Resilience Assessment

Civil Defense is a municipal government agency tasked with protecting residents from natural disasters and responding before, during, and after they occur. It mediated implementation with community leaders from Morro da Formiga and Morro dos Macacos.

The UCRA team conducted three multistakeholder workshops, at which city officials, civil society partners, and community residents selected the UCRA indicators best suited to their local context. The survey methodology and questionnaires were developed in collaboration with Rio Resiliente, the Department of Civil Defense, and community leaders. Two hundred primary surveys were administered in each community.

Rio's *favelas* are not homogenous. They vary in size, level of development, and social capital. Differences in geography, topography, housing quality, poverty, and infrastructure mean that residents experience different levels of climate-induced risks. Morro dos Macacos and Morro da Formiga were chosen for UCRA implementation according to four criteria:

Figure 3.1 | Boundaries of Morro da Formiga and Morro dos Macacos, in Rio de Janeiro

Source: City of Rio de Janeiro.

- Civil Defense identified them as high-risk, vulnerable communities.
- They are part of the Civil Defense and the Resilient Communities program of the United Nations Office for Disaster Risk Reduction.
- Both communities have installed early warning systems, which are activated during heavy rains.
- The survey teams could safely operate in both communities.

Unstable community leadership in Morro da Formiga impeded the ability to see the project through to its end there.

Summary of Findings

The UCRA surveys revealed significant gaps in community preparedness and individual capacities (Table 3.1). For example, most respondents said they attended resilience and emergency response trainings held by the Civil Defense, but few maintained emergency kits. As a result of the periodic drills and trainings held in their neighborhoods, residents said they maintain back-up documents, save emergency numbers on their phones, and expressed a willingness to invest in community resilience efforts.

Table 3.1 | Findings from the Urban Community Resilience Assessment of Morro da Formiga and Morro dos Macacos (percent of survey respondents, except where indicated otherwise)

ITEM	MORRO DA FORMIGA	MORRO DOS MACACOS
Community resilience		
Social cohesion		
Average number of neighbors' telephone numbers saved	2.3	2.8
Attended community meetings in previous six months	47	29
Community preparedness		
Early warning systems activated during heavy rainfall events	Yes	Yes
Community resilience taskforce established	Yes	Yes
Training on resilience and emergency response services conducted by the Civil Defense	Yes	Yes
Individual capacities		
Perceive climate-induced natural disasters as life risk	99	74
Practiced one resilience habit to cope with heavy rainfall	54	66
Participated in resilience training	31	4
Have no back-up copy of identification documents	58	56
Have smartphone	79	71
Have emergency resilience kit	21	9
Have emergency phone numbers saved	59	14
Have emergency savings	33	7
Willing to invest in resilience	51	33

Residents of Morro da Formiga and Morro dos Macacos maintained good social relations with their neighbors (Figure 3.2, panel a), but few residents kept their neighbors' phone numbers as emergency contacts (Figure 3.2 panel b). Most respondents said they had not attended a single community meeting in the last six months, and more men than women attended these meetings. Respondents showed strong social networks but had weak political engagement (except regarding decision-making processes in their neighborhoods), inhibiting their resilience capacities.

Community Resilience Needs

The UCRA team conducted workshops in only one of the two communities, after incidents of violence and hostility toward the survey team made it impossible to proceed in Morro da Formiga. The survey results were presented to the residents of Morro dos Macacos in two workshops held at the residents association center. The workshops focused on heavy rainfall events that result in landslides and extreme floods. Residents selected four indicators they considered critical for their resilience during these events and developed actions to achieve them (Table 3.2).

Figure 3.2 | Informal Social Cohesion in Morro da Formiga and Morro dos Macacos

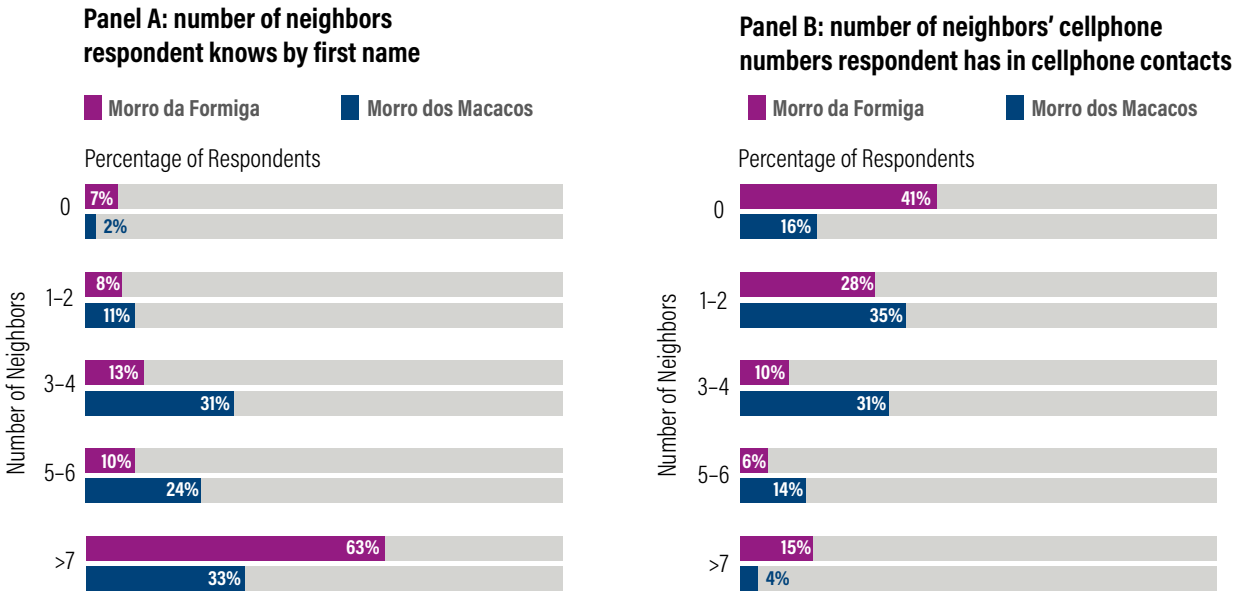


Table 3.2 | Resilience Solutions Identified by Residents of Morro dos Macacos

INDICATOR	PROPOSED SOLUTIONS
Access to waste collection services	1. Reinstate the Gari Comunitário scheme (a government-run community waste collection employment scheme), adapting it so that it does not overburden workers. 2. Install more waste dumpsters, to reduce the risk of overflow that often blocks vital drainage lines. 3a. Organize campaigns on the correct disposal of waste when organized by local institutions and waste-collection "meet-ups." 3b. Create communication groups to monitor waste heaps, especially before heavy rainfall periods. 3c. Empower the residents association to implement solutions.
Political engagement	1. Introduce more activities at residents association meetings, to improve outreach. 2. Improve accountability on issues raised by residents and feedback on decisions. 3. Improve engagement of government authorities, small and medium-size enterprises, and youth at residents association meetings.
Knowledge of resilience habits	1. Strengthen communication between the municipal government, Civil Defense, and residents. 2. Enhance communication, using various media, such as posters and pamphlets. 3. Ensure that radio announcements reach the most vulnerable neighborhoods in times of emergencies and to increase health awareness to improve resilience habits after heavy rainfall events.
Strength of social networks	1. Help older people store and save neighbors' cellphone numbers. 2. Encourage residents to share contact numbers through awareness campaigns focused on responses to incremental losses and emergencies. 3. Promote resilience habits by sharing information in frequently visited spots.

Surat, India

Located in the state of Gujarat on the floodplain of the Tapti River, Surat is home to 5 million people (Census of India 2011). It is the fourth-fastest-growing city in the world (City Mayors Foundation 2017) and home to a large migrant population, which has settled in slums and informal settlements along the floodplain of the river since the 1950s (Santha et al. 2015). Surat is highly exposed to flooding, because of heavy rains and coastal and river overflow (Table A.3 in Appendix A describes the city's vulnerability).

Between 2008 and 2016, the Surat Municipal Corporation (or Surat city government) worked with ACCCRN and 100 Resilient Cities on dynamic and proactive resilience planning. In 2012 the Surat Municipal Corporation and the Southern Gujarat Chamber of Commerce co-founded the Surat Climate Change Trust (formed by members who are part of the city government, the Chamber of Commerce, civil society partners, and independent subject experts to address issues of climate change vulnerability in Surat city) (ACCCRN 2016).

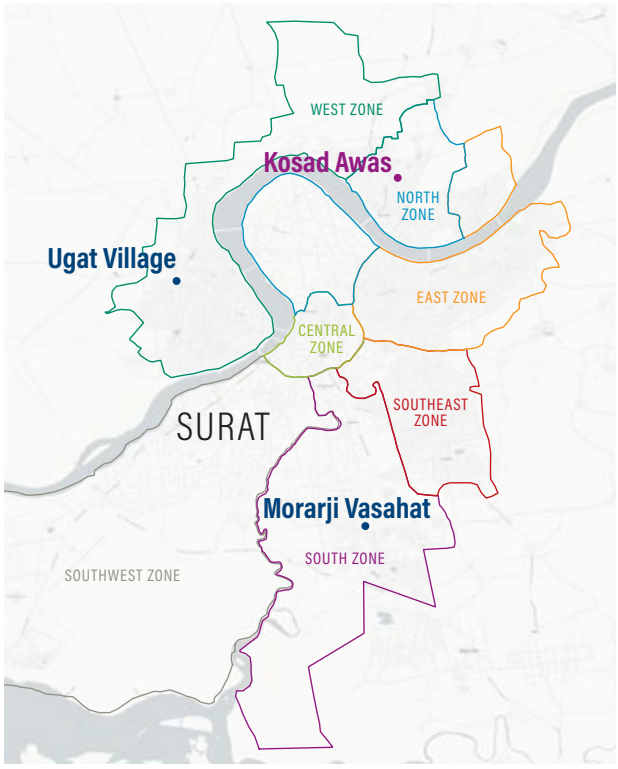
Implementation of the Urban Community Resilience Assessment

The UCRA was executed in partnership with the Urban Health and Climate Resilience Centre for Excellence (UHCRCE) and the Chief Resilience Officer of 100 Resilient Cities. Three communities—Morarji Vasahat, the Ugat Site and Services Scheme, and Kosad Awas—were selected according to two criteria: location in different administrative zones of the city and different housing and infrastructure conditions of urban poor settlements in the city (Figure 3.3; Table A.4 in Appendix A describes the communities).

Morarji Vasahat is an old slum located in the textile area of the city, where people from several slum communities in the zone work. Most residents have lived together for more than 30 years.

The Ugat Site and Services Scheme is a newer settlement in a peri-urban part of the city. It has poor infrastructure and urban services.

Figure 3.3 | Boundaries of Morarji Vasahat, the Ugat Site and Services Scheme, and Kosad Awas, in Surat



Kosad Awas is a massive slum relocation and rehabilitation scheme. Residents from various other slum settlements in Surat were relocated to Kosad from 2012 onward.

The UHCRCE team led all the field activities in the three communities, which included administering 513 household surveys, conducting 12 focus group discussions (6 of which were gender segregated), and holding two multistakeholder workshops with city officials and civil society members.

Summary of Findings

The UCRA focused on migrant workers' health, sanitation, and resilience to heat and flooding on the basis of the built environment.[5] Surveys revealed that 75 percent of respondents experienced severe or recurrent health impacts related to extreme heat and waterlogging, and 63 percent reported losses in income or livelihoods (Table 3.3).

Table 3.3 | Findings from the Urban Community Resilience Assessment Survey of Three Communities in Surat (percent of respondents)

DIMENSION/ CATEGORY	INDICATOR	COMMUNITY		
		MORARJI VASAHAT	UGAT SITE AND SERVICES	KOSAD AWAS
Community resilience				
Social cohesion	Contacts neighbors during emergency	63	59	47
Community preparedness	Cleans drains before monsoon	51	61	32
	Has access to shelter during floods	56	37	3
Governance and political engagement	Knows local leader	72	9	6
	Knows location of ward office	56	48	15
Resilient built environment	Uses communal garbage bins	95	98	3
	Has door-to-door waste collection	5	1	75
Individual capacities				
Risk preparedness	Fears climate change	46	42	26
	Maintains flood emergency kit	21	23	34
Communication and awareness	Receives weather-related health alerts	45	64	17
Economic resources	Has lost 6–8 work days every monsoon	59	63	47
	Has lost income during extreme heat	54	53	47
	Has emergency savings	13	20	18
	Has health insurance	6	6	6

Inadequate infrastructure and services have compromised communities' resilience capacities. Residents in all three communities had access to electricity, water, and sewage networks, but the quality of these services and the social factors mediating access often left them vulnerable to disasters. For example, even though most residents in Ugat Site and Services and Morarji Vasahat have access to indoor water taps, their drinking water supply often got mixed with wastewater, resulting in incidents of severe illness.

Residents had clear perceptions of climate-induced risks but poor preparedness and emergency responses. More than 60 percent of respondents from the three communities confirmed an increase in heat and frequent incidents of waterlogging and prolonged flooding in Surat. More than 70 percent said health impacts of heat and flooding (malaria, dengue, and other fevers) were concerns. More than half reported that heating and periodic flooding affected their livelihoods negatively, and about 30 percent reported that they would not find new employment in the event of job loss.

Residents appeared to connect these losses with the need for action. More than 60 percent of respondents across the three communities were willing to invest in neighborhood resilience actions, either financially or with labor.

In terms of communication and awareness, residents received emergency weather-related health warnings from local *anganwadis* (community

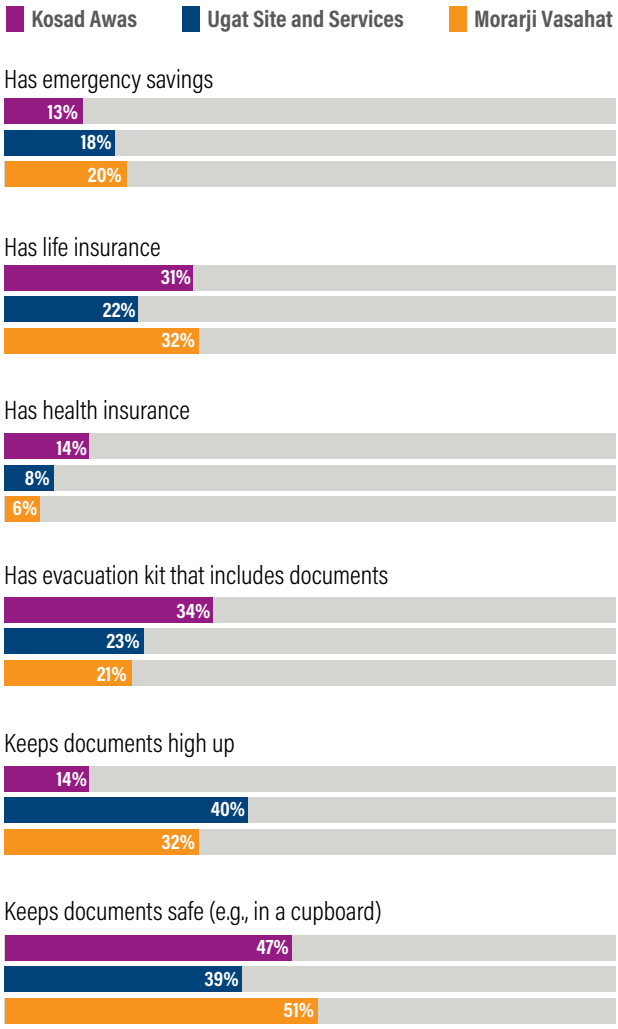
centers) and health centers (64 percent in Ugat Site and Services, 45 percent in Morarji Vasahat, and 17 percent in Kosad Awas). Respondents revealed poor preparedness habits, with less than 20 percent maintaining emergency savings and only 35 percent having health and life insurance (Figure 3.4). Women were more likely than men to have evacuation kits and emergency savings.

Strong social networks and shared experiences of disasters led to higher resilience capacities. Morarji Vasahat and Ugat Site and Services are located in flood-prone areas of the city. Most of their residents had participated in collective resilience initiatives, such as cleaning blocked drains, filling potholes, levelling their streets, and waterproofing their roofs (Figure 3.5).

Residents repave their streets in the Ugat Site and Services Scheme before the monsoon.

Photo credit: WRI India.

Figure 3.4 | Individual Preparedness Measures to Cope with Emergencies in Three Communities in Surat (percent of respondents)



Residents of Morarji Vasahat had lived together for more than 30 years. They were not only more socially organized but also more engaged politically than residents of Ugat Site and Services, who had lived together for just 13 years.

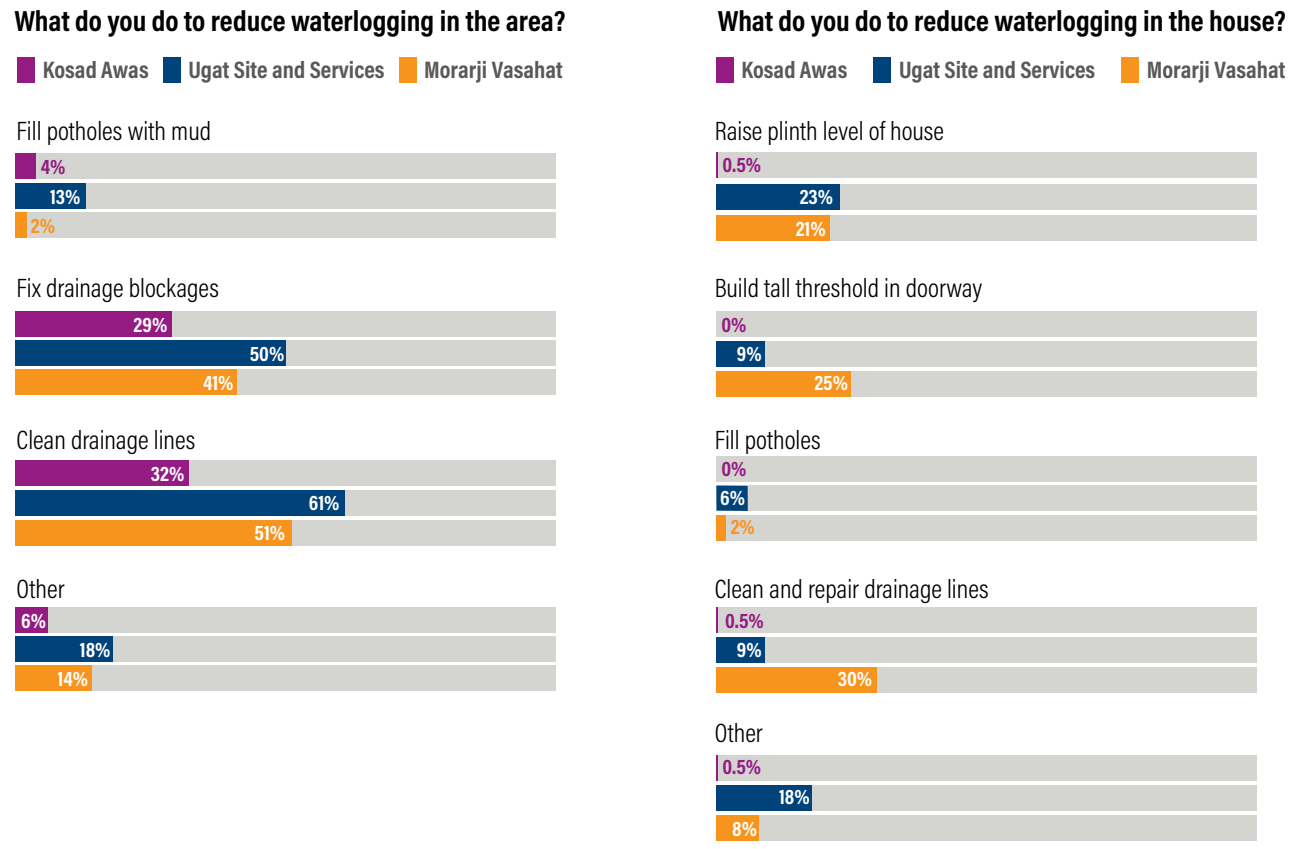
In Morarji Vasahat, the community temple and community centers led evacuation missions, and residents knew their area's municipal leader. Women showed greater political awareness than men; most women reported knowing their corporator (a trusted community leader) and were aware of ward meetings conducted in the area.

Residents were least organized in Kosad Awas, a new community. They lacked faith in the civic system and had poor access to political leadership, leaving them highly vulnerable during extreme events.

The Kosad Awas resettlement colony has few trees or green areas, leaving residents vulnerable to heat stress.

Photo credit: WRI India.

Figure 3.5 | Community Preparedness Measures Adopted to Manage Frequent Waterlogging in Three Communities in Surat (percent of respondents)



Community Resilience Needs

The UCRA results were shared with community members in gender-segregated community workshops held in the *anganwadi* of each neighborhood. Residents identified three areas of focus. Together with city officials, they came up with the solutions shown in Table 3.4. (Appendix D includes the three community resilience plans.)

The UCRA results and solutions discussed in the community workshops were presented at a multistakeholder planning workshop attended by city officials, civil society partners, and researchers from Surat. Officials were struck by the findings, including the fact that 60 percent of respondents reported increases in ambient temperature and residents reported higher temperatures indoors than outdoors. They committed to integrate some of them into the city's heat action plan.

Officials discussed the possibilities of (a) increasing urban vegetation to manage rising temperatures; (b) introducing "greenbelts" around high-heat-emitting land uses, such as industrial buildings; and (c) requiring that building regulations restrict the use of heat-conducting building materials. The UCRA findings and recommendations were submitted to the Surat Municipal Corporation to incorporate into the city's resilience strategy.

Table 3.4 | Resilience Solutions Identified by Community Members and City Officials in Surat

INDICATOR	PROPOSED SOLUTIONS
Community preparedness during heavy rains	1. Co-develop evacuation plans marking civic institutions, so that residents know where to go during emergencies. 2. Ensure that city-wide early warning systems reach the poor via their preferred telecommunication mode and language. 3. Install flood-level markers to warn residents to take appropriate actions when water levels rise. 4. Introduce health awareness trainings in *anganwadis* and health centers to train residents in managing climate-induced health risks.
Access to waste collection services	1. Install more waste dumpsters. 2. Explore low-cost options for door-to-door waste collection, which provides employment opportunities for local residents. 3a. Conduct health trainings in *anganwadis* and health centers to help residents make the connection between health and hygiene. 3b. Raise awareness of health impacts resulting from poor waste management, which increase during extreme weather conditions. 3c. Create peer groups of households along a street to hold residents accountable for their streets.
Enhancing social cohesion and political engagement	1a. Empower resident welfare associations to prioritize women's safety and monitor dark alleyways and crime hotspots. 1b. Create a neighborhood watch connecting residents through SMS or WhatsApp groups, to ensure collaborative monitoring. 2. Enhance civil society or NGO support, to improve political and city engagement. 3. Introduce skill development workshops or vocational trainings in the neighborhood to reduce unemployment.

Semarang, Indonesia

Located along the northern coast of the Java Island in Indonesia, Semarang is the capital of the Central Java Province. It is one of Indonesia's largest cities, with a population of 1.6 million people (Census of Indonesia 2015). The city is divided into 16 subdistricts and 177 *kelurahan* (villages) (ACCCRN and ISET 2010).

Semarang is exposed to myriad climate-induced risks, including tidal flooding, sea level rise, and land subsidence on the coast (Marfai et al. 2008); frequent landslides and water scarcity in the hills; and river flooding along the canals during the monsoons (Table A.5 in Appendix A describes the vulnerability context).

In partnership with 100 Resilient Cities and Mercy Corps Indonesia, Semarang's city government developed a city-wide resilience strategy ("Moving Together towards a Resilient Semarang"). Semarang was also part of the Asian Cities for Climate Change Network (ACCCRN); the ACCCRN vulnerability assessment was used to score the vulnerability context for the UCRA in Semarang.

Implementation of the Urban Community Resilience Assessment

The UCRA was implemented in collaboration with the Chief Resilience Officer's team from 100 Resilient Cities and a local partner, the Initiative for Urban Climate Change and Environment (IUCCE), which had spearheaded several resilience planning activities in Semarang over the last decade. It conducted a city-level vulnerability assessment with ACCCRN and developed the city resilience strategy with the 100 Resilient Cities team. The ACCCRN Vulnerability and Resilience Assessment, completed in 2010, was used as a guide to assess the vulnerability context indicators for the UCRA.

Three communities exposed to different risks and located in different parts of the city were selected to capture their needs and experiences and develop resilience actions that may be relevant to communities that face similar vulnerabilities (Figure 3.6; Table A.6 in Appendix A summarizes the three communities' resilience characteristics). The IUCCE team administered 501 household surveys in the three communities.

Figure 3.6 | Boundaries of Tambaklorok, Kaligawe, and Delikaseri, in Semarang

Source: City of Semarang.

Tambaklorok is located in a low-lying coastal area exposed to tidal flooding, sea level rise, and land subsidence. Most people in the community are engaged in fishing, although young migrants often work as port laborers.

Kaligawe is a southern coastal area near the East Flood Canal and River Es. It is prone to river and tidal flooding and land subsidence. Community members work as laborers. The community has a large population of older residents and is home to many migrants from Central Java.

Delikaseri, in the northern hills of Semarang, is exposed to landslides, forest fires, and frequent droughts. Most of its residents work in the informal sector as laborers and drivers.

Delikaseri has a single source of fresh water, collectively managed by community members.

Photo credit: WRI.

Summary of Findings

The UCRA in Semarang focused on resilience to landslides, river flooding, sea level rise, and land subsidence. Table 3.5 summarizes the survey results for each category.

Communities are socially cohesive. Residents know their community leaders but are not involved in any decision-making processes.

Semarang has a culture of community consultations at the neighborhood level. Residents participate in regular meetings in their neighborhood, counselling (penyuluhan), women's capacity trainings (Pembinaan Kesejahteraan Keluarga), and festivals. They indicate strong social networks and report liking living with one another.

Most residents from Kaligawe and Tambaklorok had met their community leaders more than 12 times the previous year. However, despite the government's public outreach, public participation in the planning process was very low (Figure 3.7), because the planning process involves only community representatives (such as community leaders or organization members); most residents found it difficult to influence the decision-making process. Engagement with NGOs was also low; few respondents received disaster-related support from them.

Residents perceive climate-induced disasters as a risk. Early warning systems were unreliable, and most residents were inadequately prepared. More than 70 percent of all respondents observed increases in temperature, rising sea levels, and several heavy rainfall events over the previous 10 years, and 60 percent reported severe health impacts associated with climate-induced risks. Only Kaligawe received early warning alerts, often in the form of announcements from the local mosque or via bamboo or wooden drums. Many residents found these methods unreliable and inaudible.

Figure 3.7 | Political Participation and Engagement in Three Communities of Semarang (percent of respondents)

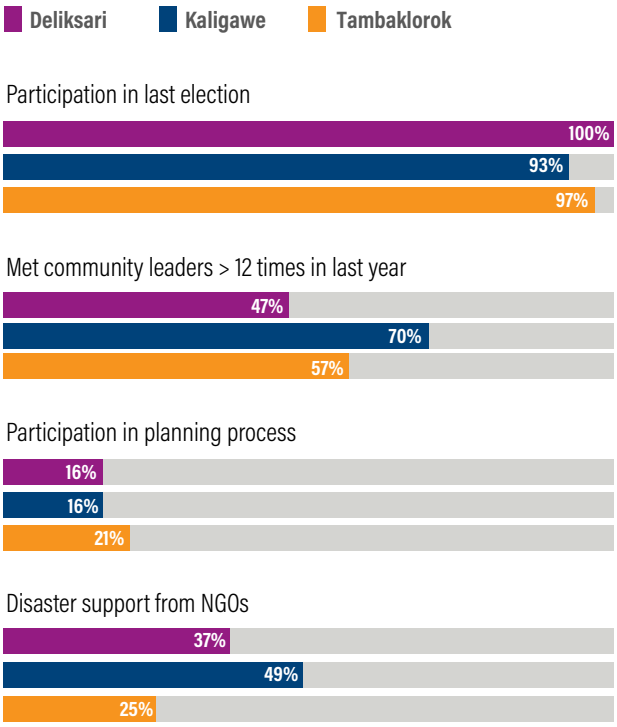


Table 3.5 | Findings from the Urban Community Resilience Assessment Survey of Three Communities in Semarang (percent of respondents)

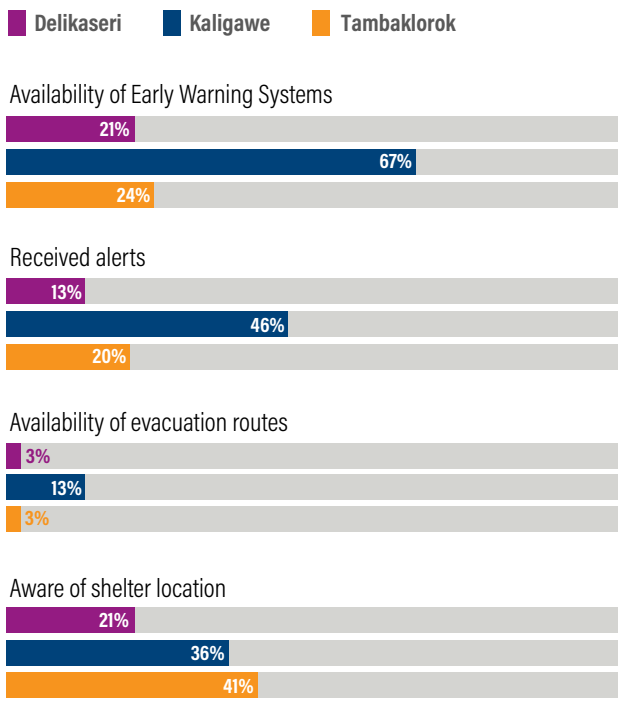
DIMENSION/ CATEGORY	INDICATOR QUESTION	COMMUNITY		
		TAMBAKLOROK	KALIGAWE	DELIKASERI
Community resilience				
Social cohesion	Visits neighbors often	76	61	68
	Is comfortable with neighbors	95	77	89
Community preparedness	Has access to early warning systems	24	67	21
	Knows of evacuation routes	3	13	3
	Has access to shelters	41	36	21
Governance and political engagement	Has met community leaders	89	70	92
	Met them >12 times in past year	57	70	47
Resilient built environment	Has drinking water	5	4	18
	Has waste collection services	31	93	0
Individual capacity				
Risk preparedness	Fears climate change	57	65	74
	Has suffered health impacts associated with climate extremes	60	68	66
	Has experienced sea level rise	92	74	X
Communication and awareness	Gets disaster-related information from newspapers	87	30	58
	Has a cellphone	45	69	68
Economic resources	Maintains emergency savings	32	36	18
	Has health and life insurance	59	77	76

Some residents received disaster-related information through daily newspapers, television, and (more recently) WhatsApp groups on cellphones, but information was limited. Most residents were unaware of evacuation routes, shelters, or refuge areas (Figure 3.8).

Residents from Kaligawe who live along the river canal are at greatest risk of flooding during heavy rainfall.

In extreme situations, residents moved to their neighbors' houses or to safer and higher locations. Although less than 15 percent of all respondents had emergency evacuation kits, more than 80 percent saved important documents. Few respondents (18 percent in Delikaseri, 32 percent in Tambaklorok, and 36 percent in Kaligawe) had emergency savings to cover frequent losses and damages.

Figure 3.8 | Emergency Readiness in Three Communities in Semarang (percent of respondents)



Residents from Kaligawe who live along the river canal are at greatest risk of flooding during heavy rainfall.

Photo credit: IUCCE.

Community Resilience Needs

The findings of the UCRA were presented in community workshops in each neighborhood. The three communities appeared to face similar challenges. They focused on acute risks rather than moderate or slow-onset events. Table 3.6 summarizes the indicators and resilience actions proposed by community members and city officials.

Table 3.6 | Resilience Solutions Identified by Community Members and City Officials in Semarang

INDICATOR	PROPOSED SOLUTIONS
Disaster preparedness plans at the community level	1. Develop evacuation plans that mark evacuation routes, shelters, and locations where preparedness equipment is located. 2. Hold workshops to familiarize residents with the evacuation plan. 3. Design early warning systems that are connected with the data center and equipped with security systems that reach local residents in all risk-prone areas
Localized capacity building and education	1. Increase outreach on climate-induced hazards, preparedness, and environmental health for community members. Efforts should include counselling, trainings, workshops in schools, and provision of information on public information boards. Activities should reflect the local risks of each neighborhood.
Building resilient infrastructure	1. Encourage community participation in all climate-resilient infrastructure projects affecting poor and vulnerable communities. Projects include provision of a fire hydrant at the river dike in Delikaseri; normalization projects in Banjir Kanal Timur and Es River; elevation of the Kaligawe river bridge; and improvement of public transport to Tambaklorok, as part of the government's fishing community improvement program.

Summary of Applications in the Three Pilot Cities

This section highlights similarities and differences in applying the UCRA in the three pilot cities (Table 3.7).

Table 3.7 | Findings, Features, and Actions Identified by the Urban Community Resilience Assessment in Three Pilot Cities

ITEM	RIO DE JANEIRO, BRAZIL	SURAT, INDIA	SEMARANG, INDONESIA
Differential needs and vulnerabilities	The two communities had different levels of political engagement, local governance, and community capacities to practice resilience habits.	The three communities present different resilience challenges because of different infrastructure and access to services, according to the age of the settlement.	The three communities face different risks: sea-level rise and land subsidence along the coast, flooding along the banks of a major canal in the inland community, and water scarcity and landslides in the hills.
Local hazards	Landslides, tidal flooding, heavy rainfall	Extreme heat, river flooding, heavy rainfall	Landslides, land subsidence, sea level rise, flooding
Socioeconomic vulnerabilities	The communities are designated as high-risk areas for natural disasters by the Civil Defense of Rio.	The communities are home to migrant workers from across India.	The communities have high unemployment rates and relatively elderly populations.
Surveys	400 individual (not household) surveys in each community	513 household surveys across all communities	501 household surveys across all communities
Gender-segregated results	Men attended community meetings more often than women.	Women maintained emergency kits and savings for the household more often than men. Men were more engaged with social/politically linked preparedness work.	Men and women were socially and politically active. Women attended monthly health-based meetings.
Resilience actions	A plan was developed for local solid waste management in Morro dos Macacos.	UCRA findings were integrated into Surat's heat and health action plan; a local flood risk management plan included proper waste management activities.	Community-level disaster preparedness plans with evacuation plans and early warning systems that reach the poor were prepared.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CHAPTER 4

RESPONSES FROM CITY OFFICIALS, LESSONS LEARNED, AND OPPORTUNITIES FOR AND BARRIERS TO APPLICATION IN OTHER CITIES

This chapter describes the responses to the UCRA findings by city officials, summarizes the lessons learned from the three pilot applications of the UCRA, and identifies opportunities for and barriers to applying the tool in other cities.

Responses from City Officials

The UCRA was applied sequentially in Rio de Janeiro, Surat, and Semarang, to allow for incremental learning. In Rio de Janeiro, the UCRA operational plans were submitted to the Municipal Civil Defense (the city's disaster preparedness department) in 2017. In Surat the UCRA findings were presented to officials from the Surat Municipal Corporation's Health Department and the Surat Smart City office (part of the Corporation) in 2018. In Semarang the UCRA team presented its findings to the city's Planning Department in 2018.

City officials in the three cities found the findings comprehensive and responsive to both genders. They explored various possibilities for integrating the findings and methods into their existing plans and processes:

1. In Rio the UCRA indicators were integrated with the city's resilience plan in 2016. Because of a change of government, the operational resilience plan developed for Morro dos Macacos may not be taken up immediately by the city government, however.

2. City officials in Surat highlighted opportunities to integrate UCRA findings focused on heat risk with the Surat Heat Action Plan. Implementation will take time.

3. The UCRA workshop in Surat led to a conversation about a potential state-wide capacity-building workshop to train officers from 170 urban local bodies in Gujarat. This training will help officials integrate a community resilience planning approach to improve existing disaster preparedness processes in their cities.

4. City officials in Semarang discussed integrating the UCRA findings in order to increase activities on climate resilience awareness in vulnerable communities and discuss resilient infrastructure projects at village consultation meetings.

Lessons Learned

Social and Political Resources

The UCRA findings suggest that aspects of social cohesion and political engagement are integral to understanding the complex relation between individuals' risk perception and preparedness. Residents depend on one another socially. Because of poor institutional support, they are not politically active and have little faith in the government. Frequent experiences of climate-induced risks bring communities together, but without institutional support, residents are unable to organize effectively and prepare for the kinds of risks they are expecting. With effective civil society support, they hold institutions and leaders accountable and are willing to invest time, labor, and finance in resilience actions.

Relocation is often considered in planning for vulnerable communities living in high-risk areas, unfit for habitation. When communities are relocated, their social functions, institutional support, and access to political leadership must be restored to help them rebuild their social capital.

Individual and Community Awareness and Preparedness

Residents from all three cities were aware of an increase in climate-induced natural disasters over the last decade. Most residents reported being aware of "climate change" and having access to weather forecasts and alerts.

When asked about individual and collective preparedness, residents shared experiences of spontaneous and intuitive resilience actions. Organized and institutionally supported disaster responses were reported after a disaster and during the recovery and rehabilitation process. Residents exposed to heat risk in Surat (an invisible risk) and land subsidence and sea level rise in Semarang (both slow-moving disasters) identified adaptation solutions that allowed them to live with these risks while trying to minimize their losses. In Surat residents tried to reduce their heat exposure, made

Residents of Tambaklorok in the Tanjung Mas area of Semarang prop up their homes on stilts to avoid tidal floods.

Photo credit: WRI.

Residents of the Morarji Vasahat slum in Surat build high plinths and thresholds to adapt to frequent waterlogging.

Photo credit: WRI India.

dietary changes, and sprayed water around their homes to reduce ambient temperatures. In Semarang residents used furniture and wooden platforms to raise their valuables above the water level, and some residents installed vacuum pumps. To manage land subsidence, they increased the height of their homes every five years.

It is increasingly important to increase awareness, build capacities, and help residents move toward transformational resilience actions. Cities must move from spontaneous and reactionary actions to planned collective preparedness methods that are designed for specific local contexts.

Climate-Resilient Infrastructure

Respondents across the three cities highlighted the need for improved infrastructure and critical urban services; in many cases, they took action to fill these gaps themselves. In Rio and Surat, residents cited inadequate waste management as a key challenge that increased flood risk during heavy rains, raising the risk of epidemics. In response, community members participated in street cleaning drives, cleaned storm water drains, repaved roads and potholes, and adopted behavioral changes for better waste management. Communities in Semarang repaved their streets, rebuilt bridges destroyed by landslides, and added stilts and scaffoldings to sinking homes.

Large climate-resilient infrastructure projects are often celebrated as the only urban adaptation efforts. The UCRA results highlight efforts made by poor communities as part of a continuous process of adaptation. With more institutional support, better information, and engaged political leadership, community-based resilient infrastructure efforts can increase urban resilience.

Information Communication Systems

Residents across the three cities report poor access to information and communication technologies. Although many residents own cellphones, very few are registered with their city's early warning system, which are often not designed for poor people, many of whom cannot afford smartphones.

In high-risk communities in Surat and Semarang, informal warning systems were in place, but the systems were often unreliable. Residents seek information on weather forecasts and flood alerts via television, radio, and local newspapers, which are convenient and accessible to them.

A tool like the UCRA can be useful in mapping (a) whether residents in poor communities receive warnings; (b) if not, whether it is because of the mode of dissemination (cellphone, smartphone app, social media); (c) if so, whether they would prefer a different mode; and (d) whether they require institutional support to understand the severity of the alert and help take appropriate actions. Residents from the three cities indicated that information must be easy to understand, comprehensive (relating to multiple risk factors), responsive to vulnerable users, and shared through affordable and convenient communications modes.

Applying the Urban Community Resilience Assessment in Other Cities

Inferences from pilot testing in the three cities point to both opportunities for scaling the UCRA to other cities and barriers that need to be overcome.

Taking Advantage of Opportunities

1. **Leverage the current global momentum.** Urban resilience is receiving more global attention than ever before. The SDGs and the Paris Agreement make clear commitments to prioritize the lives and well-being of vulnerable communities living in cities. The UCRA is well positioned to help cities leverage this international momentum to strengthen social resilience while achieving resilience goals.

2. **Collaborate with city-based resilience efforts.** Urban resilience efforts through global networks such as 100 Resilient Cities, Arup's City Resilience Index, C40 cities, and ACCCRN focus on city-level vulnerability and resilience assessments. The UCRA can contextualize city vulnerability and resilience assessments to the local neighborhood and household level, filling essential knowledge gaps.

Urban resilience is receiving more global attention than ever before. The SDGs and the Paris Agreement make clear commitments to prioritize the lives and well-being of vulnerable communities living in cities. The UCRA is well positioned to help cities leverage this international momentum to strengthen social resilience while achieving resilience goals.

3. **Encourage a multistakeholder, community resilience approach.** The UCRA process is an opportunity to engage city officials in a planning process that empowers poor and vulnerable communities as allies and change agents rather than victims of climate-induced natural disasters. Doing so can improve interdepartmental coordination, build empathy among various stakeholders, and encourage strong leadership in city government.

4. **Develop a baseline for cities.** The UCRA helps cities create a baseline of resilience indicators that can be monitored periodically to assess the reach, relevance, and efficiency of resilience actions developed through the UCRA process. The flexible and customizable framework and the participatory process of adapting the indicators help contextualize the baseline.

5. **Explore causal relationships across indicators and categories.** The UCRA framework allows planners to explore correlations between indicators and categories across the three dimensions (vulnerability context, community resilience, and individual capacities). Doing so results in resilience actions that are integrated and address multiple aspects. Collective experiences of urban risks may bring communities together through collective preparedness activities or resilience trainings. These correlations are essential in building comprehensive resilience strategies.

Breaking Down Barriers

1. **Reduce costs.** The cost of the UCRA is high for the implementing agency, especially if it is not the city government. To ensure cost efficiency, all implementation partners—the city government, a civil society partner (or a committee of partners), and other resilience partners in the city (global networks, and consultants)—need to be willing to cooperate and share data. Chapter 5 describes measures that can be deployed to reduce costs and increase efficiency.

2. **Ensure political will.** Lack of political will and city leadership to drive the UCRA process increases the time needed to implement the tool and reduces effectiveness. Chapter 5 suggests ways of increasing political support for the UCRA.

3. **Identify a committed team of experts as advisors.** The UCRA must be implemented in alliance with a team of experts that support the preparatory and project planning phases. Identifying the right stakeholders, sensitizing them, and seeking their commitment throughout the process may demand greater flexibility, however, impeding the standardization of the UCRA.

4. **Fill data gaps.** Lack of access to spatial analytical tools, such as the city's GIS database, can compromise the results of the UCRA and make it difficult to integrate it into city plans and city-level vulnerability analyses. Data gaps at the city level lead to inaccurate vulnerability assessments.

5. **Break down language and terminology barriers.** Language can be a barrier in multilingual cities or cities that attract many immigrants or migrants. Terms like *resilience* and *adaptation* may not be understood.


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CHAPTER 5

OPPORTUNITIES FOR ENHANCEMENT OF THE UCRA TOOL

This chapter identifies research gaps and makes recommendations for fine-tuning and formalizing the UCRA approach. The goal is to improve the tool so that it is globally applicable yet locally relevant, flexible, and responsive to vulnerable individuals.

Improving Data Collection and Ownership

The UCRA should be implemented by local government, using management information systems that are already in place. Application needs to be demand-driven, with the city taking ownership of data collection, analysis, and storage.

Some data may be available only at the city scale, not at the granular scale that will yield information about poor and vulnerable communities. Cities that do not want to incur the cost of a survey to collect the needed data can use proxy indicators, such as access to urban services (water, electricity, sanitation); the material of buildings included in the city's census survey; and electoral lists, which can be used to assess voter participation. They can also build an information management system that draws on innovative and cost-effective data collection methods—partnering with cellphone operators, for example, to develop specialized data collection applications or offering discounts for people who take a survey and provide data.

Application of the UCRA should prioritize the use of existing city-level data, including a GIS database, to assess the city's vulnerability context. Cities should build on and adapt the UCRA to existing data analysis capacities and resources already in place. With adequate resources, cities can develop a phone-based application to collect UCRA data and a web-based platform to analyze and store results, thereby reducing the costs of data collection, and encourage regular monitoring of indicators and resilience actions over time.

Strengthening Data Analysis

Analysis of the UCRA indicators is done manually in Excel, and UCRA does not allow users to easily visualize the results via maps. Addressing both issues would render the tool more accessible and useful.

Data analysis could also be strengthened by disaggregating the analysis and developing insights into the resilience of particular groups of people. Are women or men within particular age groups more likely to practice resilient habits? Which groups of people display higher levels of political engagement? Are older people more or less likely than younger people to have strong social networks? Analysis at this level could help city managers understand the resilience of vulnerable people. Such analysis also underpins the notion that vulnerability is differentiated, that different groups of people will experience climate impacts differently. It helps city managers better target resources and implement policies that increase the resilience of key groups.

Moving from Information to Action

The UCRA has the potential to promote peer-to-peer learning between cities that focuses on increasing the resilience of people living in poor and vulnerable communities. Developing an online community of practice on resilience and preparedness, for example, could help promote pro-poor urban climate resilience planning, allow cities to exchange insights and display and share results, and help cities overcome barriers to implementation more rapidly.[6]

APPENDIX A: PILOT CITIES AND COMMUNITIES AT A GLANCE

The tables in this appendix describe the city vulnerability context, socioeconomic characteristics, and resilience challenges of the communities in each of the three pilot cities.

Table A.1 | Rio de Janeiro at a Glance

ITEM	STATISTIC
Population	6.45 million
Area	1,200 square kilometers
Administrative structure	5 planning areas, 33 administrative regions, and 161 neighborhoods
Percent of population living in *favelas*	22
Vulnerability of informal housing	*Favelas* are often located on hillsides, leaving residents exposed to landslides during heavy rainfall
Evacuation routes in high-risk areas	All high-risk areas have designated evacuation routes implemented by the Civil Defense
Human Development Index	0.61 (figure for Brazil is 0.75)
Annual violent crime rate per 100,000 residents	18.42
Percent of population with access to piped water supply, adequate sewage treatment, energy supply, and household waste collection	90

Table A.2 | Morro dos Macacos and Morro da Formiga at a Glance

ITEM	MORRO DA FORMIGA	MORRO DOS MACACOS
Population	4,312	5,072
Number of households	1,279	1,384
Survey sample size	200	200
Ratio of women to men	50: 50	45: 55
Percent of population under age of 19	7	9
Unemployment rate (percent)	19	4
Average family size	4.0	3.0
Percent of population living in nuclear family households	46	49
Average monthly family income	R$1,628 ($439)	R$2,526 ($681)
Education Levels	63 percent completed primary school, 35 percent completed secondary school, 2 percent have some higher education	50 percent completed primary school, 50 percent completed secondary school
Percent of respondents that own their own home	82	50
Resilience challenges	Community is highly susceptible to landslides, classified as high-risk by municipal Civil Defense.	Since the Gari Comunitário program (which hired residents to collect waste within the community) was shut down, waste has blocked drainage pipes and increased exposure to health risks and landslides.

Table A.3 | Surat at a Glance

ITEM	STATISTIC
Population	4.58 million
Area	327 square kilometers
Administrative division	7 administrative zones, 29 electoral wards
Percent of population residing in areas at risk of high air pollution, historic river flooding, and high surface temperatures	36
Percent of population that is homeless or lives in a slum	11
Summer heat index	Number of summer days when temperature exceeds 40°C has increased over past 10 years.
Precipitation	Average annual rainfall has increased since 1990.
Extreme weather events	Frequency of heavy rainfall events (exceeding 65 millimeters) has increased since 1983; major floods occurred in 1990, 1994, 1998, and 2006.
Percent of population informally employed or unemployed	3.6
Percent of population that is literate	88
Percent of population under the age of 15 or over the age of 65	41
Ratio of women to men	76: 100
Percent of population that are migrants	58 (largest share in India)
Annual violent crime rate per 100,000 people	1,407
Access to piped water supply, adequate sewage treatment, energy supply, and household waste collection	More than 95 percent
Percent of population with storm water drainage	59
Number of hospital beds available per 100,000 people	25
Percent of population with access to public transit	52

Table A.4 | Communities in Surat at a Glance

ITEM	MORARJI VASAHAT	UGAT SITE AND SERVICES	KOSAD AWAS
Population	5,920	3,255	26, 578
Number of households	1,184	651	19,000
Survey sample size	167	171	175
Ratio of women to men	54: 46	55: 45	56: 44
Percent of population under 18	33	41	38
Unemployment rate (percent)	4	4	3
Average family size	4.69	5.04	4.26
Percent of population living in nuclear family households	59	60	68
Main origin of migrants	Gujarat, Maharashtra	Gujarat, Uttar Pradesh	Uttar Pradesh, Orissa
Percent of respondents that own their own home	83	77	59
Percent of respondents that have bank account	50	44	43
Settlement and housing type	Old slum settlement; metal roofs, low-capacity drainage, low water quality, paved roads	Site and services scheme; self-built homes, low-capacity drainage, low water quality, dirt roads	Slum rehabilitation building; concrete, four-story walk-up buildings with poor ventilation.
Level of social cohesion	High; residents have lived together for more than 30 years.	Moderate; residents were allocated land in areas many years ago.	Low; residents were resettled in area from 2012 onward.
Resilience challenges	Flood management: Settlement is in a low-lying area. Residents have raised plinth levels and built thresholds at their doorways to prevent waterlogging.	Waste management: Low-capacity drainage and improper waste disposal methods cause health problems, particularly during monsoons	Safety and cohesion: Residents were allotted homes via a lottery system, eroding past social networks.

Table A.5 | Semarang at a Glance

ITEM	STATISTIC
Population	1.7 million
Area	374 square kilometers
Administrative division	16 subdistricts and 77 villages
Percent of population at risk of landslides and coastal flooding	37
Number of people living in slums	110,000
Percent of population living in areas of land subsidence	14 (rate of subsidence is 2–8 centimeters a year)
Precipitation	Rainfall increased markedly between 1993 and 2012.
Annual rise in sea level (millimeters)	6
Percent of population that is unemployed	5.8
Percent of school-age children in school	More than 90
Number of elementary and high schools as percentage of needed numbered	51
Percent of population under the age of 15 and over the age of 65	39
Ratio of women to men	1.04: 1
Percent of population living below the poverty line	4.8
Percent of population connected to the water distribution network	82
Percent of population with access to sanitation and sewage treatment	76
Percent of population with electricity	97
Percent of population with access to waste collection	82
Number of hospital beds per 10,000 people	31
Percent of population with access to public transit	24
Percent of city roads with built-in storm water drainage facilities	7.4
Percent of population living in areas prone to fires	25

Table A.6 | Communities in Semarang at a Glance

ITEM	TAMBAKLOROK	KALIGAWE	DELIKASERI
Location	Coastal	East Flood Canal	Northern Hills
Population	8, 252	1,547	687
Number of households	2,032	452	213
Survey sample size	334	129	38
Ratio of women to men	66: 34	72: 28	87: 13
Percent of population under 25	2	3	8
Percent of population unemployed	40	42	58
Average family size	4.5	4.4	4.6
Percent of population living in nuclear family households	69	65	63
Percent of population that owns their own home	94	58	87
Average monthly household income	RP 2–4 million ($147–$287)	RP 2 million ($147)	RP 2 million ($147)
Services and Infrastructure	No clear waste management system is in place. Inadequate garbage disposal blocks drainage. Community lacks septic tanks and toilet facilities.	No clear waste management system is in place. Inadequate garbage disposal blocks drainage.	Access to clean water is minimal. Water from small spring is shared on a rotational basis. No clear garbage disposal system is in place.
Access to information	No source of disaster-related information or early warnings; local disaster risk reduction DRR groups do not disseminate information when received.	Drum- and loudspeaker-based early warning system in place; local DRR groups disseminate updates on flooding in the upstream canal.	No early warnings, but individuals monitor weather and news. Local DRR groups do not disseminate information when received.
Resilience challenges	Coastal area facing tidal flooding, sea level rise, and land subsidence.	Low-lying area with river flooding, tidal inundation, and land subsidence.	Slopes of more than 40 percent incline cause landslides during heavy rains; droughts and forest fires are frequent.

APPENDIX B: SCORING METHODOLOGY

The scoring method was developed for each city based on the questionnaire and the secondary data used to analyze the vulnerability context. All scores are on a five-point scale.

In Rio the UCRA team used context-specific thresholds to score each indicator (for a detailed description of this method, see Elias-Trostmann et al. 2018). In Surat and Semarang, the team used four analytical methods, depending on the kinds of indicators and data used. This appendix describes the four scoring methods using examples from Surat.

Method 1: Multihazard Mapping

A multihazard mapping method was used to identify the most vulnerable areas and communities in a city. A multihazard map provides a "composite picture of natural hazards of varying magnitude, frequency, and area of effect" (Mahendra et al. 2011, 303).

In Surat raster and vector GIS[7] were used to combine data on population density at the city level with spatial data on three main climate risks: the historic extent of river flooding in 2006 (Bahinipati et al. 2015), landsat[8] data on surface temperature, and the concentration of PM10 and PM2.5 pollutants.[9] (Urban Emissions 2011). When spatial data were in the form of vector shape files, spatial interpolation was used to create a continuous surface and the resulting files converted to raster grids. After all the shape files were rasterized, the risk factors were reclassified using local algebraic operations (raster calculator) to yield a scale ranging from 1 (least resilient) to 5 (most resilient). Table B.1 shows the typical UCRA score calculator developed on the basis of the mean and standard deviation for a given indicator.

Table B.1 | Meaning of Urban Community Resilience Assessment Scores

SCORE	INTERPRETATION
1 (least resilient)	More than (Mean + Standard Deviation)
2 (not very resilient)	(Mean + 0.33 Standard Deviation) to (Mean + Standard Deviation)
3 (moderately resilient)	(Mean – 0.33 Standard Deviation) to (Mean + 0.33 Standard Deviation)
4 (resilient)	(Mean – Standard Deviation) – (Mean – 0.33 Standard Deviation)
5 (most resilient)	Less than (Mean – Standard Deviation)

The three grids were then equally weighted and combined using local algebraic operations (raster calculator) to produce the final map of high- and low-risk areas (Figure B.1).

Subcity population data were overlaid on this map to reveal the number of people residing in the high-risk zones. Each subcity location was scored using a five-point scale, based on the percentage of residents living in high-risk areas.

Method 2: Moving-Average Analysis

Ten-year moving averages were used to calculate the summer heat index, precipitation, and extreme events indicators and to plot the percentage of days in which the heat index exceeded 40°C. For all three climate risk indicators, the mean and standard deviation values of the moving averages were used to set the scoring ranges (Table B.2). Climate data were sourced from a secondary climate data portal frequently used by researchers (TuTiempo.net n.d.). When insufficient data points prevented the use of the standard deviation values, quintiles were used.

Table B.2 | Distribution of Urban Community Resilience Assessment Scores in Surat

SCORE	PERCENT OF TOTAL
1 (least resilient)	16
2 (not very resilient)	22
3 (moderately resilient)	24
4 (resilient)	22
5 (very resilient)	16

Method 3: Comparative Thresholds

Indicators that assess city-level vulnerabilities using secondary data are scored using a comparative thresholds method. This method uses country- and city-specific standard deviation values to develop a scoring range (see Table B.1). Depending on the indicators, national or global thresholds were used. For example, to score the high-risk labor profile indicator for Surat, the city's labor profile was compared with the percentage of informal/casual labor in all Indian cities with more than 1 million people. The standard deviation and mean values were determined to set up thresholds and calculate the scoring range (Table B.3).

Figure B.1 | Map of Multiple Risks in Surat

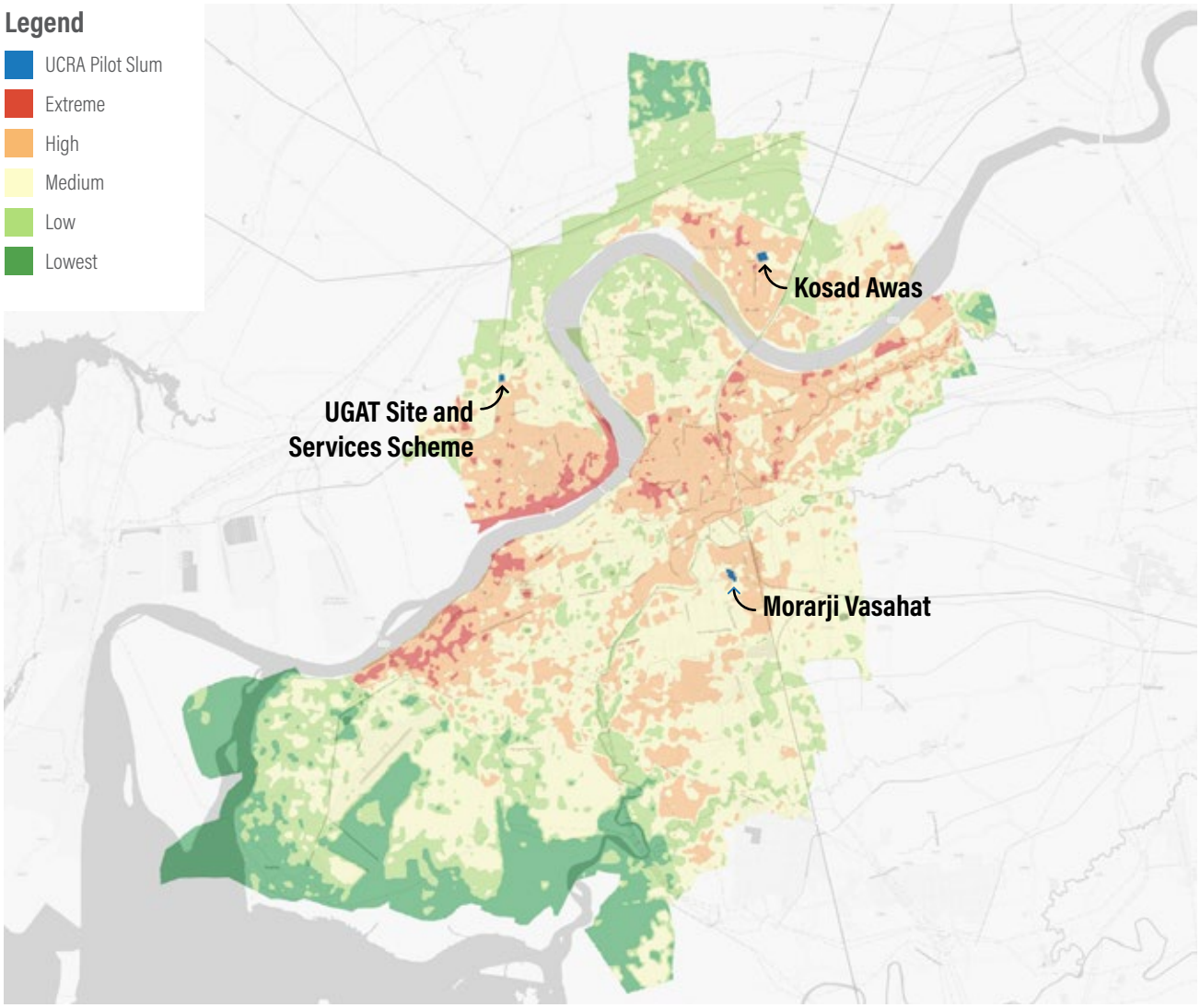

Table B.3 | Distribution of Scores for High-Risk Labor Profile Indicator in Surat

SCORE	SCORING RANGE	PERCENT OF TOTAL
1 (least resilient)	More than 20	16
2 (not very resilient)	14–20	22
3 (moderately resilient)	9–14	24
4 (resilient)	3–9	22
5 (very resilient)	Less than 3	16

Where national thresholds were not available (as in the case of literacy), global thresholds from several other countries (taken from UNESCO's Education and Literacy Rate Report 2017) were used. The standard deviation (17.8 percent) and mean values (83.7 percent) were used to establish thresholds and determine the scoring range (Table B.4).

Table B.4 | Distribution of Scores for Literacy Profile Indicator in Surat

SCORE	SCORING RANGE	PERCENT OF TOTAL
1 (least resilient)	Less than 66	16
2 (not very resilient)	66–78	22
3 (moderately resilient)	78–90	24
4 (resilient)	90–98	22
5 (very resilient)	More than 98	16

On the basis of these values, subcity level literacy rates were scored. The final score for the literacy profile indicator was the average of the subcity scores.

Method 4: Quintile Scale

For the community and individual dimensions of the UCRA in Surat and Semarang, the survey posed mostly yes/no questions. Responses were aggregated and a score was assigned according to the percentage of "yes" responses (Table B.5). In cases where several survey questions were used to calculate the score for the indicator, the final score was an average of the individual scores for each question.

Table B.5 | Scoring of Community Resilience and Individual Capacity Dimensions in Surat

RESILIENCE LEVEL	PERCENT OF "YES" RESPONSES
1 (least resilient)	0–20
2 (not very resilient)	20–40
3 (moderately resilient)	40–60
4 (resilient)	60–80
5 (very resilient)	80–100

Some questions used a Likert scale (most favorable to least favorable) to capture qualitative and experiential data. The percentage of respondents who answered within a predetermined range (e.g., "favorable to most favorable") were aggregated and scored according to a 1–5 scale. Hence, if 65 percent of the respondents answered within the favorable to most favorable range, the score for the indicator is 4.

APPENDIX C: QUESTIONNAIRE USED IN SURAT

The questionnaire shown here was used in Surat. Questions that refer to conditions in Surat were drafted with inputs from the stakeholder committee and pilot tested. This questionnaire cannot therefore be used elsewhere. Implementers can, however, use this questionnaire as a guide to test similar questions in other cities.

SOCIOECONOMIC EVALUATION

1.1 Total number of family members: _____ **1.2 Type of family:** ☐ Nuclear ☐ Joint (extended) ☐ Migrants living together

1.3 Religion: ☐ Hindu ☐ Muslim ☐ Christian ☐ Parsi ☐ Jain ☐ Other

1.4 Caste: ☐ Scheduled tribe _____ ☐ Scheduled caste _____ ☐ Other Backward Tribe _____
☐ General _____ ☐ Other: _____

1.5 Languages you use at home: _____

1.6 Ownership of house: ☐ Own ☐ Rent ☐ Live with friend or relative

1.8 Ownership of vehicles: ☐ Cycle ☐ Two-wheeler ☐ Autorickshaw ☐ Car ☐ Truck ☐ Light Commercial Vehicle (LCV)

1.9 Ownership of electrical appliances: ☐ Refrigerator ☐ Washing machine ☐ Cooler/air conditioner ☐ TV ☐ Water pump
☐ Other: _____

1.10 How do you get local news? ☐ Newspaper ☐ Radio ☐ Friend/relative ☐ Computer ☐ Mobile ☐ Smartphone/WhatsApp
☐ TV ☐ Other: _____

1.11 Do you have insurance? ☐ Yes ☐ No **Type:** ☐ Health ☐ Life ☐ Home ☐ Business assets ☐ Accident ☐ Natural disaster

1.12 Have you taken any loans? ☐ Yes ☐ No **From where:** ☐ Bank ☐ Sharaf ☐ Private **How much:**_____

RESILIENT BUILT ENVIRONMENT

2.1 House construction type (fill in based on house inspection): ☐ Temporary construction ☐ Permanent construction
☐ Partly permanent ☐ Other: _____

2.1a Material of walls: ☐ Cement ☐ Brick ☐ Metal sheet ☐ Wood ☐ Other: _____

2.1b Material of floor: ☐ Cement ☐ Stone ☐ Mud ☐ Other: _____

2.1c Material of roof/terrace: ☐ Cement ☐ Tiles ☐ Metal sheet ☐ Asbestos ☐ Other: _____

2.2 Number of floors: ☐ Ground structure ☐ Ground plus one floor ☐ Ground plus two floors ☐ Other: _____

2.3 Age of structure:_____ **Number of rooms:** ☐ 1 (studio) ☐ 1 + kitchen ☐ 2 + kitchen ☐ Other: _____

2.4 Open area around the house? ☐ Yes ☐ No ☐ In front ☐ In the back ☐ On one side ☐ On both sides

2.5 House ventilation: ☐ Yes ☐ No ☐ Window opposite window ☐ Window opposite door

2.5a Do you need any artificial lighting in the day? ☐ Yes ☐ No **2.5b If yes, for how many hours of the day?** _____

2.6 Potable water source: ☐ Tap (inside) ☐ Tap (outside) ☐ Bore well ☐ Public tap ☐ Well ☐ Tanker

2.6a Do you store water? If so, where? ☐ Water tank ☐ Open tub ☐ Can ☐ Earthen pot ☐ Bucket ☐ Other: _____

2.6b What kind of toilet do you use? ☐ Personal (in-house) ☐ Community ☐ Pay and use ☐ Other: _____

2.7 Do you have electricity in the house? ☐ Yes ☐ No ☐ Provider: Torrent ☐ Provider: DGVCL

2.8 What cooking fuel do you use? ☐ Liquefied petroleum gas ☐ Kerosene ☐ Coal ☐ Wood ☐ Dung ☐ Other:_____

2.9 What kind of waste collection system do you have? ☐ Door-to-door collection ☐ Common dustbin ☐ Throw out in the open ☐ Other: _____

2.9a Is your house connected to the sewer system? ☐ Yes ☐ No

2.9b Is your house connected to the city's storm water drain? ☐ Yes ☐ No

PERCEPTION OF CLIMATE RISKS AND PREPAREDNESS

3.1 Have you experienced a change in the climate during the years of your stay in Surat?
☐ Increased heat ☐ Increased cold ☐ Increased rainfall ☐ No change so far

3.2 How has climate change affected your life? _____

3.2a Health impacts in the household: ☐ Yes ☐ No ☐ Don't know

3.2b Impact on life and livelihood: ☐ Yes ☐ No ☐ Don't know

3.2c Floods cause loss and damage, and require evacuation: ☐ Yes ☐ No ☐ Don't know

3.2d Family safety: ☐ Yes ☐ No ☐ Don't know

3.3 Do you fear changes in the climate? ☐ Yes ☐ No **What fears:** _____

3.4 What do you do to relieve yourself from heat during days of extreme heat?
☐ Put on fans ☐ Spray water outside the house ☐ Insulate metal roofs with grass/ other material ☐ Sit on the porch of the house
☐ Sit under trees close to the house ☐ Other: _____

3.4a Do you have access to shaded refuge areas near your home? ☐ Yes ☐ No ☐ Describe: _____

3.5 How do you change your diet in response to extreme heat?
☐ Eat more bland food ☐ Drink more water ☐ Drink cooling drinks (buttermilk) ☐ Other: _____

3.6 Does extreme heat affect your livelihood? ☐ Yes ☐ No **If yes, how?** _____

3.7 During heavy rains does your area get flooded? ☐ Yes ☐ No **If yes, how much?** _____

3.8 What do you do to reduce waterlogging in your area?
☐ Fill up potholes with mud ☐ Clean drains to relieve blockages ☐ Repave streets ☐ Other: _____

3.9 Who should take responsibility for preventing waterlogging?
☐ City corporation ☐ Residents ☐ Elected representative ☐ Others: _____

3.10 Does water enter your house during heavy rainfall? ☐ Yes ☐ No **If yes, how much?** _____
Does it happen every monsoon? _____ **Reasons for waterlogging:** _____

3.11 What steps do you take to prevent waterlogging in the house?
☐ Raise the plinth of the house ☐ Build a tall threshold in the doorway ☐ Waterproof the roof ☐ Other:_____

3.12 Impact of heavy rainfall/flooding on your livelihood: ☐ Lose days of work ☐ Don't get work ☐ Other:_____

3.13 What illnesses do you see more of during the monsoons? _____

3.14 What health precautions do you take during the monsoon? ☐ Boil water for drinking ☐ Eat hot cooked meals
☐ Avoid getting drenched in the rain ☐ Avoid mosquito infestations in and around the house
☐ Fill up any potholes outside the house ☐ Other: _____

3.15 Did you or any member of your household participate in health awareness trainings/drives? ☐ Yes ☐ No
If yes, who took part? _____ **In what?** _____

3.16 Is there an emergency shelter for refuge in a severe flood? ☐ Yes ☐ No **If yes, where?** _____

3.17 Do you keep an evacuation bag ready in your house? ☐ Yes ☐ No
If so, what is in it? ☐ Documents ☐ Money ☐ Medicines ☐ Batteries

3.18 Where do you keep important documents during a flood? ☐ Cupboard ☐ On a high shelf ☐ At a friend or relative's home
☐ Other: _____

3.19 Do you have emergency savings? ☐ Yes ☐ No **If so, where?** ☐ Bank ☐ Co-saving model ☐ With relatives

COMMUNICATION, AWARENESS, AND INFORMATION

4.1 Do you think information on natural hazards would be helpful? ☐ Yes ☐ No **If yes, how?** _____

4.2 Are you aware of an early warning system? ☐ Yes ☐ No
Have you received messages? ☐ Yes ☐ No If so, through whom? _____

4.3 How do you prefer receiving early warning systems or weather forecast awareness?
☐ Cellphone ☐ TV ☐ Radio ☐ Loud speaker announcements ☐ Other: _____

4.4 Where do you get weather information? ☐ Cellphone ☐ TV ☐ Radio ☐ Newspaper ☐ Other: _____

4.5 Do you receive weather-related health information?
☐ Yes ☐ No ☐ Anganwadi ☐ Health center ☐ TV ☐ News ☐ Information boards ☐ WhatsApp

SOCIAL COHESION

5.1 In times of emergency, whom would you contact first? ☐ Relatives ☐ Neighbors ☐ Friends ☐ Other:_____

5.2 Has there been an incident when you needed help from your neighbors?
What help did you get? _____ Did you get help during a flood? _____
What help did you give? _____ Did you ever provide help during a flood? _____

5.3 What festivals are celebrated in your neighborhood? ☐ Ganpati ☐ Navratri (durga puja) ☐ Holi ☐ Diwali
☐ Other: _____

5.4 Do you participate in these celebrations? ☐ Yes ☐ No

5.5 How comfortable are you with the people in your neighborhood? ☐ Not at all ☐ A little ☐ Moderate ☐ Like a lot

5.6 Are you happy staying in this neighborhood? ☐ Yes ☐ No

5.7 Would you like to live here for as long as you are in Surat? ☐ Yes ☐ No **If not, why not?** _____

GOVERNANCE AND POLITICAL ENGAGEMENT

6.1 Is your name on the voter list? ☐ Yes ☐ No

6.1a Did you vote in the last election? ☐ Yes ☐ No

6.2 Do you know your area corporator (elected representative)? ☐ Yes ☐ No

6.2a Have you met the corporator? ☐ Yes ☐ No

6.3 Do you have a community leader in your area? ☐ Yes ☐ No

6.3a What support do you get from him or her?

6.4 Do you know where your ward office is? ☐ Yes ☐ No
Have you gone there? _____ **Reason for visit:** _____

6.5 Do you know where the civic center for your zone is? ☐ Yes ☐ No
Have you gone there? _____ **Reason for visit:** _____

6.6 Are there civil society organizations active in your area? ☐ Yes ☐ No

6.6a Do you get support from them? ☐ Yes ☐ No

6.7 Are you willing to invest/participate in improvements in your area?
☐ Yes ☐ No ☐ Finance ☐ Time/ labor ☐ Participation in meetings ☐ Other: _____

APPENDIX D: DIAGNOSTIC REPORT SUBMITTED TO THE SURAT MUNICIPAL CORPORATION

This appendix is a condensed summary of the resilience diagnostic report submitted to the Surat Municipal Corporation to complete the UCRA process and make recommendations about the city's resilience strategy. It includes the UCRA scorecard, divided by dimension: city-level vulnerability scores and community- and individual-level resilience scores for the three communities in Surat. It also includes recommendations from the community workshops, a short summary of gender-based results, and recommendations from the multistakeholder workshop with city officials.

The UCRA Scorecard by Dimensions

Each of the indicators was assigned a score between 1 (least resilient) and 5 (most resilient). Vulnerability context scores for the city (Table D.1) were based on official census data, climate data, and secondary data on urban services from official city-wide surveys. Indicators for community resilience (Table D.2) and individual capacities (Table D.3) were scored using primary household survey data and focus group discussions. Each score card by dimension is followed by a summary of results that explains how the data analysis and indicator scores relate with each other.

Vulnerability Context

City-level scores reveal that Surat is highly prone to extreme heat events, flooding from excessive rain, and coastal and river flooding from heavy rain upstream. Few people in Surat still live in slums (hence the score for housing for the urban poor is quite high). However, study of the slum rehabilitation scheme in Kosad Awas reveals several challenges facing urban poor communities living in formal housing. The city scores high on several urban amenities and services, but adequate health facilities, green areas, and storm water drainage to manage the two climate risks are few and need improvement.

Table D.2 summarizes the indicators under the vulnerability of setting category from the first dimension. It shows how results are to be presented in the diagnostic report to help city officials understand the city context and the scoring analysis.

Community Resilience

This section includes three tables. Table D.3 summarizes the socioeconomic profile of survey respondents in Surat. Table D.4 presents the resilience scorecard for community resilience indicators by category and indicator for the three communities. Table D.5 summarizes community resilience indicator results, showing survey questions and community-wide responses. The tables reveal that social cohesion in the three communities in Surat is high but political linkages are weak, resulting in low community and individual resilience capacities (Tables D.4 and D.6).

Table D.1 | Resilience Scorecard for Vulnerability Context Indicators in Surat

ITEM	SCORE
Vulnerability of setting	**2.7**
High-risk areas	2.0
Housing for the urban poor	4.0
Summer heat index	1.0
Precipitation anomaly	3.0
Extreme events	3.5
Preexisting social vulnerability	**3.5**
High-risk labor profile	4.0
Literacy profile	3.0
Age profile	5.0
Gender profile	1.0
Migration profile	—
Crime rate	3.0
Disability profile	—
Social profile	5.0
Access to urban services	**4.0**
Water distribution network	5.0
Sewage treatment network	5.0
Electricity grid	5.0
Waste collection network	5.0
Urban health amenities	3.0
Storm water drainage	4.0
Reliable and affordable mobility	3.0
Green areas and natural infrastructure	2.0

Note: — Not available Moderate resilience High resilience

Individual Capacities

This section includes two tables. Table D.6 presents the resilience scorecard for individual capacities indicators by category and indicators. Table D.7 summarizes the results of survey questions and community responses.

Table D.2 | Summary of Results for the Vulnerability of Setting Indicators for Surat

INDICATOR	DESCRIPTION
High-risk areas	A multihazard map was used to overlay the risks presented by river flooding in 2006, high surface temperature, and air pollution at the city level. It revealed that 36 percent of the population resides in high-risk areas.
Housing for the urban poor	City-level GIS data on urban poor settlements were used to assess the percentage of area occupied by informal settlements and the number of homeless people in each administrative ward in the city.
Summer heat index	A 10-year moving average of the city's heat index indicates an increasing trend in perceived heat between 1995 and 2017.
Precipitation anomaly	A 10-year moving average of seasonal precipitation indicates a marked increase in rainfall between 1993 and 2012.
Extreme events	Ten-year moving averages of spikes in heat and precipitation indicate an increase in extreme rainfall events between 2000 and 2015.

Table D.3 | Socioeconomic Profile of Survey Respondents in Surat (percent of total)

CHARACTERISTIC		MORARJI VASAHAT	UGAT SITE AND SERVICES SCHEME	KOSAD AWAS
Major occupations		Students, laborers, homemakers, salaried workers	Students, laborers, self-employed workers, homemakers	Students, salaried workers, laborers, homemakers
Education through grade 10		50	43	55
Cellphone ownership		41	33	42
Access to government identity card		90	93	87
Walk to work		75	48	39
Vehicle ownership	Bicycle	12	16	51
	Two-wheel motorized vehicle	30	43	21
Household assets	Television	82	78	72
	Refrigerator	30	24	12
Home ownership		83	77	59
Insurance	Health	6	22	31
	Life	32	8	14

Table D.4 | Resilience Scorecard for Community Resilience Indicators for Three Communities in Surat

INDICATOR	MORARJI VASAHAT	UGAT SITE AND SERVICES SCHEMES	KOSAD AWAS
Social cohesion	4.3	4.5	4.5
Informal social networks	4	4	4
Neighborhood socializing	4	5	5
Neighborhood preference	5	5	5
Sense of community identity	4	4	4
Community-based livelihoods	—	—	—
Community preparedness	1.8	2.0	1.5
Community-led resilience activities	2	4	2
Community health awareness programs	1	1	1
Access to early warning systems	1	1	1
Refuge area	3	2	2
Indigenous community knowledge	—	—	—
Governance and political engagement	3.0	2.0	1.8
Political and city engagement	3	2	1
Voter participation	5	4	4
Trust in community leader	2	1	1
Nongovernmental support	2	1	1
Resilient built environment	1.6	2.0	2.8
Access to urban amenities	4	4	5
Mobility	1	1	1
Access to natural features	1	2	2
Construction type	1	2	5
Availability of shade	1	1	1

Note: — Not available Low Resilience Moderate Resilience High Resilience

Table D.5 | Community Resilience Indicators in Three Communities in Surat (percent of respondents)

INDICATOR	SURVEY QUESTION	MORARJI VASAHAT	UGAT SITE AND SERVICES SCHEME	KOSAD AWAS
Social cohesion				
Informal social networks	Contact neighbors first during emergencies	63	59	47
	Share good relations with their neighbors	85	83	86
Neighborhood socializing	Participate in neighborhood festivals and celebrations	78	80	93
Neighborhood preference	Are comfortable living in this neighborhood	88	80	86
	Like the people in the neighborhood	72	61	58
Sense of community identity	Consider yourself native to Surat city	92	88	87
Community preparedness				
Community-led resilience activities	Clean drains before the monsoon to avoid waterlogging	51	61	32
Community health awareness programs	Receive health awareness information and trainings from their local *anganwadi*	16	15	17
Access to early warning systems	Are aware of an early warning system in Surat	22	15	7
	Receive early warning alerts	19	12	6
Refuge area	Have access to refuge areas during a flood	56	37	3
Governance and political engagement				
Political and city engagement	Know your local elected representative	72	9	6
	Know your ward office	56	48	15
	Know your area's civic center	9	3	0.6
	Are aware of ward meetings in area	43	36	9
Voter participation	Are registered to vote	92	71	70
	Voted in last municipal election	87	67	61
Trust in community leader	Receive support from community leader	22	2	3
Nongovernmental support	Receive no support from NGO	94	100	100
Resilient built environment				
Access to urban amenities	Have access to tapped water	71	66	95
	Have legal electric connection	99	99	100
	Use liquid petroleum gas cylinders for cooking	81	75	95
	Have access to toilets	98	98	97
	Percent of respondents with access to door-to-door waste collection services	5	1	75
	Percent of respondents who's homes Are connected to the city's sewer system	97	99	100
Access to mobility	Percent of respondents who use public transport	1	0	0.4
Construction type	Percent of respondents who live in homes constructed as permanent structure	7	30	99
Access to areas of shade	Have access to refuge area close to home	20	0.6	2.8

Table D.6 | Resilience Scorecard for Individual Capacities Indicators for Three Communities in Surat

CATEGORY/INDICATOR	MORARJI VASAHAT	UGAT SITE AND SERVICES SCHEMES	KOSAD AWAS
Risk perception	3	3.3	2.5
Perceived climate risk	3	3	2
Practice of resilience habits	5	5	5
Resilience kits	2	2	2
Back-up of documents	2	3	1
Communication and awareness	3.6	3.8	3.6
Cellphone ownership	3	3	3
Internet access	2	2	1
Access to local news	5	5	5
Weather forecast awareness	5	5	5
Weather health awareness	3	4	4
Economic resources	3.2	3	3.2
Alternative livelihood options	2	2	3
Emergency savings	2	1	1
Health and life insurance	2	2	2
Below poverty line card/proof of identity	5	5	5
Willingness to invest in resilience	5	5	5

Note: Low Resilience Moderate Resilience

Table D.7 | Individual Capacities Indicators in Three Communities in Surat (percent of respondents)

INDICATOR	SURVEY QUESTION	MORARJI VASAHAT	UGAT SITE AND SERVICES SCHEME	KOSAD AWAS
Risk perception				
Perceived climate risks	Perceive climate risks as a life threat	46	42	26
Practice of resilience habits	Change diet to manage extreme heat	68	67	72
	Make changes in home to increase indoor comfort during the summer	49	47	35
	Take some precautions before monsoon to increase resilience	58	61	62.5
Resilience kits	Maintain emergency kits	21	23	34
Back-up documents	Keep documents safe to manage emergencies	20	20	20
Communication and awareness				
Cell phone ownership	Own a cellphone	41	33	43
Internet access	Have access to Internet	25	19	27
Access to local news	Get local news through television	74	75	71
Weather forecast awareness	Get weather alerts through television	87	78	80
Weather health awareness	Get information from the local *anganwadi*	29	44	38
	Get information from local health center	36	37	56
Economic resources				
Livelihood impacts	Suffered livelihood impacts due to flooding	44	43	36
	Suffered livelihood impacts from extreme heat	54	53	47
Emergency savings	Maintain emergency savings	13	20	18
Health and life insurance	Have health insurance	6	8	14
	Have life insurance	32	22	31
Proof of identity	Have government identity card	90	93	87
Willingness to invest in resilience	Willing to invest money toward resilience efforts in area	61	84	77
	Willing to invest labor toward resilience efforts in area	58	74	55

Needs Assessment for Communities in Surat

The UCRA analysis revealed three key themes across the three communities in Surat. First, community preparedness mechanisms to deal with floods—such as early warning systems, health awareness programs, and areas of refuge—are scarce. There are no reliable community mechanisms to access preflood warnings. Most residents indicated that early warning messages would be useful, but less than 20 percent said they were aware of early warning alerts in their neighborhoods. Less than 15 percent of respondents attended community-led health awareness events in the three communities, even though more than 70 percent are concerned about the health impacts of climate change. Individual flood preparedness is also low, with less than 30 percent of residents having insurance, emergency savings, or disaster preparedness kits.

Second, poor solid waste management is a key barrier to flood resilience in Surat. Wastewater flooding, caused by the breakdown of low-capacity drainage pipes in the Ugat Site and Services Scheme and Morarji Vasahat during floods, often leads to dangerous health conditions, including fever, malaria, cholera, leptospirosis, and skin infections. Ninety-five percent of the residents from the Ugat Site and Services Scheme and Morarji Vasahat said they use communal garbage bins that are inadequate and always overflowing. Inappropriate infrastructure, inadequate provision, or interrupted services and maintenance of systems result in waterlogging and increase health risks in poor settlements.

Third, social cohesion is the foundation for effective community resilience in Surat. Communities that had well-developed neighborhood relationships were better equipped to deal with climate risks. In Morarji Vasahat, where most residents have lived together for more than 30 years, half of all respondents reported gathering at a community center or a temple while evacuating from a previous flood as part of an informal community agreement. In the Ugat Site and Services Scheme, women who frequently socialize and work together provide financial and health-related help to one another via a local *sakhi mandal* (microfinance self-help group). (Box D.1 describes the gender focus of the UCRA application in Surat.) In Kosad Awas, clashes between neighbors within different identity groups often result in crime, infighting, and a lack of safety, especially for women. Sixty-three percent of residents in Morarji Vasahat and 59 percent of residents in the Ugat Site and Services Scheme call their neighbors first for emergency financial and

BOX D.1 | FOCUSING ON THE RESILIENCE NEEDS OF WOMEN IN SURAT

The project team hosted community workshops in *anganwadis* (government-instituted community centers mandated to enhance women's health and early childcare and nutrition). Hosting the workshops in institutions that women visited frequently and trusted implicitly for resources, information, and support was intended to engage women in the UCRA process. In gender-segregated workshops, women discussed their needs openly and freely.

In Morarji Vasahat and the Ugat Site and Services Scheme, men focused on changes in infrastructure and the built environment to increase resilience, whereas women articulated the need for community-based resilience measures and behavioral changes. They suggested health awareness trainings and emergency kits, as well as the need for proper waste segregation and disposal mechanisms at the community level. Social spaces identified by women in all three neighborhoods included the porch and street outside their homes; *anganwadis*; and the way to the market, school, or other essential places. Men identified corner shops, playgrounds, or street squares as social spaces, noting that they socialize in these spaces regularly.

TABLE BD.1.1 GENDER-SPECIFIC RESILIENCE NEEDS AND ACTIONS IN SURAT

Need	Solution
Flood alerts arrive too late, resulting in recurrent asset losses	Involve women in designing early warning alerts, addressing the preferred mode, language, and type of information.
Women lack knowledge about managing climate-induced health risks.	Provide government-run health trainings, information kiosks, and awareness campaigns at *anganwadis.*
In Kosad Awas, gender-based violence, fighting, theft, and alcoholism are barriers to community resilience. The magnitude of these barriers was not as evident in discussions with men in Kosad Awas, who said that they were comfortable with their neighbors despite the frequent violence.	Create a safety and social cohesion plan. Women residents talked about strengthening their cooperative societies as "resident welfare associations" that can monitor dark alleys and crime hotspots through a neighborhood watch or peer group–connected SMS or WhatsApp technology.

health-related support. In Kosad Awas, the figure is only 47 percent. Low social cohesion directly affects resilience to extreme events, as community members fear one another and are less likely to work together and help one another.

Developing Resilience Action Plans

Community Responses

Community members from Morarji Vasahat, the Ugat Site and Services Scheme, and Kosad Awas met in gender-segregated workshops, where the team presented the UCRA findings to them and members identified a key challenge to discuss and plan for.

Community-driven flood-risk management in Morarji Vasahat: Residents mapped streets and areas that frequently get waterlogged as well as community bins and corners prone to garbage overflowing. They recommended four actions:

- Co-develop an evacuation plan.
- Mark flood levels and high-risk level markers at key junctions.
- Ensure end-user connectivity for early warning systems.
- Increase health awareness trainings.

Solid waste management plan for the Ugat Site and Services Scheme: Residents mapped dumping sites, community bins, and streets prone to waterlogging because of clogged drains. They recommended four actions:

- Increase the number of communal garbage bins.
- Train residents to participate in door-to-door waste collection.
- Create peer groups along streets to keep them clean.
- Increase health-related trainings.

Neighborhood watch and social cohesion plan in Kosad Awas: Women mapped out unsafe lanes in the neighborhood, many of them in back alleys between buildings and behind shops. They recommended three actions:

- Create a neighborhood watch and reactivate the residents' welfare association.
- Enhance civil society support.
- Introduce a vocational training cell to enhance community skills and livelihood options.

City-Level Resilience Actions to Manage Heat Risk

The UCRA findings and community action plans were presented to city officials, civil society partners, and subject experts who were part of the first UCRA preparatory workshop at a city-level workshop held at the Surat Municipal Corporation. The UCRA revealed that half of all residents lost income because of missed days of work in the summer and suffered heat-related fevers, nausea, and sicknesses. Several factors in the built environment contributed to higher perceived heat in communities: poorly ventilated houses, metal roofs that conducted heat in the Ugat Site and Services Scheme and Morarji Vasahat, high-rise concrete buildings in Kosad Awas, a lack of green cover, and general discomfort from overcrowding. However, despite high levels of daily discomfort and illness, many residents treat heat as an inconvenience rather than a pressing climate disaster. There were no community-led activities to deal with heat.

In response to these findings, city officials talked about improving the existing heat and health action plan in Surat, by introducing the following actions:

- "Climate-proof" areas by introducing a greenbelt around high heat-emitting land uses, such as industrial complexes.
- Increase green cover in the city, by engaging at the local neighborhood level, especially in poor communities, where resources are scarce and heat-health poor.
- Use heat-resistant paint or white-washed metal roofs/terraces to reduce indoor temperatures, and use more heat-specific construction in the form of higher ceilings, local materials, fewer glass facades, and more openings for the movement of air.
- Train nurses and doctors to deal with heat-related illnesses, giving them priority, and in case of fatalities to collect data for future awareness.
- Increase the capacity of active community-based organizations, such as the residents' welfare association, Hamara Bachpan (an Indian non-profit organization that focuses on children's health and safety in low-income urban communities), and women's trusts, to circulate heat protection and safety messages.

ENDNOTES

1. The UCRA was initially developed and piloted in the Brazilian cities of Rio de Janeiro and Porto Alegre. Under the project funded by Cities Alliance, the tool was applied in two Asian cities, Surat, India, and Semarang, Indonesia.

2. Communities are defined as individuals living in urban settlements that share a sense of identity based on their proximity of residence, income, occupation, race, or religion. When referring to a geographically defined area of a city confined by jurisdictional, socio-political, or physical property ownership boundaries, the term *neighborhood* is used.

3. A working paper reports the findings, analyses, and resilience actions developed by community members in Rio (Elias-Trostmann et al. 2018).

4. The Rio Resiliente is a resilience cell that was set up by 100 Resilient Cities in Rio de Janeiro to develop the city's resilience strategy, which included guidelines aimed at addressing the city's major vulnerabilities to make it more resilient.

5. Appendix D includes a summary of UCRA findings from the Resilience Diagnostic Report that was submitted to the city as part of the UCRA process. Although most of the findings in this case study aggregate the results for the three communities, the appendix provides results for each community.

6. PREPdata is a map-based, open data online platform that allows users to access and visualize spatial data reflecting past and future climate, as well as the physical and socioeconomic landscape for climate adaptation and resilience planning. It was developed by The Partnership for Resilience and Preparedness (PREP), a partnership of leading research institutions, government agencies, adaptation practitioners, and technology companies. More information at: www.prepdata.org.

7. In GIS two types of data are used to represent spatial information. Raster data is stored as pixels or images while vector data is in the form of points with x and y coordinates.

8. Landsat data is collected remotely using landsat satellite sensors that measure light energy emitted from the earth under seven light bands. These can be analyzed to study many phenomena—heat stress due to high surface temperature, is one.

9. PM refers to particulate matter present in the atmosphere, which along with gaseous matter in increasing levels, impacts air quality. Commonly known as "floating dust", this particulate matter is categorized according to size (10 or 2.5) measured by the aerodynamic diameter of the dust particle.

GLOSSARY

Adaptation: "The process of adjustment to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate change and its effects" (IPCC 2014).

Adaptive capacity: "The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences" (IPCC 2014).

Climate change: "A change in the state of the climate that can be identified (for example, via 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 forcing such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use" (IPCC 2014).

Climate-induced natural disasters: Weather-based events such as flash floods, surges, cyclones, and severe storms, the severity and frequency of which is increased by climate change. (IPCC 2012).

Climate-induced natural hazards: Weather-based events such as droughts, tropical cyclones, heat waves, and floods, the severity and frequency of which is increased by climate change (IPCC 2012).

Climate-resilient infrastructure: "Robust infrastructure that can cope with current and projected climate impacts and uncertainty without massive failures and economic cost" (UK Government 2011).

Climate-resilient pathways: "Iterative processes for managing change within complex systems in order to reduce disruptions and enhance opportunities associated with climate change" (IPCC 2014).

Community: "The totality of social system interactions within a defined geographic space such as a neighborhood, census tract, city, or country" (Cutter et al. 2008).

Community-based: Actions and processes that are based on the participation of residents and members of vulnerable communities and in some contexts led by community members. Also referred to as community-driven.

Community-based adaptation practices: Practices that involve "identifying, assisting, and implementing community-based development activities that strengthen the capacity of local people to adapt to living in riskier and less predictable climates" (Ayers and Forsyth 2009).

Community-based resilience measures: Actions, practices, or processes executed by community members in the face of a disaster that "reduce risk and resource inequities, engage local people in disaster mitigation, create organizational linkages, boost and protect social supports, and plan for not having a plan, which requires flexibility, decision-making skills, and trusted sources of information that function in the face of unknowns" (Norris et al. 2008).

Disaster: "Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery" (IPCC 2014).

Disaster risk management: "Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development" (IPCC 2014).

Disaster risk reduction: "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 2014).

Early warning system: "The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organizations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of harm or loss" (IPCC 2014).

Exposure: "The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected" (IPCC 2014).

Gender: "Gender refers to the social attributes and opportunities associated with being male and female. These attributes, opportunities, and relationships are socially constructed and are learned through socialization processes. They are contextual, time-specific, and changeable. Gender determines what is expected, allowed, and valued in a woman or a man in a given context. In most societies there are differences and inequalities between women and men in responsibilities assigned, activities undertaken, access to and control over resources, as well as decision-making opportunities" (UN Women 2018).

Gaps: Missing links in information, resource availability, processes, and institutional and governance mechanisms that result in a failure of comprehensive and connected resilience action.

Hazard: "The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this report, the term hazard usually refers to climate-related physical events or trends or their physical impacts" (IPCC 2014).

Impacts: "Impacts is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes" (IPCC 2014).

Informal settlement: "A term given to settlements or residential areas that by at least one criterion fall outside official rules and regulations. Most informal settlements have poor housing (with widespread use of temporary materials) and are developed on land that is occupied illegally with high levels of overcrowding. In most such settlements, provision for safe water, sanitation, drainage, paved roads, and basic services is inadequate or lacking. The term slum is often used for informal settlements, although it is misleading, as many informal settlements develop into good quality residential areas, especially where governments support such development" (IPCC 2014).

Livelihood: "The resources used and the activities undertaken in order to live. Livelihoods are usually determined by the entitlements and assets to which people have access. Such assets can be categorized as human, social, natural, physical, or financial" (IPCC 2014).

Poverty: "Poverty is a complex concept with several definitions stemming from different schools of thought. It can refer to material circumstances (such as need, pattern of deprivation, or limited resources); economic conditions (such as standard of living, inequality, or economic position); and/or social relationships (such as social class, dependency, exclusion, lack of basic security, or lack of entitlement)" (IPCC 2014).

Preparedness: A state of being prepared, in managing recurrent climate hazards and the impacts of climate change. The state of preparedness can be determined by the level of awareness, access to resources, and the ability of vulnerable people and communities to quickly and easily respond to climate impacts.

Resilience: "The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation" (IPCC 2014).

Risk: "The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In this report, the term risk is used primarily to refer to the risks of climate-change impacts" (IPCC 2014).

Risk management: "The plans, actions, or policies to reduce the likelihood and/or consequences of risks or to respond to consequences" (IPCC 2014).

Sensitivity: "The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise)" (IPCC 2014).

Social resilience: "All definitions of social resilience concern social entities—be they individuals, organizations or communities—and their abilities or capacities to tolerate, absorb, cope with and adjust to environmental and social threats of various kinds" (Keck and Sakdapolrak 2013).

Urban climate resilience: "Urban climate resilience embraces climate change adaptation, mitigation actions, and disaster risk reduction while recognizing the complexity of rapidly growing urban areas, and the uncertainty associated with climate change and economic growth. Urban resilience to climate change describes a city that is resilient on three levels: the systems of the city survive shocks and stresses; the people and organizations accommodate these stresses into their day-to-day decisions; and the city's institutional structures continue to support the capacity of people and organizations to fulfill their aims" (ADB 2014).

Urban Community Resilience Assessment (UCRA): A framework of more than 60 indicators identifying a neighborhood's vulnerability context, community resilience potential, and individual resilience capacities. The UCRA provides cities with a process to engage community members in urban resilience planning.

Urbanization: "The gradual shift in residence of the human population from rural to urban areas" (UN-DESA 2018).

Vulnerability: "The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt" (IPCC 2014).

Vulnerability assessment: Vulnerability assessments inform the "development of policies that reduce the risks associated with climate change" (Fussel and Klein 2006). These policies may include the "specification of long-term targets for the mitigation of global climate change, the identification of particularly vulnerable regions and/or groups in society to prioritize resource allocation for adaptation, and the recommendation of adaptation measures for specific regions and sectors" (Fussel and Klein 2006).

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ISBN 978-1-56973-954-4