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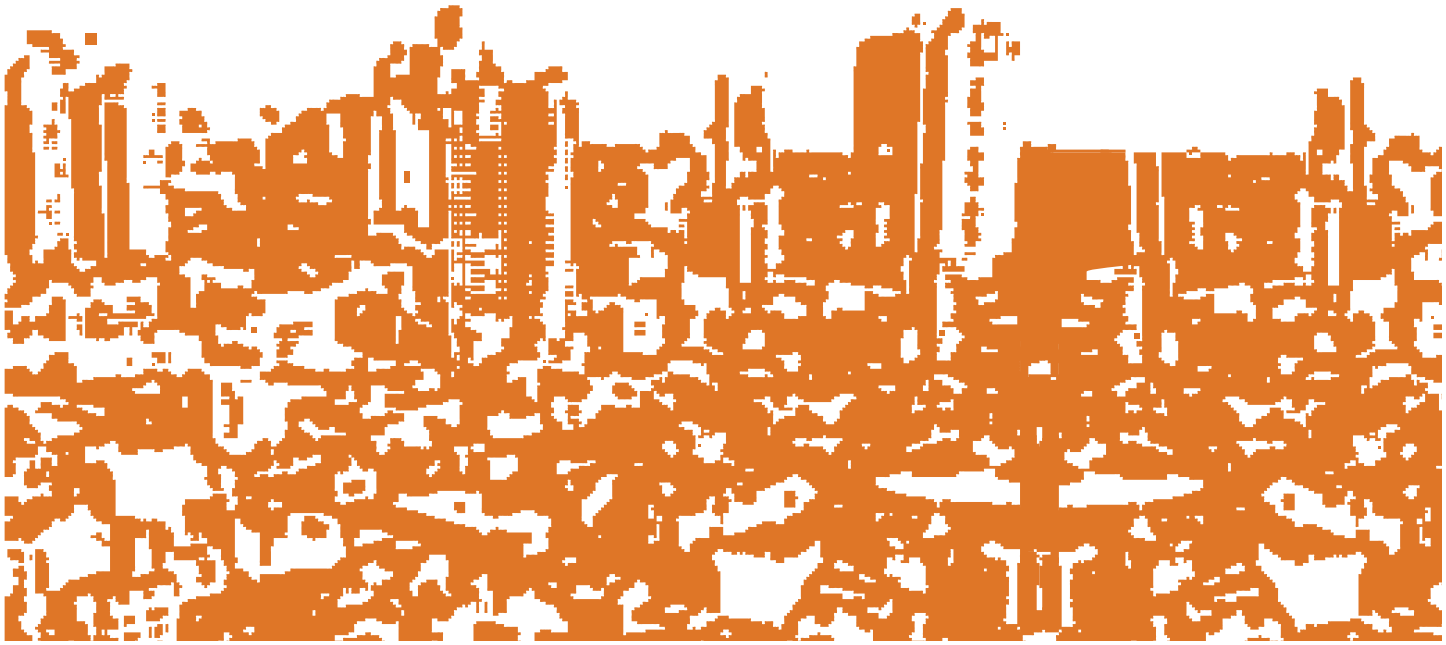
Urban Climate Resilience: A review of the methodologies adopted under the ACCCRN initiative in Indian cities

BY DIVYA SHARMA, RAINA SINGH AND ROZITA SINGH



Urban Climate Resilience: A review of the methodologies adopted under the ACCCRN initiative in Indian cities

Asian Cities Climate Resilience Working Paper Series

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The series has arisen out of the Asian Cities Climate Change Resilience Network (ACCCRN, www.acccrn.org), an initiative funded by the Rockefeller Foundation.

The series is intended to present research in a preliminary form for feedback and discussion. Readers are encouraged to provide comments to the authors whose contact details are included in each publication.

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Glossary

ACCCRN	The Asian Cities Climate Change Resilience Network
BMC	Bhubaneswar Municipal Corporation
CAA	Constitutional Amendment Act
CAC	City Advisory Committee
CPL	Community Participation Law
CRS	City Resilience Strategy
CSC	City Steering Committee
DFID	The UK Department for International Development
DPR	Detailed Project Report
EoIs	Expressions of Interest
GCMs	Global Climate Models
GDD	Guwahati Development Department
GDP	Gross Domestic Product
GEAG	Gorakhpur Environmental Action Group
GIS	Geographic Information System
GoI	Government of India;
HFL	High Flood Level
ICLEI	Local Governments for Sustainability
IDA	Indore Development Authority
IMC	Indore Municipal Corporation
IMD	India Meteorological Department
ISDA	The Infrastructure Deficiency Analysis
ISET	Institute of Social and Environmental Transition
IUIS	Indian Urban Infrastructure and Services
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
LULC	Land Use and Land Change
MCC	Mysore City Corporation
MLD	Million Litres per Day
MoEF	Ministry of Environment and Forests
MoUD	Ministry of Urban Development

NIUA	The National Institute of Urban Affairs
NMSH	National Mission on Sustainable Habitat
NSSO	National Sample Survey Office
PLA	Participatory Learning Action
PRA	Participatory Rural Appraisal
SCCT	Surat Climate Change Trust
SGCCI	Southern Gujarat Chamber of Commerce and Industries
SLD	Shared Learning Dialogue
SLF	Sustainable Livelihoods Framework
SMC	Surat Municipal Corporation
TERI	The Energy and Resources Institute
UCRP	Urban Climate Resilience Planning
UCRPF	Urban Climate Resilience Planning Framework
UHCRC	Urban Health and Climate Resilience Centre
ULB	Urban Local Body

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Abstract

Cities across the world have started recognising the need to address urban climate vulnerabilities. In Asia, the role of the Asian Cities Climate Change Resilience Network (ACCCRN), a nine-year initiative (2008-2017) supported by the Rockefeller Foundation, has been significant. Over the years, ACCCRN has worked in ten cities in four Asian countries (India, Indonesia, Thailand and Vietnam) on developing and demonstrating effective processes and practices for addressing urban climate vulnerabilities. This Working Paper aims to document and analyse the several methodologies adopted in the seven Indian ACCCRN cities: Surat, Indore, Gorakhpur, Shimla, Bhubaneswar, Mysore, Guwahati. The paper analyses these methodologies and the overall process adopted in each of these cities for its potential for replication in other cities in India, and brings out the inherent challenges, gaps and opportunities in achieving this.

The study indicates that the overall process adopted was unique in each of the cities and that differences in the methodologies have arisen due to a number of contextual factors in each of the cities, including existing governance structures, industrial makeup, population and demographic conditions, as well as the implementing partners' prior experience and level of comfort with quantitative and qualitative assessments. Data availability and inter-departmental coordination were quoted as some of the key challenges experienced by the implementing partners. In addition, lack of implementation support in terms of policy mandates, financial support, capacity building were cited as key challenges by the city level stakeholders involved throughout this process.

Drawing from these experiences, and with the aim of overcoming these challenges, this paper contributes recommendations on various stages of resilience planning exercises which would be beneficial to cities that plan to undertake such planning in the future. These recommendations will guide the cities on how to use the processes and methodologies developed as part of ACCCRN.

1. Context

1.1 Background

India is a climate sensitive nation and is ranked high amongst the nations exposed to climate change risks. With immense geographic diversity and different climate zones, vulnerability to climate change and risks are varied and multi-dimensional. Considerations for climate proofing are therefore not only desirable for climate sensitive sectors such as agriculture and water, but also for the overall development paradigm, so as to develop resilience to climate change impacts in the long term. Urban areas in a developing country like India are important investment grounds contributing 60% of the total GDP of the nation (PTI, 2008). This figure is projected to increase to more than 70% by the year 2030 (Raje, 2013). As per the report of the high powered committee on Indian Urban Infrastructure and Services (IUIS), (Government of India; 2011:75) the urbanisation trajectory in India places a key role for cities in contributing to the sustained high rates of economic growth. This report makes a comprehensive case for a revision in urban policy and planning and a paradigm shift in the way urban areas are planned, developed and managed in India. While it is pertinent to look at urban policy, planning and management of urban areas, it is increasingly felt that environmental considerations, particularly those related to climate change impacts, need to be factored into the urban development planning space.

The IUIS Report projects a requirement of INR 39.2 trillion (or 600 Billion USD) on urban infrastructure and services for the time period 2012-31. It also states that about 70% of the construction in India is yet to take place. Considering the increase in climate-related extreme events, for example, high rainfall events and associated floods and destruction (in Uttarakhand, Uttar Pradesh, Mumbai), and climate variability being felt increasingly across cities in India in one form or another, it is opportune to build climate resilience into urban planning development and investment decisions.

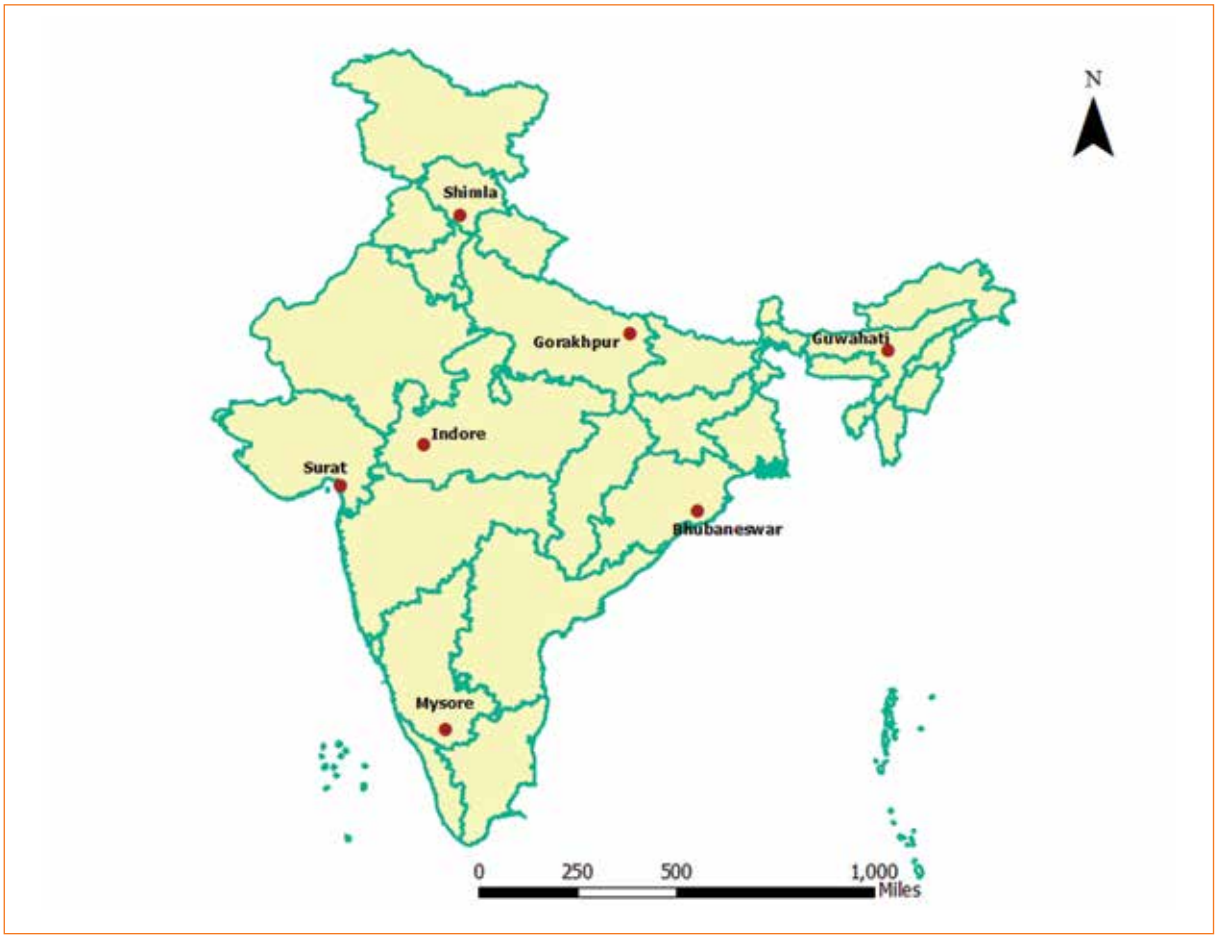
The Asian Cities Climate Change Resilience Network (ACCCRN) is a nine-year initiative, launched by the Rockefeller Foundation in 2008. Aimed at catalysing attention, funding and action to strengthen cities' resilience to climate change impacts, ACCCRN has been working in ten cities in four Asian countries (India, Indonesia, Thailand and Vietnam) to develop and demonstrate effective processes and practices for addressing urban climate vulnerabilities using participatory planning as well as implementing targeted intervention projects. The initiative is now poised to expand its network and reach 30+ cities in six countries, including Bangladesh and the Philippines. It has involved multi-partner engagement with different partners taking up work in different sets of cities.

These partners used and tested their own methodologies to assess risk and vulnerability in their respective cities and also in the preparation of resilience strategies. The methodology and the overall process adopted were unique to each of the cities, taken up under the initiative as per the city's context. The approach brought out several examples and methodologies that offer huge potential for replication and adoption for other cities. These methodologies could also be developed further in the form of toolkits that the cities can use in future to prepare their own resilience strategies.

The purpose of this paper is to document and analyse the different methodologies adopted in the seven Indian ACCCRN. This paper arises from the need to initiate discussion amongst social scientists on the merits and potential for replication of these methodologies that have evolved through the process. The study also demonstrates that the methodologies adopted for a specific city have to be contextualised as per each city's needs and that a generalised approach may not be

fruitful for successful preparation and implementation of the resilience strategy. This paper draws from literature reviews, detailed discussions and structured interviews with all the Indian national partners and the key city stakeholders involved in the process in each of the seven cities (Refer to Annex A). The cities considered in this paper are the three core cities of Surat, Indore and Gorakhpur, and four cities from the replication phase – Shimla, Bhubaneswar, Mysore and Guwahati (Figure 1).

Figure 1. The seven ACCCRN cities profiled in the working paper



1.2 Resilient cities – The ACCCRN framework

The ACCCRN programme adopts the Urban Climate Resilience Planning Framework (UCRPF) (Moench et al, eds; 2011:35). The framework was developed by ACCCRN partners: the Institute of Social and Environmental Transition (ISET), a non-profit international research organisation, and ARUP International, a consultancy firm. The framework focuses on resilience more than adaptation and directs its attention to urban systems and their inherent interactions. The framework links the spatial, physical and economic connections of direct climate impacts on these urban systems.

The UCRPF focuses on the vulnerable population in urban locations and their marginalised subsistence that lacks secure access to services and depends on fragile urban systems. This makes them vulnerable to system failures in the wake of climate related stress. Besides this, the framework provides information on agents and institutions as enablers to resilient systems in a city, thus defining three pillars of resilience building within a city system:

- Strengthening fragile systems
- Strengthening social agents
- Strengthening institutions to support the two above.

In doing so, the programme considers targeting urban systems in cities including infrastructures and ecosystems; agents including community, government, NGOs; institutions including regulations, laws (Tyler and Moench, 2012:319). The definition of resilience as adopted under the ACCCRN programme is "…*the ability to absorb disturbances, to be changed and then to reorganise and still have the same identity (retain the same basic structure and ways of functioning)"* and draws from literature on ecosystems and socio-ecological systems. The programme thus views resilience as an ability of a system to not only withstand and resist climate circumstances, but also to recover and reorganise functions to prevent failures and irrevocable damages (Brown, *et al.*, 2012: 534). The concept of resilient systems as adopted under the ACCCRN framework is a system which avoids failures and has the ability to transform itself in the wake of changing climate. Rather than relying on the strength of individual components, resilient systems retain functionality through flexibility and diversifying functional dependence (Tyler and Moench 2012:313).

The resilience approach to target climate impacts provides larger benefits when compared to various other approaches such as an adaptation-based approach, which often has a limited window to improve the overall capability of a city to withstand climate impacts. The resilience approach has been described as going beyond adaptation (Da Silva, 2012:133) as it targets achieving compound benefits through approaches that are multipronged and focus on capacity, institutions, agents, and urban systems alike (Moench *et al.*, eds; 2011:34). It is pertinent to note here that adaptation is considered as a part of the larger resilience building objective. The approach is said to have the potential of addressing the vulnerability of urban systems to specific climate conditions. It also displays an equal focus on increasing the capacity of urban systems to withstand extreme climate events and shocks , while also increasing the institutional capability of the urban system to support and develop the resilient systems.

The ACCCRN methodology in the cities revolves around the following four basic components which are explained in detail in Chapter 2:

- Shared learning dialogues
- Vulnerability assessments
- Sector studies and pilot engagement projects
- Resilience planning and strategy.

The methodologies and the processes defined and adopted within ACCCRN cities have looked at all the above components of resilience building. However, these have differed from city to city in terms of their relative intensity and level of importance within a city, displaying an inherent need for a better understanding of a city's context, and for devising methods and processes that are suited to city-specific needs.

While the paper will discuss these characteristics from the seven cities examined, the overall question of replication potential of these approaches will determine the level of scaling-up that can be achieved within this programme.

1.3 Replication

The ACCCRN programme was devised as a holistic programme involving multiple partner organisations with an objective of building capacities to plan, finance and coordinate resilience strategies in the chosen cities, develop networks for knowledge and learning from the experiences of the cities and eventually "scale up" the learning and processes to new cities. The programme looks at scalability as something that is supported by the existing experiences from the project cities in terms of the technical, financial and policy aspects, and supports replication that would accommodate a larger number of cities. This would essentially look at refined processes that draw from ACCCRN experiences, yet , which are focused and dovetailed to their contextual aspects: institutional, systemic and financial. Literature available

on "replicability" confirms that direct replication attempts of any phenomena or experiment are not common, while conceptual replication attempts are common and have a benefit of testing the validity of phenomena at large (Pashler et al, 2012:533).

Replication of the ACCCRN programme has the potential to enlarge and broaden the resilience perspectives in a number of cities and in a number of ways. The ACCCRN programme is already in its replication stage and Shimla, Mysore, Bhubaneswar and Guwahati, were the first cities to take part in this phase. It is therefore interesting to locate the differences and similarities in the core cities and in the cities at the replication stage. The paper also looks at the methodology adopted by cities in the context of its usability in the future. The results of the study should inform the toolkits, guidelines and approaches that could be devised to scale up the programme and its inherent objectives.

1.4 Research questions and analytical approach

The underlying questions that this research paper seeks to answer are:

a) What is the potential for replicating the ACCCRN methodology and processes in other cities in India?

b) What are the key characteristics of the processes which could be used for resilience planning in different urban contexts?

The approach adopted in this paper compares and analyses various cities along some key dimensions:

1. The motivation and drive of a city to plan for climate resilience
2. The city's ease in using these meths
3. The challenge of data intensiveness that might or might not deter the cities from taking up resilience planning exercises
4. Factors that could affect the implementation of various in-built processes such as:
   - Conducting stakeholder dialogues
   - Mobilising communities
   - Securing interdepartmental coordination
   - Presence /absence of a champion in the city
   - Getting relevant data for required time frame and frequency
   - Access to information on a future climate regime
   - Support from the State/National Government
5. The potential of the resilience planning exercises to inform the on-going programmes of the Ministry of Urban Development, government of India such as the JNNURM[1], NMSH[2] etc.

This study analyses the technical details of the methodologies through a literature review, and the replication potential through a questionnaire survey of the ACCCRN partners and city stakeholders.

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1 *The Ministry of Urban Development (MoUD) and the Ministry of Housing and Urban Poverty Alleviation (MoHUPA) are jointly implementing a programme called Jawaharlal Nehru National Urban renewal Mission (JNNURM) which provides financial assistance to the cities under two basic components; (a) Basic services to urban poor; (b) Urban infrastructure provision and governance. Under this, City Development Plans have been prepared for 65 selected cities*

2 *The National Mission on Sustainable Habitat (NMSH) of the National Action Plan on Climate Change (NAPCC) underscores the importance placed on climate resilience planning for urban centres. The Mission focuses on making the habitats sustainable by enhancing the energy efficiency of buildings, solid waste management and enhancing public transport. (Ministry of Urban Development, undated)*

1.5 Questionnaire survey approach

In order to understand the perspectives of the ACCCRN partners and city stakeholders on the methodology and process adopted in the respective cities, questionnaire surveys were administered to them. The objectives for the questionnaire survey were:

1.5.1 For the ACCCRN partners

a) To understand their methodological and procedural details in the cities in which they worked

b) To understand the challenges and opportunities that they faced and their views and experience for the scaling-up step

c) To understand the partners view on the city's ability and motivation to take up the exercise by themselves

d) To receive inputs on how climate resilience could be initiated in more and more cities in India.

The questions posed to the ACCCRN partners (refer to Annexe B) considered the following parameters:

1. **Methodology** – The technical methodology used for the assessment of risks and vulnerability of the city and its systems to climate impacts
2. **Process** – The overall process adopted for the preparation of the city resilience strategy (CRS) starting from engaging with the city and the stakeholders, the shared learning dialogues, the data collection process, the risk and vulnerability analysis and identification of the resilience strategy.
3. **City's buy-in** – The level and extent of the city's engagement in the process and the city's buy-in to take forward the recommendations and to implement the resilience strategy.
4. **Opportunity for replication** – The replication potential on the basis of characteristic features of the process and the methodological details.
5. **Policy** – Need for policy support to institutionalise climate resilience in urban areas. Role of enabling policies to facilitate scaling-up and replication.
6. **Finance**-The availability of finance both during and after implementation of the strategies.

1.5.2 For the city stakeholders:

a. To learn about the city's experience of the ACCCRN process

b. To understand their perception of the need to plan for climate resilience in cities

c. Their views on the process and methodology, data requirements and stakeholder engagements conducted within the ACCCRN process.

The questions posed to the city partners (Refer to Annex C) included the following parameters:

1. **Motivation and drive** – The motivation and interest of the city to get involved in the ACCCRN process
2. **Methodology –**
   - The city's understanding of the methodology proposed by their respective ACCCRN partners.
   - Type and extent of the city's engagement.
   - The city's feedback on challenges encountered during the process and
   - Suggestions for changes in methodology.

3. Stakeholder engagement –

- Frequency of the meetings
- The city's experience from the city advisory committee (CAC) and suggestions for improvement
- Level and extent of community engagement and the benefit derived from these engagements

4. Interdepartmental engagement –

- The process adopted to facilitate interdepartmental communication
- Challenges experienced during the process

5. Outcome –

- Interest of the city in implementing the CRS
- The city's plan to take forward the resilience strategy
- Support (financial and institutional) needed to implement the CRS

6. Replicability –

- The city's readiness to implement the entire resilience planning exercise on its own.
- The support required to initiate action on urban climate resilience
- Need for capacity building and external support
- The starting point and the potential roles for various city level agencies

7. Policy and mainstreaming –

- Efficacy of bringing in resilience planning into the urban planning framework and the suitable entry points (community, city, state, national)
- Governance instruments required

1.6 Structure of this paper

The working paper is structured around four main chapters. Chapter 2 presents a detailed review of the ACCCRN process and methodology adopted and used in the seven case study cities for this paper. Chapter 3 makes an assessment of the detailed methodologies adopted by the seven cities under ACCCRN. It also presents the responses to the questionnaire that were completed by ACCCRN and city partners. This chapter also analyses the replication potential of the individual methodology and process adopted in these cities. Chapter 4 presents detailed concrete observations considering the replication potential of ACCCRN methodologies and provides recommendations to scale up the ACCCRN programme and to enable cities to take the lead in planning for their resilience, leading to the conclusion in chapter 5.

2. City resilience strategies in seven cities – A review of the ACCCRN methodology and process

2.1 ACCCRN –Broad process outline

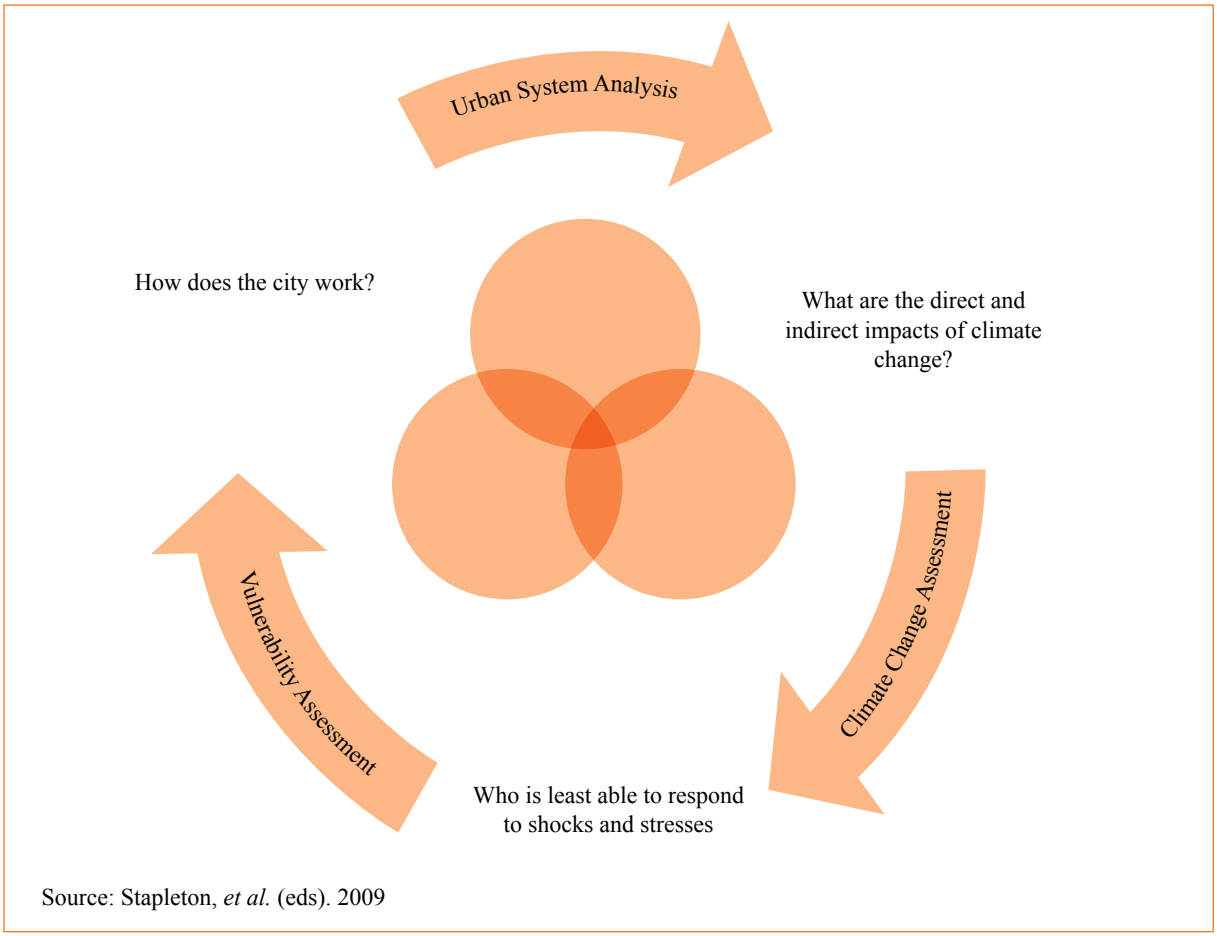
Phase II of ACCCRN in India began with the three core cities of Surat, Indore and Gorakhpur. The implementing partner for Surat and Indore was TARU, a private consultancy company while the Gorakhpur Environmental Action Group (GEAG), an environmental NGO, was the implementing partner in Gorakhpur. During phase III of the programme – the replication phase – four more cities were added to this initiative: the city of Guwahati through TERI, a non-profit research institute, and the cities of Shimla, Mysore and Bhubaneswar through ICLEI, an international association of local and metropolitan governments, as the implementing partner.

With the end objective of developing a CRS for each city and additionally implementing key pilot projects for the core cities, the common approach adopted in each city involved examining the intersection of climate change, urban systems, and vulnerability to test resilience strategies by considering both direct and indirect impacts of climate change (See Figure 2). The cities engaged in the ACCCRN process focused their studies on anticipating how their city's vulnerabilities would be exacerbated and altered by climate change; identified urban populations most affected by changing conditions, and developed climate resilience strategies and actions to meet the most serious climate impacts. (Stapleton, *et al.,* eds; 2009:2)

The common ACCCRN methodology (adopted by each ACCCRN city) can be divided into the following key components:

1) Shared learning dialogues –The shared learning dialogue (SLD) techniques serve as a mechanism to engage scientific experts, local government officials, research centres, civil society, private sector and community representatives in local deliberations and knowledge sharing for identifying key priorities, needs and gaps in the cities. They facilitate open communication between various stakeholder groups and are designed to facilitate mutual learning and joint problem-solving within a project city to understand the linkages between urban growth and development and climate change and vulnerability of people and sectors; and to be able to identify actions to undertake urban climate change resilience (ACCCRN, 2013).

Figure 2. Core approach of ACCCRN



Source: Stapleton, *et al.* (eds). 2009

2) Vulnerability assessments – Each ACCCRN city undertakes climate vulnerability assessments to provide a basis for better understanding how individuals, communities, and urban systems specific to their city may be affected by future climate impacts – both directly and indirectly. The assessments included study of city's exposure to climate risks in-terms of its impact on people and city systems. This assessment is carried out by the ACCCRN partner and explores the existing capacities of the city to adapt and provides vital information about the way the city should plan its climate resilient future.

   ACCCRN partners adapt existing tools and methodologies for conducting vulnerability assessments to their specific contexts, but each climate vulnerability assessment largely entails:

   - An understanding of projected climate projections and potential impacts and the limitations of the projections
   - Identification of who/what are the most vulnerable groups, areas, sectors, and urban systems and how they may be affected
   - Identification of the range of factors that systematically combine to make them vulnerable, including both direct (e.g. exposure to hazards) and indirect (e.g. regional or international food security) factors
   - Assessment of existing capacities to adapt

   (Stapleton, *et al.,* eds; 2009:9)

3) Sector studies – After the initial vulnerability assessments, the cities conduct in-depth and detailed sector studies on water, transport, etc. to understand the sector specific needs and multi-sectoral linkages. These studies are facilitated by the implementing partners and in some cases also involve local universities. In addition to this stage, the core cities also identified pilot projects that emerged as immediate steps to resilience building in their cities and were implemented with local support.

4) City resilience planning and strategies

A key step in the ACCCRN process is the production of city resilience strategies which prioritise the necessary actions to address urban climate risks and variability, and guide the implementation of the same.

All the aforementioned steps culminate in a city resilience strategy – a detailed plan of action that draws from the shared learning dialogues, sector specific studies and vulnerability assessments and addresses climate resilience for the city in question through specific strategies.

While the Indian ACCCRN partners largely used the core themes of the ACCCRN methodology as the starting point of their resilience building exercises, it was observed that different partners tested different methodologies and used a combination of methods and tools to assess risk and vulnerability in their respective cities and also for the preparation of resilience strategies.

ISET worked with the partners in the three core cities to develop the UCRPF towards the end of phase II based on the experience of ten cities across ACCCRN. This step led to further streamlining of the methodology which was adopted by many partners. The partners experimented with this framework and contextualised it as per their needs. ISET supported them by reviewing and finalising their methodologies. For instance, for the purpose of preparing common toolkits for cities, ICLEI required a less intensive methodology which was then developed with ISET and tested in three cities (Shimla, Mysore, Bhubaneswar). The ACCCRN partners evolved their own strategy while implementing their activities. For instance, TARU conducted risk to resilience workshops and scenario building exercises whereas GEAG added a participatory component to their methodology. ISET provided climate modelling support to TARU, whereas GEAG carried out the downscaling exercises and the subsequent analysis. The roles of key ACCCRN actors are outlined in Table 1, while Table 2 provides brief profiles of the cities discussed in this paper.

Table 1. List of organisations involved in ACCCRN cities

City	Stage	Organisation involved	Type of organisation
Gorakhpur	Risk assessment and vulnerability exercise; Resilience strategy preparation	Gorakhpur Environmental Action Group (GEAG)	Environmental NGO
	Climate scenario projections	Institute of Social and Environmental Transition (ISET)	Not for profit international research organisation
	Sectoral studies	ARUP and GEAG	ARUP – international consultancy firm
	Policy advisory to city advisory consultations and preparation of mainstreaming action plan	The Energy and Resources Institute (TERI)	Not for profit research institute
Surat and Indore	Risk and vulnerability analysis; Climate projections; preparation of CRS	TARU	Consultancy
Guwahati	Risk and vulnerability assessment; climate projections; preparation of CRS and mainstreaming plan	TERI	
Shimla, Mysore, Bhubaneswar	Methodology preparation	ICLEI and ISET	
	Risk and vulnerability assessment; preparation of resilience strategy	ICLEI	International association of local and metropolitan governments dedicated to sustainable development

Table 2. Profiles of the Indian ACCCRN cities

City	Characteristic Feature	Location	Population	Key Climate Risks
Gorakhpur	Medium sized city, functions as the district and divisional administrative headquarter	State of Uttar Pradesh, north-east India at 26° 45' N and 83° 24' E, at a height of 102m above sea level, on the convergence of Rapti and Rohin rivers set in the foothills of the Himalayas, in the region also known as the 'terai'.	1.1 million (urban agglomeration population as per Census 2011)	Flooding and water logging
Indore	Largest city of the Madhya Pradesh State. The city serves as the headquarters of both Indore District and Indore Division.	Situated on the western part of the Malwa (Deccan Plateau) on the banks of two small rivers, the Khan and the Saraswati. The city is situated on the fertile Malwa Plateau located at 22° 43'N latitude and 76°42'E longitude.	Total provisional population of Indore is 1.9 million. Urban agglomeration population is 2.1 million.	Increased temperatures and water woes
Surat	Second largest city in the state of Gujarat	Located 21°10′N 72°50′E with an altitude of about 13m above mean sea level. Surat is situated on the banks of the Tapi River, which flows into the Arabian Sea.	4.4 million	Sea level rise and flooding
Guwahati	Capital city of the State of Assam and the biggest urban centre in north-east India.	Located at 26° 10' N and 92° 49' E and has an undulating topography. River Brahamaputra and several of its tributaries pass through the city.	0.97 million as per Census of India, 2011 (urban agglomeration population)	Increased temperature, increased frequency of high rainfall events leading to floods
Mysore	Second largest city in the state of Karnataka	Located at the base of the Chamundi Hills about 146 km southwest of the state capital Bangalore, it is spread across an area of 128.42 km^2	0.9 million (Census 2011)	–
Shimla	Capital of the northern state of Himachal Pradesh	Located in the north-western ranges of the Himalayas. It is located at an average altitude of 2397.59 meters (7866.10 ft) above mean sea level. The city is spread on a ridge and its seven spurs.		–
Bhubaneswar	Capital city of Orissa. largest city of the state, and has become the centre of economic and religious importance in the region	–	0.8 million as per the 2011 census	–

The following sections discuss the detailed methodology and process adopted by each city. This primarily draws on available documentation from each city, such as sector studies and resilience strategies. For Shimla, Mysore and Bhubaneswar, where a resilience strategy document is not available, the section has drawn on a presentation by ICLEI and interviews with ICLEI.

2.2 Gorakhpur city resilience strategy and mainstreaming plan

2.2.1 Introduction

Owing to its almost flat topography, strategic location and administrative importance, Gorakhpur has grown rapidly into an economic and institutional hub in the region. However, the city is also grappling with insufficient infrastructure facilities and basic services due to tremendous pressure from the influx of rural populations, leading to a proliferation of informal settlements. There are about 110 slums in the city, accommodating 33% of the total population (GEAG, 2009:14). Basic service provision is far behind demand, and the city is facing problems of flooding, water logging, temperature extremes, power shortage, poor quality of water and increased incidence of water and vector borne diseases. All these pressures are likely to be aggravated by potential climate change impacts which were analysed while preparing the resilience strategy for Gorakhpur.

The Gorakhpur Risk Assessment and Vulnerability Analysis was conducted as part of Phase II (2009-2010) of the ACCCRN initiative in India. The resilience strategy addressed a number of cross sectoral issues in the city, water logging being the primary one of them. Additionally, the strategy also identified three pilot projects which are being implemented in the city with ACCCRN support.

In the next phase, a review exercise of the existing laws, standards, policies and programmes in the urban development sector was carried out by TERI. The study involved a detailed review of regulations and policies applicable to the city of Gorakhpur and the State of Utter Pradesh, in order to identify the entry points for mainstreaming the Gorakhpur Resilience Strategy.

2.2.2 Methodology

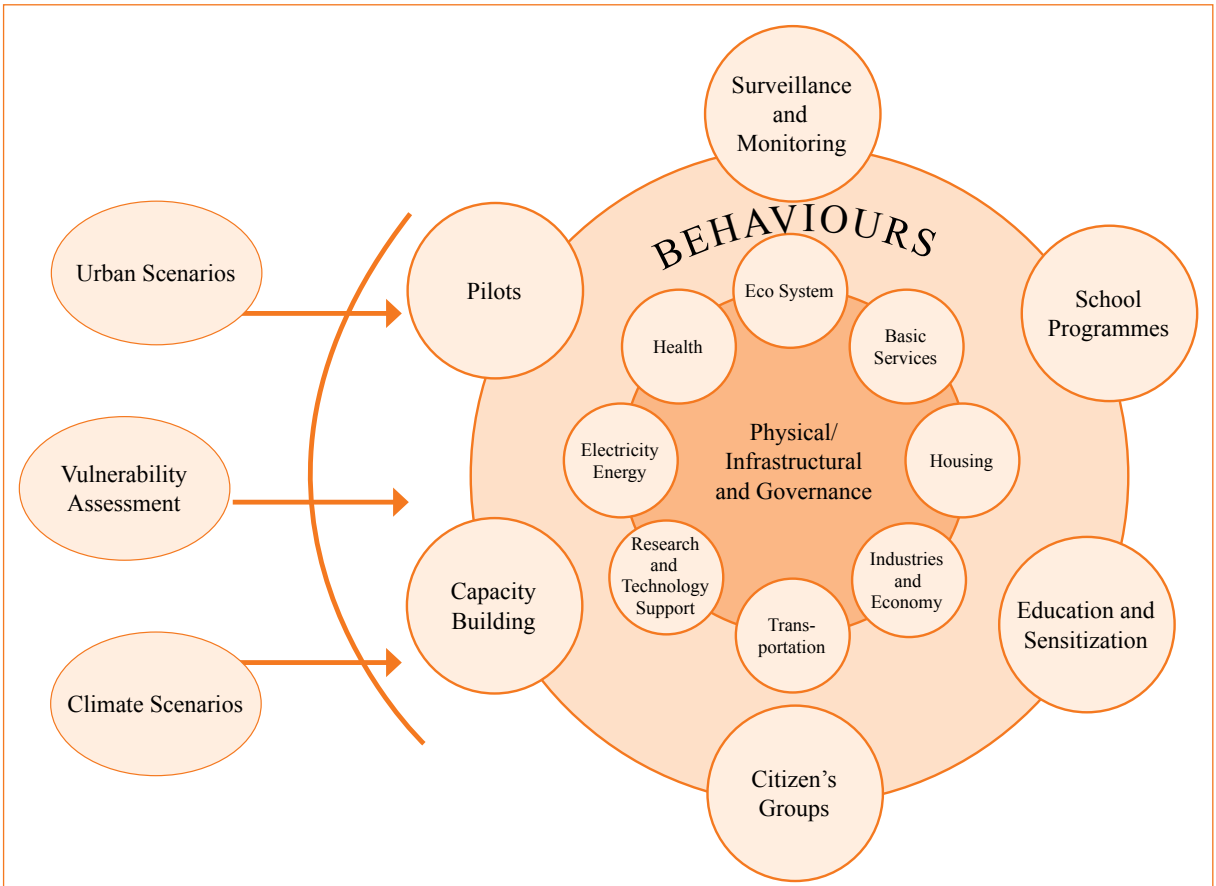
Climate projections

The climate projections by ISET were developed in two parts: a trend/historical analysis carried out from the data received from the meteorological department, and model outputs from global climate models were statistically downscaled (see Annex D for details of the approach). Based on the climate projections, an increase in maximum temperatures and humidity was predicted for 2046-2065. For rainfall, a high uncertainty was predicted with a likelihood of increase in the months of March, April, May, October and November and decrease in the months of December, January, and February.

Vulnerability assessment

For the vulnerability assessment, GEAG developed a methodology which was based on the climate projections, primary data/survey, participatory methodology tools and shared learning dialogues.

Figure 3. Methodology and tools used for the vulnerability assessment in Gorakhpur



Source: GEAG, 2009: 3

The primary data on socio-economic parameters and risk prone areas was collected through community level focused group discussions and household questionnaires which were applied to carry out surveys in a sample of 14 out of a total of 70 wards in the city (GEAG, 2009: 3). The main thrust was to rely on participatory appraisal tools and city level projections with the help of secondary data. The shared learning dialogues were conducted around the following themes:

- SLD around the climate projections
- SLD around the urban scenario
- SLD around future vulnerability and sectoral scenario

The sample surveys were specifically carried out in the wards that came up as risk prone areas in the city in the SLD. The sample was selected proportionately to represent all the socio-economic classes in the area. The information obtained from the primary data collection was then superimposed on the maps generated as part of the SLDs. Based on this output, water logging hot spots were identified and mapped.

The climate projections and the subsequent vulnerability analysis led to the identification of sectors and strategies for adaptation. The vulnerability assessment carried out by GEAG, identified the following four risks:

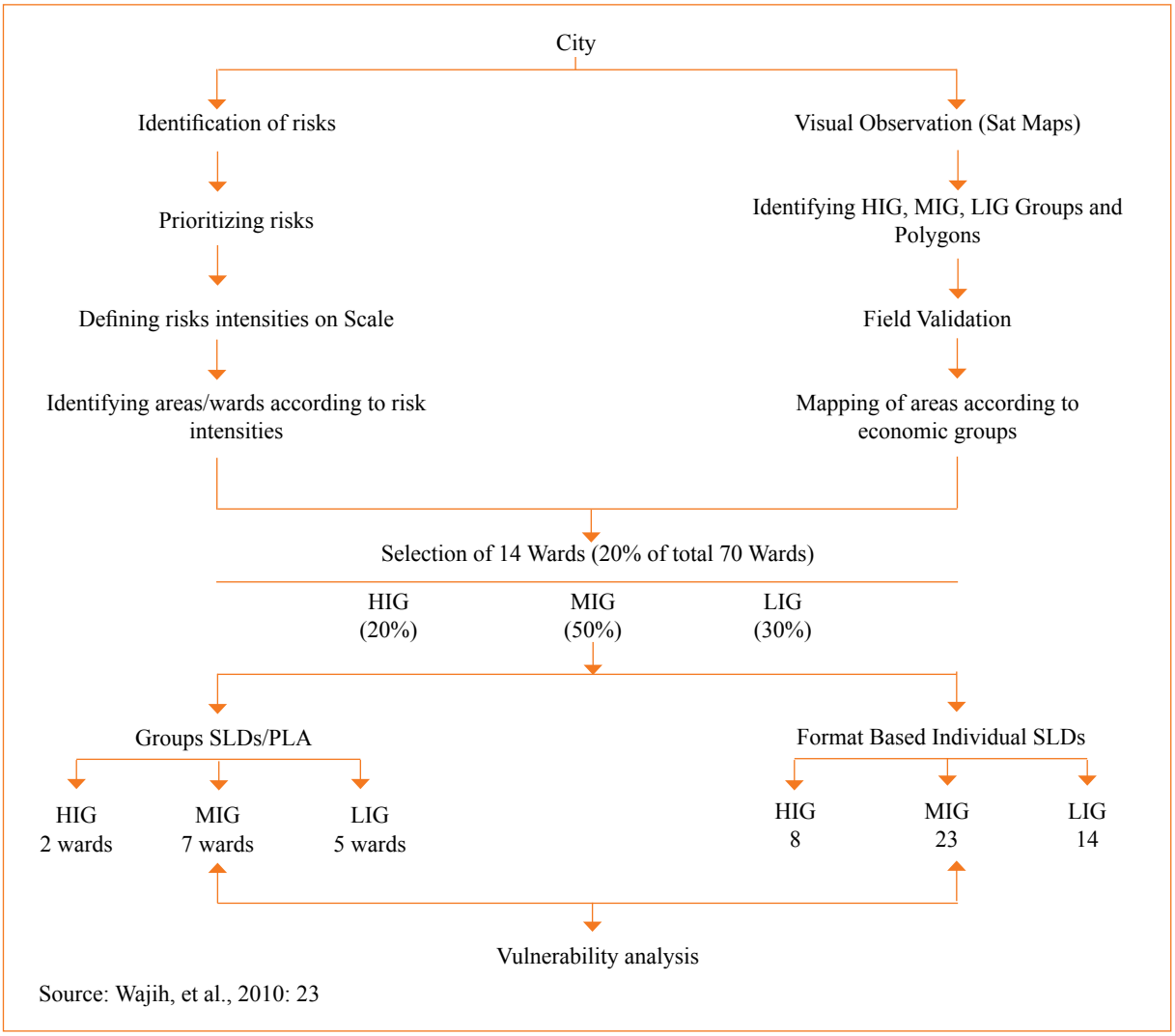
- Water logging
- Sewerage and sanitation
- Solid waste management
- Drinking water quality and availability

Based on these four identified risks, the vulnerable sectors and their associated impacts were also identified through the SLDs themselves. It may be noted here that no detailed quantitative assessment was carried out to understand the extent of vulnerability in the present or under the impact of climate change in future. However, a few detailed studies were carried out which included a study on the geohydrology of the city conducted by the University of Gorakhpur, another study on polythene and other solid waste, and a study on the drainage in the city done by ARUP. Apart from this, the master plan was evaluated to understand the cause-and-effect relationship of planning and development paradigms on the risks and vulnerability of the city. This was done through external advisory support from urban planning experts.

Preparation of the Gorakhpur resilience strategy

Having considered the risks and vulnerability of the city and its population, a CRS was prepared for Gorakhpur by GEAG during ACCCRN phase I. The strategy document focuses on building resilience gradually in multiple arenas, with targeted sector specific actions proposed for the identified sectors during the vulnerability assessment exercise. It suggests targeted physical and institutional actions to improve drainage, housing, health and communications systems, demonstrating in the process the benefits derived in terms of climate proofing the city's infrastructure and assets. The strategy gives utmost priority to the advocacy and capacity building activities to raise public awareness, to developing the institutional and governance mechanisms required to implement these activities and to strengthening the critical systems that contribute to resilience and enable adaptation.

Figure 4. Gorakhpur resilience strategy framework



Source: Wajih, et al., 2010: 23

Preparation of the mainstreaming action plan

In the next phase, TERI formulated a mainstreaming action plan for the implementation of the Gorakhpur CRS prepared by GEAG. Water logging had been identified as the primary risk in the city and five key sectors were identified as having a cause-and-effect linkage with water logging. These were: housing and urban planning, basic services (water, drainage, solid waste management and services to the poor), ecosystem conservation and flood management, energy and health (TERI, 2012:2). An analytical review of the vulnerability assessment and resilience strategy document and sector studies were carried out for all of the five sectors. A detailed review of all the prevailing laws, regulations, policies and the institutional framework for the relevant sectors in the urban development arena in Gorakhpur was carried out. A similar analysis was also conducted for the State of Uttar Pradesh where urban development is a state subject. Based on this review, a mainstreaming action plan was proposed which suggested sector-wise structural and regulatory/ institutional recommendations, and a city level charter of activities to implement the resilience strategy and mainstream climate resilience in the urban planning and development process at city and state level in Uttar Pradesh.

2.2.3 Process

As discussed above, GEAG's methodology relied heavily on the SLDs and inputs from the City Steering Committee (CSC). As per GEAG, the objective of the initial SLDs was also to communicate the city's environmental and climate change related concerns and get the city government's buy-in. It was observed by the respondents during the city stakeholder's questionnaire survey that these meetings brought forth a number of issues which were being dealt by them on a day-to-day basis, for example water logging. This alignment of the resilience strategy with the larger vision of the city was one of the key motivating factors for their engagement.

GEAG members opined that another reason for extensive use of participatory tools for risk identification and vulnerability assessment exercises was the challenge in data collection. Much of the data that is required for a quantitative assessment was not available at the city level in the required format and scale. The following approaches were adopted in various stages of the process:

1. **Community consultation and SLDs at various levels:** Various administrative departments, informed elective citizen representatives of different wards and academic personnel were consulted outside the consultation with communities of various socio-economic groups. For this purpose, various PRA/PLA tools were identified and used for SLDs and community consultations (Wajih, *et al.,* 2010: 15).
2. **Steering committee:** A city level Steering Committee was constituted with representatives from all key stakeholders in the city – officials of the municipal corporation and other public agencies, academics, subject experts, doctors, social activists, NGOs, and the corporate sector. Regular inputs and feedback were obtained from the Steering Group during the risk analysis and vulnerability assessment, the sectoral studies, preparation of the resilience strategy, and the identification and implementation of the pilot projects.

When TERI prepared the Mainstreaming Action Plan for implementation of the resilience strategy, this again involved the key stakeholders and members from the City Steering Committee. Inputs and feedback was sought on the present policy, regulatory and institutional frameworks and the reforms required to build in urban climate resilience into the urban development process (TERI, 2012: 2). During the partner interviews for this study, it was observed by GEAG that it was not just one person who could champion the whole process in the city. There were a number of people at different levels in various public agencies, including the Gorakhpur Municipal Corporation, academic and research institutions, activists who contributed in taking forward the resilience agenda in Gorakhpur. Apart from the state government departments, other stakeholders, such as the railways, the hotels association, and the local community, played a big role in implementing some of the projects identified by the resilience strategy and are still sustaining the process.

Although about 12 public agencies were actively involved in the ACCCRN initiatives in the city, implementation of the entire resilience strategy is challenging to both GEAG and the city stakeholders as it is not a statutory document. Hence, all the respondents emphasised the need for policy/ regulatory back-up and financial support to implement the resilience strategy and integrate climate resilience into the formal set-up. Implementation of the 74th Constitutional Amendment

Act (CAA) was also highlighted as an important requirement to strengthen community engagement and bring the focus on micro-level processes for urban planning, disaster management and climate resilience building.

As observed by city respondents and GEAG during the questionnaire survey, there have also been some key achievements in the process. The foremost is awareness and sensitisation at the city level about climate change and its impacts which lead to an increased present and future vulnerability of the city and its population. The involvement of public agencies in the process and the sharing of the CRS document with all the key development departments have also contributed to initiation and reworking, as well as a request for funds from the state government for implementation of a few infrastructure projects. GEAG has also communicated with the Relief Commissioner, Disaster Management Department, of the government of Uttar Pradesh and shared the Gorakhpur CRS with him. TERI's action points that were submitted to Mr. K. Ravindra Naik, Divisional Commissioner Gorakhpur, have also been taken up by some of these agencies. Mahewa, which was one of the most vulnerable wards identified by the city resilience strategy and the site of an ACCCRN pilot project, has now also been adopted as a pilot project for disaster risk reduction by the District Administration.

2.3 Indore and Surat city resilience strategy

2.3.1 Introduction

Indore

Owing to rapid urbanisation and immigration, Indore's population is expanding rapidly. Since Indore is also a major industrial hub in western India, the industrial demands are adding to urbanisation pressures. Around 27 % of the city's population currently lives in slums (TARU, 2012:31). Out of these, significant proportions of the slums are located along rivers and are prone to floods. During the last decade, three flood events (2002, 2005, and 2009) with increasing intensities have taken place in the city (TARU, 2012:27). The city resilience strategy, however, identifies water scarcity as the key problem that the city needs to address as an effect of rapid population growth. At present, around 90% of Indore's total water supply comes from surface water, namely the Narmada Water Supply Scheme (77%), Yeshwant Sagar Reservoir (12%) and the Bilaoli Tank (5%). Tube wells as a public water supply constitutes around 9.23% of the total water supply (TARU, 2012:23). Indore receives around 171 MLD to 199.5 MLD from the Narmada Project, Yeshwant Sagar, Bilawali and municipal tube wells. The present water demand is 410 MLD and the industrial requirement is 30 MLD (Chauhan, 2009:10). The industrial demand is expected to double from 30 MLD to 60 MLD by 2030. After deducting the current supply, a gap of 360 MLD is expected by 2024 and the total net requirement is expected to reach 564 MLD by 2024.

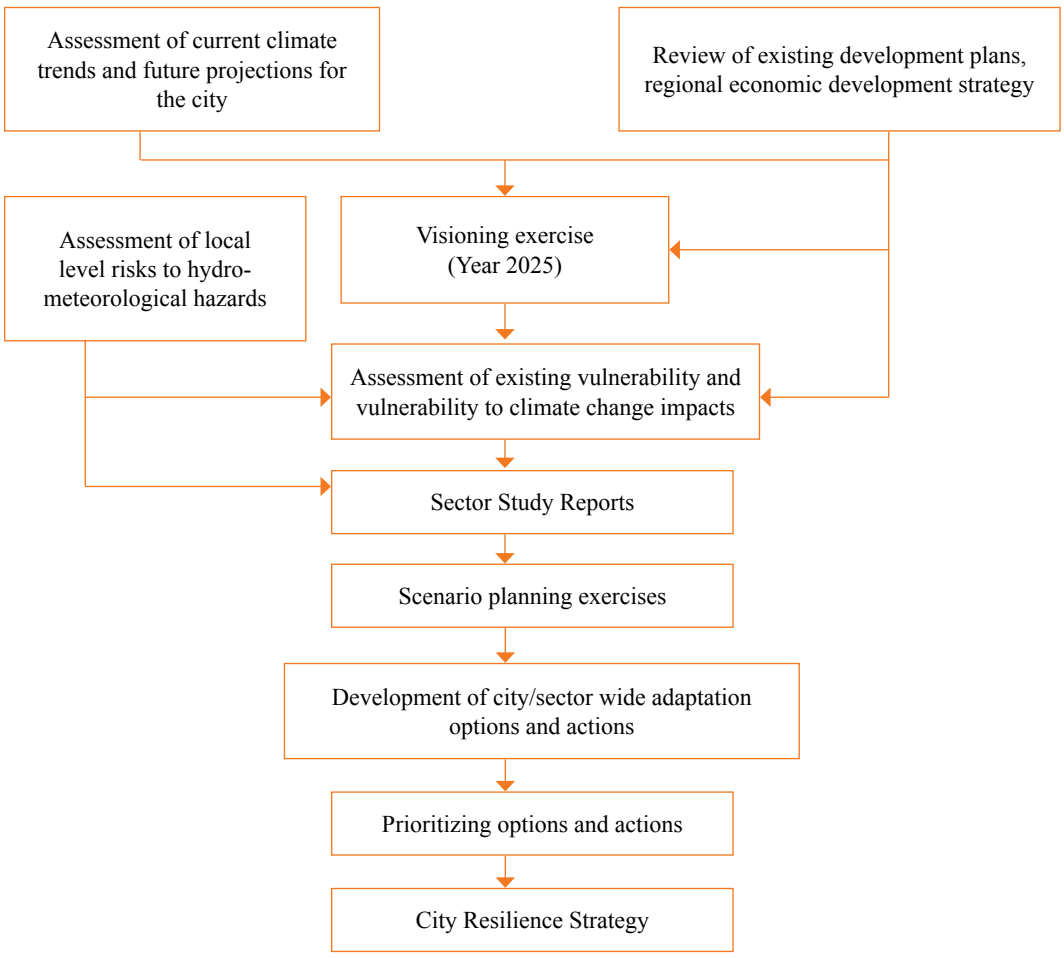
Surat

Surat faces the risks of both sea level rise and flooding. The Ukai multipurpose dam built upstream, 94 km from Surat, was meant for flood control management and for irrigation and power generation. During the end of the monsoons, when the dam is near to its capacity, unexpected rains for 3 to 5 days can create situations forcing discharges of around 36,811 cumecs (1.3 million cusec), leading to floods in Surat (TARU, 2011:25). During the last two decades, the city of Surat and the surrounding metropolitan region have witnessed major floods. The Tapi River is one of the major sources of water available to Surat. In 2005, the demand for water was 615 MLD which is projected to reach 1315 MLD by 2021. The current water sources (river and upstream dam) may not be able to cater to the increased demand in future.

2.3.2 Methodology

The key steps and phases adopted as part of TARU's methodology in Surat and Indore are outlined in Figure 5.

Figure 5. Key steps followed by TARU in developing the CRS for Surat and Indore



Source: Rajasekar and Karanth, 2012:3

a) Climate Projections

The PRECIS[3] Model (Regional Climate Model, RCM) results were used to analyse the regional climate projections for the period 2020 to 2100. In addition, results from *Climate Explorer*[4] were also used to study and compare the climate projections for 11 Global Climate Models (GCMs). Historical weather data from the India Meteorological Department (IMD) which included temperature (1969 to 2009) and precipitation (1901 to 2009) were analysed for studying climatic trends. The same data was used to correct the biases of the RCM & GCM projections.

Apart from the climate prognosis analysis, hazard risk modelling was carried out for both Surat and Indore. In Surat, inundation modelling was conducted to map flood risk prone areas in the city. The inundation model scenarios were developed using historical precipitation, tide and river discharge information. Recorded High Flood Level (HFL) marking within the city was used for validation. In Indore, the risk modelling involved mapping of malaria prone areas in the city. The maps were validated using sample household survey data.

3 *PRECIS (Providing REgional Climates for Impacts Studies) is essentially a regional climate modelling system based on the third generation of the Hadley Centre's regional climate model (HadRM3), together with user-friendly data processing and a visualization interface.*

4 *The Climate Explorer is a web application based scientific tool to analyse climate data.*

b) Vulnerability analysis

The methodology for ACCCRN in Surat and Indore evolved from TARU's prior experience of working on hazards and risk assessment studies. Since their previous work primarily revolved around disasters and livelihoods, the Sustainable Livelihoods Framework (SLF)5 developed by DFID was modified for the urban context to analyse different aspects of vulnerability and capacity[6].

GIS enabled sampling and aggregation methods were used to analyse the vulnerability. Google Earth imagery (1m spatial resolution) was used for delineating homogeneous areas based on texture, pattern, building densities, roof types and road network distribution. These polygons indicated homogeneous settlement types. This object oriented analysis from 1m resolution remote sensing imagery is able to delineate areas/neighbourhoods which are likely to be populated by fairly homogeneous socio-economic groups. In each type of objects across the city, representative Geopsy[7] transects were selected and key indicators , such as population density, infrastructure and service levels were explored by community level survey instruments (TARU, 2010:22).

The Infrastructure Deficiency Analysis (ISDA) of water supply, sewerage and drainage infrastructure was conducted based on these Geopsy transects and aggregation in 1200 households in Surat and 750 households in Indore. The data was aggregated to the city level. The spatial distribution of infrastructure and service delivery was presented in a set of indicators and maps. Sector studies (Environment, Flood Risk and Management, Health, Energy Security, Green Buildings, Urban Transport, Water Security) were undertaken to determine the degree to which existing systems can adjust in response to, or in anticipation of, changed climatic conditions. The assessment results supported an integrated resilience approach for the city of Indore and Surat in dealing with climate variability and climate change (Rajasekar and Karanth, 2012:4)

The SLF was modified by TARU by using proxy indicators to define capacities and vulnerabilities (Table 3). The capacities were separated from vulnerabilities since the former provides resilience while the latter increases the impacts during slow and fast onset disasters (TARU, 2010:17)

Table 3. Set of indicators

S.No	Livelihood capitals used in SLF	Proxy indicators used by TARU	Type
1	Human	Education	Capacity
2	Social	Social network and access	Capacity
3	Financial	Income stability (size of incomes, ratio of stable incomes to total, dependency ratio)	Capacity
		Loans or lack of insurance	Vulnerability
4	Physical	Lack of physical infrastructure access (water supply, sewerage, roads)	Vulnerability
5	Natural	Water scarcity (Separate from infrastructure)/ floods	Vulnerability

Source: TARU analysis, 2009 cited in: TARU, 2010. Phase 2: City vulnerability analysis report (Indore & Surat).

5 *SLF has been used extensively for rural conditions and provides a sound basis for analysis of vulnerability. It defines five capitals which control the livelihoods of the poor, namely physical, human, financial, social and natural capitals.*

6 *The inherent capacities, tangible and intangible, that prove to be advantageous as coping mechanisms*

7 *Geopsy is a small area covered by buildings on both sides-a stretch of 50 to 100m depending on building density. It is selected representing the average density of the polygon. About 25-50 buildings are covered in each geopsy.*

Table 4. Data sets used for deriving capacity and vulnerability indicators

Indicator	Data used	Weightage	Comments
Education index	Maximum education in the household and aggregated as average community level	Low weightage up to 10th standard, then increase rapidly with 10 for postgraduate/ professional level	Higher levels of education increase capacity to earn and also empower the next generation to benefit from education
Income stability index	Per capita income, ratio of stable and unstable incomes, dependency ratio	Equal weightage to all three factors	Income stability provides resilience during disasters, and ability to invest in adaptation
Social capacity index	Existence of community groups in settlement, membership of households in these groups, access to political leadership, benefits derived	Equal weightage to all four factors	Capacity to access the network critical in group level resilience
Loan and insurance vulnerability index	Loans taken, Lack of insurance	Equal weightage	The higher the loans, the less households will be able to invest in adaptation. Lack of insurance results in most of the damages borne by the household, which can put back the household finances for long period.
Physical infrastructure vulnerability	Drainage, sewerage facilities within the settlement	Scores for different types of drainage and sewerage	Lack of drainage and sewerage increases risk of floods
Water scarcity (Indore only)	Number of water supply sources, Average lpcd collected, Max distance of source during a scarce period Water supply frequency, time required for water management during scarcity	Equal weightage	Provides a snapshot of scarcity situation
Water logging/flood vulnerability (mainly for Surat)	Distance from flood prone river, depth of inundation during last floods, duration of inundation	Equal weightage	Provides snapshot of flood/ waterlogging events faced by the household as well as possible risk

Source: TARU analysis, 2009 cited in: TARU, 2010. Phase 2: City vulnerability analysis report (Indore & Surat).

c) Sector studies

In Indore, impact studies included urban health and environment, the transport sector, water security, energy security, and green buildings. The objective of these studies was to capture the systemic vulnerabilities of these sectors in the city and to highlight cross-sectoral linkages amongst the various sectors in the city. In Surat, sector studies examined energy security, water security, health impacts, environmental impacts and flood risk management. Intervention ideas were generated primarily by TARU and through sector studies in Surat and Indore, with workshop participants providing inputs for prioritisation (Tyler et al., 2010: 30).

Household and community questionnaires were used for sector studies and also aided in checking what information was available at the city level, and to measure household assets. This helped in studying details like insurance value and asset loss. The household surveys were later validated with community consultations (with a sample of around 1500 households), and with census and National Sample Survey Office (NSSO) data.

d) SLD

A series of workshops were conducted by ISET and TARU to understand the critical uncertainties and possible future scenarios for Surat and Indore. After several deliberations, the city stakeholders identified two critical uncertainties that are likely to shape the future of the city: the economy and social cohesion in the case of Surat, and migration patterns and city level resource/infrastructure management in the case of Indore. Based on these critical uncertainties, four sets of future socio-economic scenarios were developed. These scenarios reflected the situation which may appear for the year 2030-2040 time period and were based on the set of certainties and uncertainties identified by CAC members. Each scenario explored changes in the ability of society to deal with the impacts of urbanisation, poverty, or the extreme events due to climate change (TARU, 2012:36; TARU, 2011:37).

e) City resilience strategy (CRS)

The CRS document for both the cities comprises the following four sections:

1. **Variability and change:** This section includes the dynamic factors that would affect the city, such as population growth projections; industrial and economic growth parameters; land use and land change components; informal settlements and migration patterns; climate projections, with temperature and precipitation as the key parameters for Indore, and an additional parameter of sea level rise for Surat.
2. **Possible impacts:** This section includes the sector study findings (divided into current status and future impact on the sectors due to climate change).
3. **Evaluation and assessment:** This section focuses on the capacities, vulnerabilities and constraints of the city.
4. **Prioritised strategies:** The final section categorises short, medium and long term strategies for each sector with the aim of reducing the impacts of climate change on the city as an approach to resilience.

The key stakeholders involved in developing the city resilience strategy in Surat were: Surat Municipal Corporation (SMC), Southern Gujarat Chamber of Commerce and Industries (SGCCI), Industry groups, academic institutions and individual experts. In Indore, the key stakeholders involved in the process were: the Indore Municipal Corporation (IMC) and the Indore Development Authority (IDA). These organisations hosted the initial ACCCRN meetings and subsequently became key members of the CAC.

2.3.3 Process

TARU engagement in ACCCRN began in Phase I, where it undertook city opportunity assessment studies which largely involved analysing the readiness of cities to engage in the resilience building exercise which was to follow. Based on this assessment, in Phase II of the programme in 2009, TARU began the resilience planning exercise in Surat and Indore as an implementing partner.

Unlike Indore, in Surat, industry is housed within the city which meant that the Chambers of Commerce had vested interests to climate proof the city, since their infrastructure and capital was also at stake. Moreover, in Surat, not only are the urban poor population vulnerable, but the middle income population is also at risk due to the existence of basements in all buildings. Thus, the city stakeholders in Surat became interested in the programme because they wanted to understand the impact of climate change on industry. Some of them feared that the minor climate change impact could hamper the double digit growth that the industry was experiencing. Concerns for sustainable and inclusive development is the primarily responsibility of the industries' community in Surat, and hence this ensured their partnership in the ACCCRN process. In Indore, the key stakeholder cited that the city wanted to be proactive which motivated them to get associated with the project.

In Surat, the first meeting for the project was held at the Southern Gujarat Chamber of Commerce and Industry (SGCCI), where a series of discussions and capacity building exercises was conducted by TARU. When the project started, there was very little understanding of climate change among the stakeholders. Therefore in the initial stages, TARU provided a lot of support to the stakeholders through various seminars and workshops.

The planning phase took six months, which included setting up the City Advisory Committee (CAC) and building the understanding of various stakeholders on concepts of climate change adaptation, risk and vulnerabilities. Since resilience planning did not figure in the cities' agenda, a visioning exercise was conducted with the city stakeholders. The stakeholders were asked to envision their city's issues and solutions through a series of workshops, with a vision to 2025. A TOR was drafted between the city and the partners, and the CAC was housed in the Municipal Commissioner's office. The terms of commitment and engagement were communicated beforehand. Key champions were identified amongst them, with the deliberate intent of champions being those able to stay with the project for a longer duration of time. In Surat, it was observed that the process was end-user or stakeholder driven, as the city stakeholders demanded an actionable agenda instead of just data and projections which projected their city as vulnerable. Also, interdepartmental coordination was a major bottleneck as there was no coordination, even at the Surat Municipal Corporation (SMC) level. The CAC tried to overcome this challenge. In Indore, it was observed that the institutional cohesion was low and private sector involvement was nearly absent. Most importantly, the cross-sectoral dialogue was low, as a result of which it was observed that as compared to Surat, there was less ownership of the CRS in Indore.

Given the amount of modelling that was involved, especially for the vulnerability analysis stage, the city stakeholders were satisfied with the support provided by TARU during the process. For sectoral studies, the stakeholders needed the initial explanation and handholding in order to provide the required data. For Surat's sectoral studies, the city stakeholders opined that an additional sector, 'food security and climate' should have been included in the study. All city stakeholders agreed that it was crucial for the state government to step in and be made aware of the results of the project, so as to foster dialogue, which ultimately results in the state taking ownership of the CRS. Sharing their viewpoints on the methodology, the Surat city stakeholders advised that the methodology needed to be verified again and again. They stressed the need for authentication and documentation to study the claims and the actual status of the project. They also observed that, while representatives of the stakeholder groups (industry) are aware of the issue, there is still a need to disseminate this awareness from top to bottom to their peers, so that there is an understanding of urban resilience at a larger level.

The impact of the ACCCRN process in Surat was that the city stakeholders themselves took the ownership of the CRS and later on spearheaded several pilot projects in their city. One of the key achievements of the project in Surat was the formation of the Urban Health and Climate Resilience Centre (UHCRC) and the Surat Climate Change Trust (SCCT). The SCCT is a city level multi-stakeholder public trust, having its office at the City Engineer's Office. It includes members from various institutions including Gujarat State Disaster Management Authority, Narmada, Water Resources and Water Supply Department, South Gujarat Chamber of Commerce and Industries, and academic institutions (SVNIT and CSS). It

was formulated with the objective of addressing problems arising out of urbanization and climate change and to facilitate capacity building of Surat to address these challenges (Surat Climate Change Trust, 2013).

Based on the health sector study carried out in 2010 under the ACCCRN initiative, the team recommended establishing the UHCRC in order to provide support to the state and central-level urban health support systems to incorporate climate change resilience issues. The SCCT played an important role in spearheading the process and in 2012 the UHCRC was established with support from Rockefeller Foundation. Established within SMC's Health Department, this first-of-a-kind institution in the country aims to address public health and climate change adaptation issues (ACCCRN, 2012). In February 2013, the SMC announced that it would allocate INR 10 million to UHCRC for its functioning (Bhatt, 2013).

In Indore, two pilot projects are currently being implemented by TARU as part of ACCCRN: i) Testing and Promoting Decentralised Systems for Differential Water Sources and Uses; ii) Strengthening Vector-borne Disease Surveillance and Response Systems.

2.4 Guwahati city resilience strategy and mainstreaming plan

2.4.1 Introduction

Guwahati was a replication city in the ACCCRN and was identified by TERI due to its pronounced climate vulnerability, urbanisation pressures and its eco-sensitive location.

Urban growth in the city of Guwahati has been rapid, unplanned and organic owing to its administrative, economic and socio-cultural importance. Change in land use patterns of the city due to uncontrolled development activities has damaged the ecology and environment of the city. The city is surrounded by one of the Ramsar notified wetlands, the Deepor Beel which is under threat due to encroachment and unplanned urban development of the city. The city is prone to floods and landslides and is located on the earthquake belt. The city lacks adequate preparedness for disasters and response.

Various parameters that were used for the city's selection are listed below:

1. Risk potential: Geographic location, climatic zone, predicted climate change impacts at regional level based on the Indian Network for Climate Change Assessment (MoEF, 2010: 10-17).
2. City profile: Medium sized (population range of 0.5-1 million), relatively high growth rate cities were taken into account. The share of urban poor/ slum dwelling population was also considered as an indicator of the vulnerable population in the city.
3. Existence of a development plan / master plan was another screening parameter. It was important that the city should also have some form of planning/ development framework in place as the ultimate aim of the study was to bring about required changes in the development planning process, bye-laws, policies and programmes of the government.
4. Working relationship with city/ state government: A working relation with the city or the corresponding state government was sought to ensure access to data, participation and inputs of the government stakeholders in the stakeholders' consultation, and receiving overall buy-in for the process.

Guwahati was selected amongst the final six shortlisted cities because of the following factors:

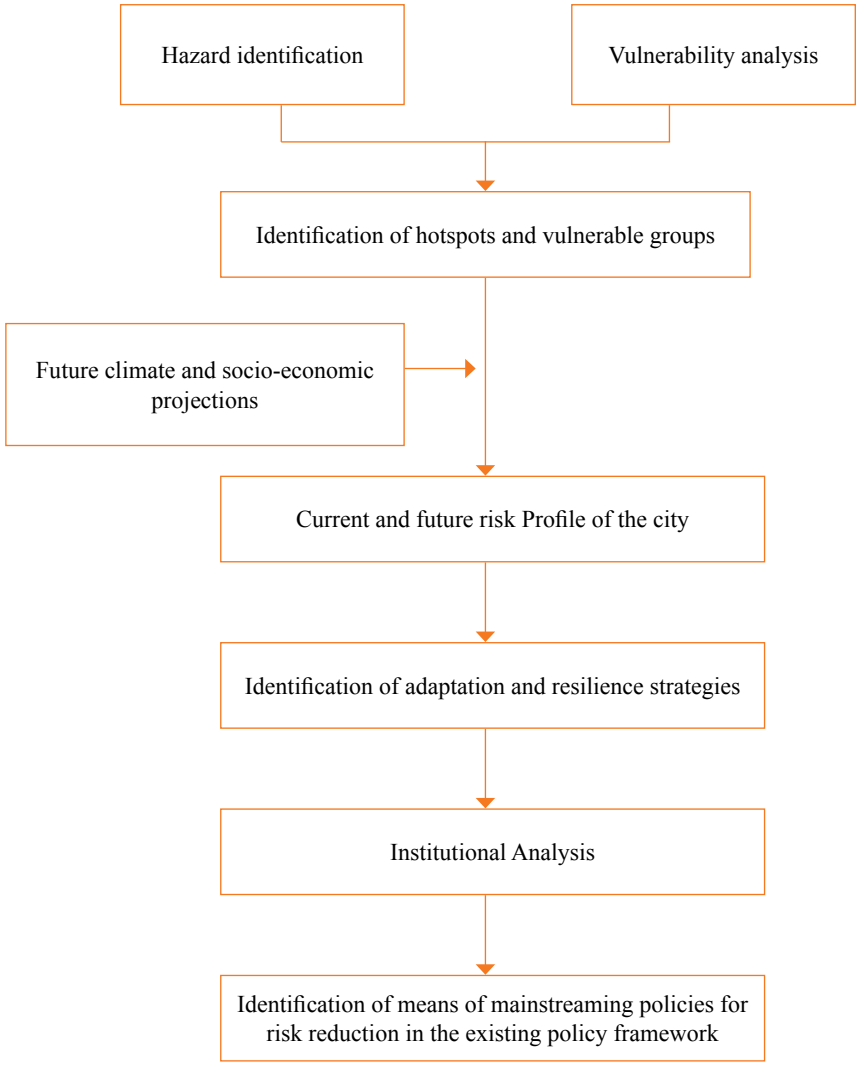
a. High risk profile of the city
b. Its relative importance for the economy of the State of Assam.
c. Approval and support from the state government and city government – the Guwahati Development Department (GDD) and the Municipal Corporation of Guwahati extended their full support to the study.
d. TERI's regional centre's location in Guwahati which could help in the process of the study, and its previous experience assisting the state government in the preparation of the State Action Plan on Climate Change.

2.4.2 Methodology

The risk assessment was based on climate projections, secondary data and consultations with government departments and relevant stakeholders. Reviews of existing policies and governance frameworks of the city were carried out to identify channels for integrating adaptation and disaster risk reduction measures in planning and development. A detailed step by step description of the methodology adopted for risk and vulnerability assessment in Guwahati is given below (TERI, 2013: 1-3).

1. **Hazard identification:** The initial step in risk assessment was the identification of natural, human-made and human induced hazards and stressors (climatic and non-climatic) affecting Guwahati. This was done on the basis of a literature review, a city level stakeholder consultation, and an analysis of the relevant secondary data.
2. **Vulnerability analysis:** An analysis of the characteristics of the city was conducted to determine the level of exposure to the identified hazards and stressors. Variables such as topography, population dynamics, socio-economic condition and land use pattern were studied to understand the sensitivity of the city to the hazards. The quantitative assessment was supported by an analysis of the spatial information retrieved from satellite imageries and inputs from the stakeholder consultations. This step also involved understanding the current coping capacities and strategies of the people in the city in case of hazards. Based on the hazard identification and vulnerability analysis, the following sectors were identified as the key sectors to address the present and future vulnerability of the city in the context of climate change impacts.
   - Housing and urban planning
   - Urban infrastructure and services (water supply; sewerage; natural and storm water drainage; solid waste management; electricity; health)
   - Informal settlements and slums
   - Ecosystems and land use
   - Emergency response capacity.
3. **Identification of hotspots:** Outcomes of the vulnerability analysis were used to identify and map the climate sensitive hotspots using GIS. The analysis also highlighted vulnerable communities and sectors as well as urban functions which are more vulnerable to risks and hazards.
4. **Climate projections:** Climate projections for the 2030s at a resolution of 25 km x 25 km were conducted for the region to understand the change in temperature (mean, minimum and maximum) and precipitation from the baseline (see Annex D).
5. **Current and future risk profile of the city:** The information generated on vulnerable hotspots, communities and urban functions was used to generate the current risk profile of the city. The results of the risk assessment were also shared and validated with the relevant city stakeholders to address any gaps.
6. **Identification of adaptation and resilience options to address the risks:** In the next step, adaptation and resilience options to address these risks were identified. The strategy aimed at having a holistic set of sector specific adaptation options to address their vulnerability and building climate resilience in the city.
7. **Review of existing policies and legislations to identify gaps in addressing to risks:** A review of existing policies, legislations and by-laws was conducted to identify the gaps in the existing policy regime to address the current and future risks and climate proof Guwahati. Based on this review, a mainstreaming action plan was also proposed a part of the Guwahati Resilience Strategy.

Figure 6. Risk assessment framework for Guwahati



Source: TERI, 2013: 2

2.4.3 Process

Since scaled-down data availability was a challenge, the vulnerability assessments were substantiated based on the multiple stakeholder workshops. These workshops facilitated sector inputs, validation, and cross-sectoral interdepartmental dialogue. Stakeholder dialogues were also a platform to receive inputs on the potential entry points in the present policy, regulatory and institutional framework for urban climate resilience.

The resilience strategy document was presented and shared with the Guwahati Municipal Corporation. The Corporation has further circulated it with other relevant city level and state line departments as a reference for the planning and development works in the city and for integration of environment and climate related concerns. The CRS and the Mainstreaming Action Plan have been formally accepted by the Municipal Corporation. Relevant recommendations have also been incorporated in the New and Revised Building Bye-laws being prepared by the GMC. However, a larger policy, institutional and financial support is required to actually implement the Resilience Strategy as a whole.

2.5 Cities of Shimla, Mysore and Bhubaneswar

2.5.1 Introduction

ICLEI joined the ACCCRN initiative during the replication phase in three additional cities of Shimla, Bhubaneswar and Mysore.

Mysore

The city has a moderate climate with summer temperature ranging from 20°Celsius to 35°Celsius while the winter temperature remains in the range of 12°Celsius to 30°Celsius. The civic administration for the city is managed by the Mysore City Corporation, which was established as a municipality in 1888 and later converted into a Corporation in 1977. The Corporation oversees the engineering works, health, sanitation, water supply, administration and taxation in the city.

Shimla

The city of Shimla is a hill city spread on a ridge and its seven spurs. Shimla features a subtropical highland climate as per the Köppen climate classification. The city is one of the most popular hill stations of India. The climate in Shimla is predominantly cool during the winter and moderately warm during the summer.

Bhubaneswar

Bhubaneswar is the capital city of Orissa State. It has an area of 135 sq. km and a population of 837,737 as per the 2011 census. It is the largest city of the state, and has become the centre of economic and religious importance in the region. Bhubaneswar is called the Temple city of India, due to the presence of large numbers of magnificent temples and architectural heritage. The city formed a Corporation in 1994.

ICLEI's engagement with ACCCRN envisaged a streamlined and replicable process that cities could implement without the need for much external support and aimed at:

- Distilling the critical successful elements of original ACCCRN processes and supplementing them with other relevant and proven approaches
- Developing a guide and toolkit to help cities develop local climate change resilience strategies
- Testing the toolkit in the three project cities.

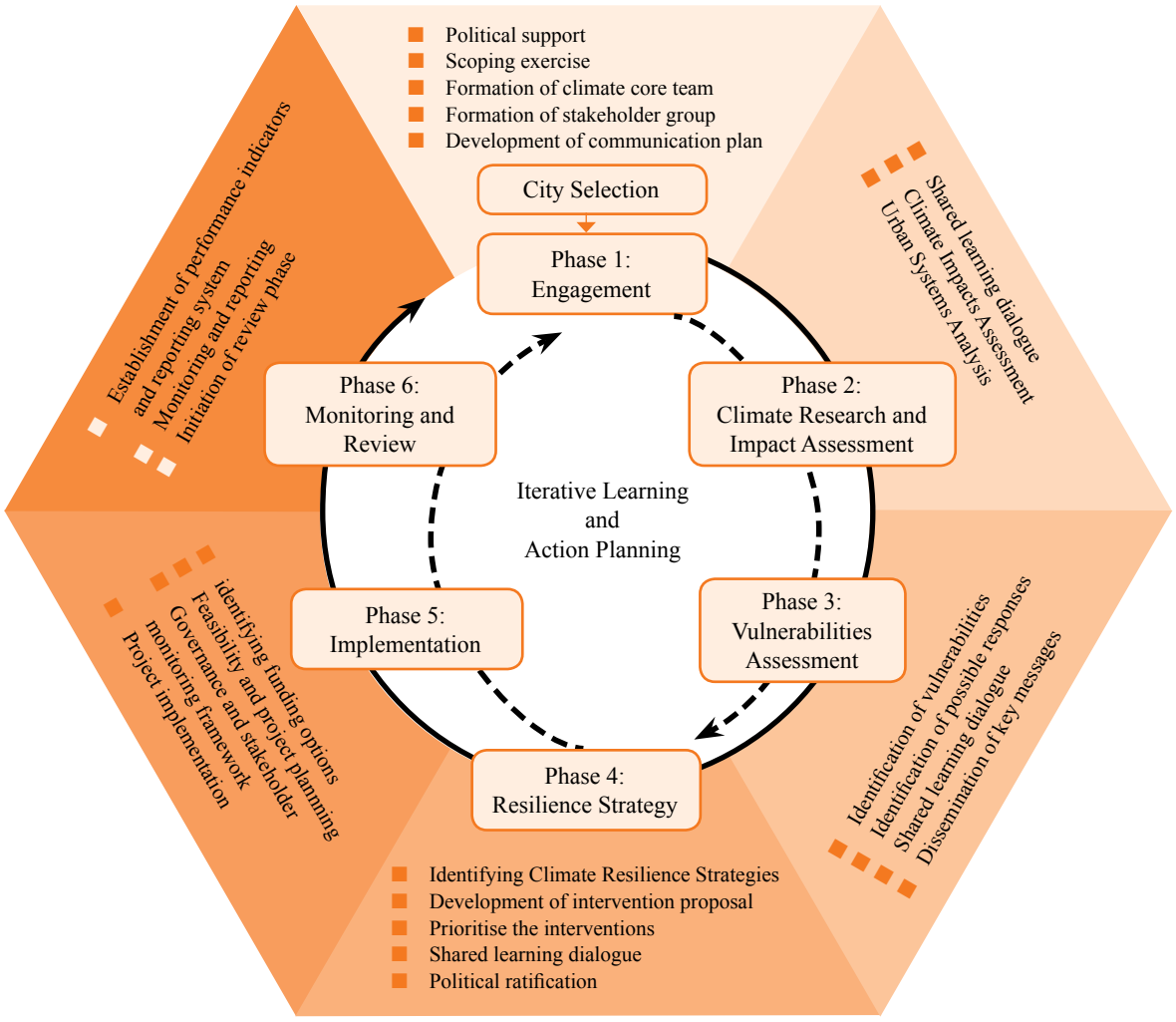
The selection process involved sending expressions of interest (EoIs) to around 35-40 cities, of which 50% responded. The prerequisite for selection of city was provision of resources: manpower and basic funds from the city's side. Based on this, the three cities were selected.

As the cities have yet to publish documents detailing the technical aspects of the methodology applied, this section relies on interviews with partners and city stakeholders, and presentations by ICLEI.

2.5.2 Methodology

The methodology adopted by ICLEI was based on ACCCRN principles and draws heavily from the SLD process where the stakeholder discussions led to understanding the vulnerability and preparing a resilience strategy. The theoretical background of the methodology has been derived from ISET's urban resilience principles (Moench *et al.*, eds; 2011) and ICLEI's own experience of working with cities. A set of 10 + tools were developed by ICLEI which were used for the process. The process was reviewed with ARUP and inputs on the process to be adopted were received from selected ACCCRN partners.

Figure 7. The ICLEI ACCCRN process



Source: Tewari, 2013.

Unlike other cities, the methodology did not rely heavily on climate projections or impacts modelling. Instead ICLEI methodology started from an identification of existing fragile urban systems and considered the reasons for the fragility. The climate component was also considered to be necessary as the resilience under consideration was for climate related impacts. Therefore, the assessment presented within the 4x4 Assessment Report[8] (MoEF, 2010) was made use of for Shimla and Bhubaneswar. An assessment undertaken by the Indian Institute of Science (IISC), Bangalore was utilised for Mysore city. The risk assessment was conducted through stakeholder exercises. The scoring on risks was subjective in nature and was based on the discussions with the stakeholders. No sector specific separate study was conducted during the process.

8 *A 2010 report from Ministry of Environment and Forests, Government of India which provides an assessment of impact of climate change in the 2030s on four key sectors of the Indian economy.*

The methodological steps included the following:

1. Engagement stage: This stage included the setting up of a climate core team, the formation of a stakeholder group and ensuring political support at the level of the city.
2. Climate research and impact assessment stage: This stage included climate impact assessment and urban systems analysis. As already discussed, the climate impacts were derived from reports of MoEF and IISC Bangalore. The urban systems analysis included a detailed study of the fragile urban systems and the risks that the urban system would face under changed climate projections.
3. Identification of vulnerability and possible responses: The vulnerable spots in the city and vulnerable groups were identified at this stage. A priority exercise was conducted to prioritise areas of vulnerability. It was followed by sector-wise vulnerability assessments of the various urban systems on the basis of the likelihood, consequence and assessment of risks attached to them. Next, wards susceptible to the identified impacts were listed. Vulnerability hotspots were located, which included all wards in which the identified fragile systems were to be impacted. Later, sector resilience actions were proposed in the three cities.
4. Preparation of resilience strategy and identification of adaptation/interventions projects: The next stages will involve implementation of the identified proposals and seeking financial support for the same followed by monitoring and evaluation process.

2.5.3 Process

A climate core team consisting of the city officials from various departments was created which included project nodal persons and external advisors. In Mysore and Bhubaneswar ICLEI conducted a training programme on "understanding climate change". ICLEI plans to take forward the work in the three cities by helping the cities prepare a DPR[9] for adaptation projects and helping them to identify financial resources. Various stakeholder consultations were conducted during the entire duration of ICLEI's engagement in these cities. The risk and vulnerability as well as the resilience strategy emerged from these stakeholder consultations.

9 *The Detailed Project Report (DPR), an essential step in planning for infrastructure development and service delivery.*

3. Analysis of literature review and questionnaire responses

3.1 Context

While Chapter 2 provided an overview of the process adopted and the methodology applied in all the seven cities, this chapter analyses the methodologies and the procedural challenges and opportunities with a point of view of their replication potential. The chapter brings in the national partners' and city partners' perspectives as discussed during the interviews.

In all the cities the basic format of engagement has been the same although the methodologies have differed. The difference in methodologies seems to have arisen due to the following factors:

a) Contextual difference between cities ranging from risks faced, existing governance structures, industrial make-up, population and demographic conditions, etc.

b) ACCCRN partner's level of comfort with quantitative and qualitative assessments

c) Availability of data and its quality

d) Extent of city engagement in the process

e) The different timeframes under which these studies were conducted for core cities (2-2.5 years) and replication phase cities (less than 1 year).

All the cities have come up with the city resilience strategies (the CRS for Shimla, Mysore and Bhubaneswar are in the pipeline). In the core cities of Surat, Indore and Gorakhpur, identification of pilot projects to be implemented with the support of the Rockefeller Foundation was an in-built component of the process, which did not extend to the replication cities of Shimla, Mysore, Bhubaneswar and Guwahati. However, it is to be noted that this replication and scaling up is not initiated by the city and would more or less follow the ACCCRN format where the partners would work on the city and the city would be engaged through consultations.

3.2 Discussion on the technical components of the methodology

The following table represents the basic components of the methodology adopted in ACCCRN cities and how they differed from city to city:

Table 5. Comparative review of methodologies across seven Indian ACCCRN cities

Core ACCCRN cities		Replication phase cities	
Gorakhpur	**Surat and Indore**	**Shimla, Mysore and Bhubaneswar**	**Guwahati**
Risk assessment: Climate projections			
Trend analysis conducted for temperature and rainfall trends for last four decades. Climate projections predicted for 2046-2065 using global climate models like CGCM3, CNRM, CSIRO, MIUB and climograph[1] analysis.	i) Historical weather data from the India Meteorological Department (IMD) which included temperature (1969 to 2009) and precipitation (1901 to 2009) were analysed for studying climatic trends. ii) The PRECIS Model results were used to analyse the regional climate projections for the period 2020 to 2100. iii) Results from *Climate Explorer* were also used to study and compare the climate projections for 11 Global Climate Models (GCMs) iv) Hazard risk modelling was carried out for both Surat and Indore. In Surat, an inundation modelling was conducted to map flood risk prone areas in the city. The inundation model scenarios were developed using historical precipitation, tide and river discharge information. Recorded High Flood Level (HFL) marking within the city were used for validation. In case of Indore, the risk modelling involved mapping of malaria-prone areas in the city. The maps so generated were validated using the sample household survey data.	4x4 Assessment report of the GoI used. No climate projections conducted over the city	A1B scenario predicted for temperature and precipitation variation for the 2030s on a 25 km x 25 km resolution using the PRECIS model.

**A climograph is a diagrammatic representation of climatic data*

Core ACCCRN cities		Replication phase cities	
Gorakhpur	**Surat and Indore**	**Shimla, Mysore and Bhubaneswar**	**Guwahati**
Risk assessment: Vulnerability assessment			
Community consultations and Shared Learning Dialogues (SLD), primary data collection through sample household surveys, secondary data collection from relevant sectoral Public Departments, and using participatory learning and action (PLA) tools	i) Adapted the Sustainable Livelihoods Framework to define three indicators each for capacity and vulnerability assessment ii) GIS based city wide vulnerability assessment was conducted to capture current vulnerability of different sections of population across space and socio-economic categories. iii) The method of stratified sampling for data collection through questionnaire based household surveys was used. iv) Stakeholder consultations and CAC meetings provided the platform for validating and updating the information from time to time.	Adapted the Urban Climate Resilience Planning Framework (ISET, ARUP, others) 10+toolkits developed and tested for their applicability in risk assessment Assessing climate trends Identifying existing fragile urban systems Expected impacts of climate projections on fragile systems Prioritisation based on risk assessment(risk scores) For each impact, identification of: – Vulnerable areas – Vulnerable social groups	Stakeholder consultations involving local experts, academia and officials from Government departments, secondary data collection from Municipal Corporation and relevant sectoral Public Departments
Risk assessment: Sector studies			
Detailed studies carried out for geohydrology, drainage and solid waste management. No other sector studies conducted.	Sectoral experts were consulted for these studies. For each of the sectors, assessments of existing vulnerability and future climate impacts on these sectors were drawn. The following sectors were covered: environment, flood risk and management, health, energy security, green buildings, urban transport and water security. The household and community questionnaires were also utilised for the sectoral studies. The household surveys were later validated with community consultations.	Sector studies not conducted.	No detailed quantitative sector studies conducted. Sector-wise analysis carried out based on data collected and inputs from stakeholder consultations.

Core ACCCRN cities		Replication phase cities	
Gorakhpur	**Surat and Indore**	**Shimla, Mysore and Bhubaneswar**	**Guwahati**
City resilience strategy			
Structural, governance and behavioural strategies proposed for the identified sectors. Identification of 3 pilot projects on peri-urban agriculture, solid waste management, micro level resilience planning.	Resilience strategy development was informed by climate projection studies, hazard and risk assessment findings, current vulnerability and anticipated future risks, risk to resilience workshops and other scenario planning exercises with stakeholders.	Under preparation Actions prioritized based on resilience indicators & feasibility criteria	Sector specific structural, institutional and regulatory measures proposed for building climate resilience in the city. Mainstreaming action plan identifies short, medium and long term action points and vehicles to aid implementation of resilience strategy by relevant city level departments.

Three basic components emerged as a prerequisite to the resilience planning exercise in cities. These are – risk assessment including climate projections, vulnerability analysis and sector studies, and CRS preparation.

3.2.1 Climate projections

As mentioned above, climate projections are an essential component of climate resilience planning. Regional climate models provide climate information at finer resolutions that can be used for policy and planning purposes. However, to be able to undertake such assessments, skilled expertise is required which is available only in few institutions across the country.

3.2.2 Vulnerability analysis

In case of Surat and Indore, the methodology was data and time intensive, technically robust and based on household and primary surveys. Regular validation of the methodology was also done.

The rationale to use SLF and economic indicators in Surat and Indore was driven by the fact that these two cities are the key economic hubs in their respective states and therefore, these indicators were used to link the cities' vulnerability and coping capacity. The cities had looked at current vulnerability and how it will be accentuated in the future due to climate change.

The primary surveys and the GIS-based vulnerability assessment techniques, although technically sound, were intensive in terms of the time and manpower resources used. For other cities to do such an exercise, they will require access to software, techniques and skilled manpower. During the questionnaire survey, the partners also highlighted the fact that the methodology is very data intensive and time consuming.

ICLEI used a comprehensive and simple methodology for Shimla, Bhubaneswar and Mysore. The data that was readily available in the city was used. As observed by the partners, the availability and the use of toolkits make this methodology easier to replicate. The work in Guwahati also relies on urban profiling to assess current urban pressures and deficiencies and integrates it with climate profiling to understand current and future climate related vulnerabilities. While ICLEI's

methodology relied on secondary data for climate projections, TERI had conducted climate projections using regional climate models which projected the climate for future time slices for the city of Guwahati at a 25 * 25 km resolution.

In Gorakhpur, local knowledge and expertise were used for the vulnerability analysis and associated sector studies, such as a geo-hydrological study. Use of local knowledge is an important component for resilience planning and would be an important asset for contextualisation and replication in other cities as well. The participatory learning action tools (PLA) used for the vulnerability assessment brought the communities' perception into the process and mobilised the community towards the implementation of pilot projects.

3.2.3 Sector studies

While the national partners in core cities conducted separate sector studies, in addition to the risk and vulnerability analysis, the four replication cities did not conduct sector studies but rather relied on detailed urban profiling, mostly because of the time constraints with the project. Like Gorakhpur, it seems more feasible to conduct detailed sector studies once the risks are prioritised and the critical sectors are identified.

3.2.4 City resilience studies

The strategies that were developed were based on the outcome of the SLDs and the vulnerability assessments. Critical sectors for intervention and pilot projects were identified in this stage. The CRS documents outlined a framework of strategies that could be adopted by cities to reduce their vulnerability and for building resilience into the risks of climate change. However, there was no roadmap for their implementation. In Gorakhpur and Guwahati, the mainstreaming action plan was prepared by TERI with an objective to facilitate this implementation process and integrate the CRS into the urban development planning framework.

3.3 Discussion on questionnaire responses

Detailed and separate questionnaires were formulated for the national partners and the city partners (Annexes B and C). The very first step was to understand the views of the stakeholders on the need and efficacy of resilience planning in cities in India. Both the city partners and the national partners agreed to the efficacy of resilience planning in Indian cities; however several issues and suggestions in the form of enabling factors required to take this forward were raised and are discussed in the following sections.

3.3.1 Motivation of the cities for planning for resilience

In terms of the motivation for involvement in the ACCCRN initiative, most of the city stakeholders felt that the programme deals with existing problems and challenges of cities (Table 6). For example, flooding and water logging in the case of Surat and Gorakhpur was not only a concern to the municipal bodies but also to other key stakeholders: the Chambers of Commerce and Industry (Surat); poor communities in city and peri-urban areas (Gorakhpur, Bhubaneswar); tourism industry (Shimla).

Another key response was that a city understood the need to climate proof itself. For example, in Guwahati, the current problem of flooding was already a concern for the city's management. The Municipal Commissioner had prepared a flood management plan which was scheduled to be submitted to the Chief Minister of the State for financial support, to be implemented in Guwahati. TERI's intervention was timely in this context and the city's buy-in was achieved given the past experience of the city. The city felt that the ACCCRN process would be able to bring in a holistic approach to the urban development planning paradigm in the city and would help them tackle the problems arising out of frequent floods, considering its changing patterns.

The technical and capacity building support offered by the ACCCRN partners was another key driver for city stakeholders to join in the process.

Table 6. Responses from city stakeholders on motivation for their involvement in resilience planning exercise

	Core ACCCRN cities			Replication phase cities			
	Gorakhpur	**Surat**	**Indore**	**Shimla**	**Bhubaneswar**	**Mysore**	**Guwahati**
Cities saw a potential funding opportunity for some of their infrastructure projects		✓		NA*			
Matched with the larger vision of the city	✓			✓		✓	
Displays proactive and forward image of the city		✓	✓		✓		
The city understands the need to climate proof itself			✓	✓		✓	✓
Deals with existing problems and challenges of cities	✓	✓			✓		✓
Availability of funds (From RF's side) for pilot projects				NA			
Technical and capacity building support/backing offered by external agents	✓	✓		✓			✓

Shaded rows indicate top responses. There was no provision for funding projects in the replication phase.*

3.3.2 Methodology

The city respondents identified certain challenges in the methodologies adopted in their respective cities. These pertained to understanding the methodology and the concepts, data availability, climate projections and the extent of stakeholder participation.

The city stakeholders felt that when the project started, there was very little understanding of climate change and its interlinkages with various urban systems. This posed a challenge in understanding the methodology for the resilience-building exercise being undertaken as part of the ACCCRN initiative. For example, there is no policy or regulation on urban resilience that applies at city level and in most cases even the meaning of mitigation and adaptation was not clear to the ULB technical staff and local communities. In some cases, though urban climate resilience was understood by the city governments to some extent, it was still not a priority as this was seen as a future problem/risk, whereas the current urbanisation pressures on the urban infrastructure and services were seen as an immediate priority to be dealt with. Therefore, the initial SLDs conducted by the partners attempted to sensitise the city stakeholders on the concept and need for climate resilience planning as well as its role in addressing not only future but also current vulnerabilities.

In terms of the assessment exercise, it was felt by the respondents that conducting quantitative and qualitative sectoral assessments is relatively doable by city-level public agencies as they have data and expertise on their respective subject. However, city stakeholders felt that when it came to relating urban issues with climate science, and the vulnerability analysis stage, they required support from external experts. It was also suggested that the methodology should be shared with various stakeholders at city and state level to seek inputs in order to contextualise it before implementation.

3.3.3 Data

The partners opined that the data collection for sectoral studies and climate projections was a challenging process. This was one reason why SLD and household surveys were relied upon for the data collection in the core ACCCRN cities. Respondents from all the seven cities felt that it was also challenging to acquire the data from the public agencies for the vulnerability assessment stage, as the data was either not available, or if available, it was not in the required format and scale.

Table 7. City stakeholder responses on challenges experienced with methodology and data

Challenges faced	**Core ACCCRN cities**			**Replication phase cities**			
	Gorakhpur	**Surat**	**Indore**	**Shimla**	**Bhubaneswar**	**Mysore**	**Guwahati**
a) Methodology							
Understanding the methodology and concepts	✓			✓		✓	✓
Inter-departmental coordination	✓	✓			✓		
b) Data							
Data was readily available			✓		✓		
Data was available only for select few sectors	✓			✓		✓	✓
Data support was minimum, partners did individual assessments	✓	✓					

Shaded rows indicate top responses.

3.3.4 Climate projections

The city respondents felt that the climate modelling/ projections need to be strengthened for a robust resilience planning exercise (Table 8). However, they also observed that currently the cities do not have the capacity to conduct this exercise on their own and will need external support in this regard. It will be in the benefit of the cities if this is taken up with support from the government of India/State governments. It was also suggested that this climate modelling exercise should be accompanied with impact assessments on urban sectors.

It was also observed that the climate modelling exercise conducted in the core cities used a framework of 2045-2060 scenarios (Wajih, *et al*., 2010). However, this timescale would not reap benefits when used as a basis for the policy and planning process and proves to be a timeframe which is a bit too far away to plan. These assessments thus need to look at the near future timelines, such as in Guwahati where the timeframe of 2015-2030 was analysed for future climate projections.

Another observation from climate modelling was of the resolution used. For the core cities' assessments, the global models were used, which presented a coarse assessment of climate change over a city level scale. Taking from this experience from core cities, in Guwahati TERI used regional models to address this gap.

3.3.5 Participatory component

The ACCCRN methodology adopted in various cities tried to follow a participatory approach, although the levels of participation varied from city to city (Table 8). SLDs and CAC consultations were conducted in most of the cities, however the city stakeholders felt that some of the other stakeholder groups were not adequately engaged in the process. For example, there was minimal engagement from community groups such as the urban poor, civil society in Guwahati, Bhubaneswar and Indore; and in Shimla, the Municipal Corporation was the only key stakeholder giving consistent inputs to the process. It was therefore suggested that inputs from local subject experts, academics, NGOs, civil society groups should also feed into the process. At the same time, the city respondents were also unsure to what extent these perceptions and aspirations were accounted for in the preparation of the City Resilience Strategies.

In terms of community engagement, the city respondents felt that there was partial engagement by the community in the process. Engagement was mainly limited to the initial stages when seeking inputs on identifying the primary risks and to an extent during implementation of the pilot projects in the core cities.

However, both the partners as well as the city stakeholders were not sure how and to what extent this engagement could be strengthened. They felt that the process was too technical and it might not be feasible to involve communities in the intermediary stages as this would be a time consuming process. Some of the stakeholders felt that a more intensive community engagement may lead to deviation from the objective of the exercise.

Table 8. Responses on components of the methodology to be strengthened

	Core ACCCRN Cities			Replication phase cities			
	Gorakhpur	Surat	Indore	Shimla	Bhubaneswar	Mysore	Guwahati
Climate modelling/projections part	✓			✓	✓	✓	
Sectoral studies	✓						✓
Participatory components		✓	✓	✓	✓		✓

An important part of the process was the formation of CACs which were a platform to receive inputs and feedback from the key stakeholders on cross-sectoral issues. These stakeholders constituted representatives from various city level public agencies, state line departments, academic and expert groups. It was felt by the partners as well as the city stakeholders that bringing about this interdepartmental coordination was a major challenge during the course of the project because of the conflicting and busy schedules of the stakeholders. This also led to delays in scheduling CAC meetings and other activities which impacted project timelines.

3.3.6 Outcomes

Although the city respondents felt that the resilience strategy would be a useful document for the city which they would like to adopt, they agreed that in the absence of any policy or statutory backing it would be a challenge to implement it completely. It was also suggested that for the complete implementation of the strategy, further hand-holding and capacity building support, and state government's buy-in were required. To receive the buy-in from the state government, some of the partners had tried to communicate the results of the study to them (for Guwahati, Gorakhpur); however, the response had been minimal.

Table 9. Implementation of the city resilience strategies

	Core ACCCRN cities			Replication phase cities			
Level of implementation	**Gorakhpur**	**Surat**	**Indore**	**Shimla**	**Bhubaneswar**	**Mysore**	**Guwahati**
Adopt partially	✓	✓		✓			✓
Adopt completely							
Need more consultations		✓	✓	✓	✓	✓	
Cannot go beyond pilot projects	✓			NA			
Cannot adopt in absence of state/national policy regulation	✓		✓	✓		✓	✓

3.3.7 Implementation support

When city stakeholders were asked about the kind of support required for initiating action on climate resilience (risk and vulnerability assessment, resilience planning, implementation of the CRS), the respondents stressed the need for an integrated approach for mainstreaming urban climate resilience. This would involve capacity building as well as policy and financial support at different stages. It was also emphasised that there is a need for building technical expertise and acquiring skilled manpower both at the ULB as well as the state level (Table 3.5).

Table 10. Responses on the required support needed by the city to initiate climate action

	Core ACCCRN cities			Replication phase cities			
	Gorakhpur	**Surat**	**Indore**	**Shimla**	**Bhubaneswar**	**Mysore**	**Guwahati**
Capacity building		✓				✓	
Policy mandate		✓				✓	✓
Skilled manpower						✓	
Financial support						✓	✓
Community participation							
Technical expertise		✓				✓	
All	✓		✓	✓	✓		

Most of the responses suggested state and city level as the main platforms to initiate climate action (Table 3.6). This also complements the structure adopted in the Constitution of India where urban development is a state subject and the larger mandate on all subjects related to urban development comes from the state government. While planning exercises are conducted at city level, the cities look at the state government for policy and regulatory support and finances for implementation of plans and projects. The respondents observed that a similar framework would be required for urban climate resilience as well.

The partners also opined that in order to replicate urban resilience activities, cities require support from the state government and the national missions need to prescribe budgetary allocations. The state would also require policy support from the national government.

The need and efficacy of integrating resilience planning with the urban planning process was also brought out in the discussions with the cities. It was pointed out that climate change does not form part of the mandate for municipal corporations and would be seen as an additional burden.

The city respondents agreed to the feasibility of introducing toolkits/ capacity building programmes to build the capacity of the cities to take up such an exercise. The partners had also emphasised the importance of toolkits for guiding cities on planning for resilience, engaging various stakeholders, risk assessments and vulnerability assessments. In order to offer a plethora of options to cities, the development of as many tools as possible was recommended. For this purpose, the customisation of tools for cities and their various sectors is required.

Table 11. Responses on the best platform to initiate climate action in cities

	Core ACCCRN cities			Replication phase cities			
	Gorakhpur	**Surat**	**Indore**	**Shimla**	**Bhubaneswar**	**Mysore**	**Guwahati**
Community					✓		
City	✓	✓	✓	✓			
State	✓	✓	✓				✓
National Government		✓			✓		
All		✓		✓		✓	

3.3.8 Finance

There are no financing mechanisms marked for urban climate resilience currently at the city or the state level. It was suggested that direct funding should be allowed from multi-lateral/ bilateral sources for the implementation of infrastructure projects at the city level which will help in building climate resilience in the long run. However, it is only possible to implement a few pilot projects through external funding, and large scale replication of such an exercise is only possible with government support.

It was suggested by the city partners during the interviews that budget analysis of various public agencies including the Municipal Corporation at the city level, as part of the city resilience strategy, will help in formulating a finance mobilisation plan for resilience building.

4. Observations and recommendations

This chapter draws from the chapter 2 and 3 and covers the literature review as well as interview responses from national partners as well as city partners. The themes for observations and recommendations pertain to the most critical issues that were raised during the interviews and that came out from the study of 7 cities during this project.

4.1 Replication

While this exercise establishes that city resilience planning is intricately related to the regular urban development planning and would be complementary to the objectives of a city's growth, prosperity and sustainability; it is also beneficial to undertake an analysis of the fact that the replication of a resilience exercise in other cities in India would need careful selection of cities for the initial stages. Replication to other cities would be gradual process and would rely on building evidence and learning from cities with previous experience, such as the ACCCRN cities.

This would depend upon the relative need of the cities in question to start planning for climate resilience. Some cities by virtue of their geographical location would feel the brunt of climate impact in a much more pronounced way than other cities. Coastal cities and riverine cities have already started experiencing the impacts of climate change in terms of increased frequency of cyclones and flooding as compared to the inland cities, where impacts manifest through subtle deviation from the normal, such as increased temperature ranges or very high or low rainfall. This calls for a careful selection of replication cities so that the planning and associated financial and capacity support is optimally utilised. The ACCCRN replication and scaling up is now extending to a further three cities in the north-east and eastern part of India, led by GEAG, and about 40 cities in four countries, led by ICLEI, of which 10 cities are in India. The replication would benefit from lessons from the ACCCRN initiative in terms of addressing the inherent challenges of applying resilience planning in Indian cities. The lessons learnt from the ACCCRN cities (including the new cities being involved in the replication and scaling up phase of the programme) must be consolidated and disseminated widely. The National Institute of Urban Affairs (NIUA) is the research and capacity building arm of the Ministry of Urban Development. The institute has been appointed by ACCCRN as the nodal organisation for capacity building of cities across India. The institute will be building capacities of various cities in India with the help of national partners in ACCCRN and selected institutes of the country. These capacity building programmes have the potential to be utilised to disseminate the lessons of ACCCRN in India.

4.2 Motivation and drive

At present, building urban climate resilience is not backed by any policy at the national or state level which poses a challenge for the cities to initiate a process on their own. In the ACCCRN cities, the financial assistance from the Rockefeller Foundation and the technical assistance from the ACCCRN partners was one of the key enablers that facilitated or ensured the city's initial buy-in.

It is understood that there is less awareness at the city level of the exact impacts of climate change and its link to urban development processes. Capacity building, dialogue and dissemination of ACCCRN and other international experiences would help in building the awareness and knowledge base in the cities towards this end. Increased awareness of the implications of climate change on urban areas, and recognition of the importance of integrating resilience planning within the urban planning process, would facilitate the expansion of this process to more cities.

Besides this, the mandate from state governments either linked with the respective State Action Plans on Climate Change, or the state environment or urban development policy, would go a long way in ensuring action by the urban areas to address climate change impacts. A policy from the national government to this end would be an important enabler for the state as well as the cities. It is important, however, that each of these policies or mandates are defined clearly and propose a detailed ecosystem of implementation, financing and institutional responsibilities.

4.3 Methodology

In terms of a technical assessment of the methodology adopted by all seven cities, it was found that although each methodology was driven by the inherent principles laid by the ACCCRN initiative, the partners contextualised the process and technical methodological details from city to city. Each method adopted has some features that could be part of the generalised methodology which could be proposed to other cities for replication. At the same time, there are components of technical methodology such as climate projections and modelling that would require hand holding and support from outside the city.

The methodology could be such that a city can conduct quick and easy assessment of their risk and vulnerability to climate impacts considering the time, capacity and absence of supporting policies with the city government. Toolkits that facilitate decision making for planning and implementation could be developed. The toolkits should be handy to use, and indicative in nature. These toolkits should cover various components of the process. The following recommendations on various stages of resilience planning exercise are given below:

4.3.1 Risk assessment

Climate projections

The cities can analyse past climate trends in-house and require external support for climate projections and detailed modelling exercises.

Vulnerability assessment

- This stage would require some toolkits and guidelines which would assist cities to conduct urban profiling and vulnerability assessments. Climate projections as suggested earlier would also require some external support.
- Local knowledge and expertise should be integrated into the process to ensure that local priorities and problems at the grass root level are addressed.
- Separate toolkits/ questionnaires/ primers should be developed for involving community in the process.

4.3.2 Sectoral impact studies

While the city starts the replication process, it should also look at conducting sectoral impact studies to understand the risks across sectors. Sectoral studies should involve a detailed spatio-temporal analysis to provide a strong basis for DPR preparation and prioritisation of required interventions.

4.3.3 City resilience strategy

- Resilience is a continuous process. Therefore it is important to identify actions in the short, medium and long term context, and also to have mainstreaming action plans for implementation of the overall CRS.
- Key adaptation projects should be identified for implementation and require preparation of DPRs for potential funding and alternative financing options should be considered. This area is not yet explored under the ACCCRN framework and needs to be developed for replication of the process in other cities.

4.4 Data

It was found during the course of the programme that the data was not available at the scales and the formats required and so departments were not equipped to provide the desired information. As a result, there were huge information gaps like that of socio-economic situations and projections, sector-specific data like that of water supply coverage, transport-related data, such as the number of registered vehicles in the city, which affected the assessments.

The proposed toolkits should also have a component on the type of data, the frequency of data and timeframe within which the essential data will be required. For example, for the climate trend analysis the climate data for at least the past 30 years is required. The city that proposes to plan for resilience would have to maintain and regularly update the required database which is multidisciplinary and housed in various departments within the city. One way to manage this data is through a centralised database management system created at the municipal corporation.

4.5 Climate projections

In the case of ICLEI, the partners utilised the 4x4 assessment report of the government of India (MoEF, 2010) to base their climate related assessments for the cities of Shimla and Bhubaneswar. While broad level climate assessment could be made using the literature available from credible sources such as the 4x4 report (MoEF, 2010), detailed climate projections over the region would be required for designing resilience strategies and adaptation projects.

This is also a need to use the regional climate models as they provide climate information at finer resolutions that can be used for policy and planning purposes. However, climate modelling is technical in nature and would require specific expertise to do so and hence this part of the assessment would depend on external support. The state government could commission detailed studies and disseminate the outcomes to the cities and maintain a repository of the climate modelling results.

4.6 Participatory component

The government of India has introduced the Community Participation Law (CPL) and made it mandatory as a reform under the JNNURM scheme. However, the culture of community participation is not popular in India as yet. The mechanism to bring in community participation and perception to planning and decision making on various issues is either very ad hoc, or non-existent. Resilience building strategies have shown very clearly that there needs to be a strong

participatory component to a resilience exercise. In one of the discussions in Guwahati, a city stakeholder opined that some of the most feasible solutions come from the community and there is merit in involving them in addressing climate change because this has a potential to affect their lives and livelihoods the most. The Gorakhpur resilience strategy is based on a strong participatory component and the implementation of the pilot project counts its success on positive public opinion.

4.7 Stakeholder engagement

Interdepartmental coordination is a prerequisite for any climate resilience exercise. As evident from the ACCCRN cities, resilience strategies move beyond the city municipal corporation's mandate. The resilience strategies are beyond administrative limits because of their inherent connection to geography, resources and their conservation, protection and management. For example, the influence area of floods, and the source of flooding in a city would be beyond the city boundaries.

Similarly many other departments which are not housed in the ULBs would need to be included in the resilience planning exercise. Climate resilience would have implications on various sectors like resource management; disaster management; environmental management and conservation, and so the purview of the task would not only go beyond that of the ULB, but would require the ULB to coordinate with the departments at the level of the state government and district government. Disaster management is one such department which is housed at the level of district collector in most of the cities in India.

Various non-government stakeholders also play an important role, for example, the role of the South Gujarat Chambers of Commerce and Industries in Surat in the overall process of resilience planning and then institutionalising the mandate within the municipal corporation cannot be undermined. In Surat, the Surat Climate Change Trust (SCCT) was also constituted which was a multi stakeholder entity to take forward the resilience agenda within the city.

The cities would therefore have to identify the relevant stakeholders and build in a process whereby regular consultations with stakeholders and inter-institutional coordination are materialised.

4.8 Capacity building

It came out very strongly during the communication with city partners that if the resilience planning is to be attempted in other cities and the cities have to lead the effort by themselves, the first step would be to build the capacities of various stakeholders extensively.

If toolkits, guidelines and training programmes are available, the cities would be well equipped to take up resilience planning and would be well aware of the steps to follow. It is recommended that toolkits may give guidance on the following:

1. Conducting risk assessments
    a. Urban profiling
    b. Vulnerability assessment
    c. Sectoral impact studies
2. Data collection and management (formats, frequency, timeframe)
3. Mechanisms for including participatory components and identifying relevant stakeholders
4. Formulation of CRS and prioritisation of adaptation projects

To bring in wider awareness and to bring in more capacity and expertise, it is also suggested that climate change should be introduced at the university level as one of the subjects for specialisation. While some of universities are already offering such courses at masters level, introducing similar courses at undergraduate level would be beneficial.

4.9 Institutionalisation

There is a strong need to institutionalise the resilience-building process at the city level. A separate cell should be constituted in the municipal corporation for this purpose. Since climate resilience would have implications on various sectors like urban development, resource management, disaster management, environmental management and conservation; the purview of the task would actually go beyond local urban bodies. Therefore, this cell should have *ex officio* representatives from relevant city level sectoral departments and state line departments or it could be integrated into the mechanism by constituting a city advisory committee. The cell could be chaired by the Divisional Commissioner, with the Municipal Commissioner as the member secretary, to ensure interdepartmental coordination, communication and engagement of various city level and state line departments. In the absence of institutionalisation and vetting of responsibilities, the agenda for resilience planning may be subsumed within the regular development priorities of a municipal body.

4.10 Implementation support

The experience from ACCCRN has proved so far that new cities would need support from the state government for the implementation of the resilience strategy. While all the ACCCRN cities engaged in the process showed utmost interest in the process, complete adoption and implementation of the same was not possible for them considering the lack of funds and also lack of a clear mandate from the state government. The cities wanted the state government's approval for implementing the resilience strategy, even for partial implementation. Therefore, policy and mandates at state and national level is needed for long term sustainability and for the complete success of this initiative. Extensive replication would only be possible when the governance systems are designed, updated and channelled towards the goal of resilient cities.

5. Conclusion

The expected outcomes of the ACCCRN process include expansion of the network to new geographies through the sharing of methods, tools and mechanisms that are developed and tested in ACCCRN cities. Therefore, the underlying aim of this paper is to understand the potential for replication of the ACCCRN methodology and processes in other cities in India, and the key characteristics of the processes which could be used for resilience planning in different urban contexts. For this purpose, the paper has reviewed and documented the experience of the seven ACCCRN cities in India.

While seven cities may not be representative enough in a country with more than 7,000 cities and towns spread across varied geographical and climatic zones, the ACCCRN experience does bring out a number of issues and questions that need to be addressed for upscaling urban climate resilience in Indian cities.

There were also some limitations to the study. One important limitation was the difference in timeframes under which these resilience planning exercises were conducted for core cities (2-2.5 years) and replication phase cities (less than 1 year). It is felt by the authors that this may have led to some inherent differences in the methodologies and affected the extent of engagements and detailing of assessments and strategies. Moreover, the observations presented in this paper are based on the experience of the stakeholders with respect to the methodology and processes that were adopted by the respective partner organisations in their city and thus may vary from city to city. The analysis of certain cities relied solely on interviews and presentations as there was no city documentation available.

It may also be noted here that this working paper brings out the critical issues for replication of the ACCCRN process and methodology, particularly keeping in view that in the future the cities would themselves take the lead in resilience planning exercises. The paper therefore, makes recommendations on how the cities could use these processes and the methodology developed under ACCCRN, as well as bringing out the need for facilitating policies and institutional arrangements.

It was quite clear from the interviews with the city partners that a strong policy and mandate at national and state level is necessary to scale up this exercise in the country and for the cities to take up resilience planning exercises. Moreover, the need and efficacy of integrating resilience planning with the urban planning process was also brought out in the discussions with the cities. Extensive replication would only be possible when the governance systems and institutional mechanisms are designed, updated and channelled towards the goal of resilient cities. This will involve capacity building as well as policy and financial support at different stages.

Besides this, capacity building, facilitation of climate projection results and data management systems have to be developed to inform decision making and subsequently develop resilience strategies. The paper also observes that toolkits and guidebooks would prove to be essential and useful means to help cities develop their resilience plans. Moreover, awareness generation at a larger scale would help to harness support and engagement of the city level stakeholders and community in the process.

Annex A
List of interviewees

a) ACCCRN partners interviewed

S.No	Name	Organisation name	Cities involved
1.	Mr Anup Karanth	TARU	Surat and Indore
2.	Mr Shashikant Chopde	ISET	Overall resilience concepts, Surat, Indore and Gorakhpur SLDs
3.	Mr Sunandan Tiwari	ICLEI	Shimla, Bhubaneswar and Mysore
4.	TERI team	TERI	Guwahati
5.	Mr Monojeet Ghoshal	GEAG	Gorakhpur
6.	Dr Verma	GEAG	Gorakhpur
7.	Dr. Bijay Kumar Singh	GEAG	Gorakhpur

b) City stakeholders interviewed

S.No	Name	Organisation name	Cities involved
1.	Mr B K Routray	Environment officer, Bhubaneswar Municipal Corporation (BMC)	Bhubaneswar
2.	Mr K S Raykar	Ex-commissioner, Mysore City Corporation (MCC)	Mysore
3.	Ms Asha Kitte Gowda	Joint Director, Town planning, MCC	Mysore
4.	Mr Chowde Gowda	Ex Joint Director, Town planning, MCC	Mysore (Telephonic interview)
5.	Mr Kamlesh Yagnik	Honorary Trustee, Surat Climate Change Trust (SCCT)	Surat
6.	Mr Chetan Shah	South Gujarat Chambers of Commerce and Industries (SGCCI)	Surat
7.	Dr Mrs. Vikas Desai	Technical Director, Urban Health and Climate Resilience Centre (UHCRC), Surat and Trustee, SCCT	Surat
8.	Mr Jatin Shah	City Engineer, Surat Municipal Corporation	Surat
9	Mr V P Kulshreshtha	Present designation- Joint Director, TCPO, Office of the Joint Director, Town and Country Planning department, District Office, Bhopal Previously – City Planner, Indore Municipal Corporation	Indore
10.	Mr Ashish Kohli,	Present Designation Deputy Director, Directorate of Education Previously – Assistant Commissioner, Shimla Municipal Corporation	Shimla
11.	Dr Omesh Bharti	Health Officer, Shimla Municipal Corporation(Nodal officer for all environment projects in Shimla)	Shimla
12.	Mr Vibhor Sood	Consultant, GIZ, Environment cell, Shimla Municipal Corporation	Shimla
13.	Mr Amarjeet Singh	Commissioner, Shimla Municipal Corporation	Shimla (Brief informal meeting)
14.	Dr Gobind Pandey	Professor and Head, Department of Civil Engineering , MMM Engineering College, Gorakhpur (Also member of the ACCRN Steering Committee)	Gorakhpur
15.	Mr C. K. Tyagi	Chief Enginee, Jal Nigam(Water Board)Gorakhpur(Also member of the ACCRN Steering Committee)	Gorakhpur

Annex B
Questionnaire for partners

Methodology		
		Remarks/guidance for responses
1	Kindly elaborate upon the methodology adopted for the following: a) Risk and vulnerability analysis b) Sector studies conducted c) Development of the resilience strategy	Please explain in terms of the quantitative component, the qualitative component and the participatory approach to the methodology. Please mark in terms of the data intensiveness of the methodology.
2	Please describe the main components of the methodology and the stages of activities.	Was there a framework developed? If an existing framework was adapted, explain the process of contextualising it.
3	Was stakeholder engagement part of the process? Who were the stakeholders involved and what was the frequency and method of these engagements?	Please also identify the most important institutions/ departments that would play a major role in resilience planning in a city context. At which stages of the resilience planning process, should each type of stakeholders be involved? (Entry point time for city leaders; policy makers; urban planners; civil society; vulnerable groups).
4	Was the methodology adapted from other work or is it a completely new methodology developed in-house?	If adapted, provide the original methodology details/ references. If new, how does the methodology align with the principles of resilience developed under t ACCCRN.
5	What were the statistical/quantitative methods used and at what stage	Provide details of the methods and data requirements.
6	Were future socio-economic projections conducted? If yes, describe the process and the timeframe.	
7	What climate models were used? Which resolution, which scenarios and what timelines in the future? Were the historical climate trends part of the analysis?	Also underline the shortcomings and challenges of using these scenarios.
8	What were the data used for: a) Modelling inputs b) Quantitative analysis c) Qualitative analysis	Please give details of the source of data, spatial and temporal scale and quality of the data. What gaps were seen and how they were tackled?

Methodology		
		Remarks/guidance for responses
9	Please elaborate on the data challenges related to the availability of data and willingness of Departments to share them and how they affected the results. How was the data managed for the analysis?	
10	Describe any changes/compromises made in adapting/developing the methodology in view of the data constraints or skill levels available at the ULBs. What components of the methodology would you like to strengthen if required data are available?	

Process		
1	What was the approach adopted to engage with the city (Shared Learning Dialogues, (SLDs))? Who were the participants of the SLDs/stakeholder consultation?	
2	Was community engagement a part of the exercise (SLD-community). If yes, then at what stage of the programme? How did the process benefit from these engagements? Were the engagements adequate? How have people's perceptions been captured within the process/the development of the resilience strategy?	Do you think engaging with community should be an integral part of the process even when the cities themselves take up the exercise? Also, is it possible to engage all sections of the community in such a process?
3	How was interdepartmental communication achieved? Was it one-to-one communication with various relevant departments or stakeholder consultation where departments also had a chance of interaction among themselves in the presence of the project team? Please convey the frequency of such interactions and the stages of the project when these were made. What was the perceived outcome of these interactions and was it successful?	Please consider whether the city should engage in interdepartmental coordination while developing their strategy?
4	Please elaborate on the total time taken by the project. Kindly also give details on time taken activity wise	Were there any delays during the process? If yes what were the reasons for the same (delays in approvals from city government, data unavailability, inter-departmental coordination, lack of cooperation from concerned officials, monsoon, holidays, etc.)
5	Who was the person at the level of the city (city level champion) who supported this project and facilitated the partners' engagement and work? Was he/she a key government functionary?	This person could be from state government/district government or could also be a group of people.

Process		
6	Was the study supported by national/state government? If yes what was the nature of the support?	Approvals, buy-ins for the potential results from the study, etc.
7	What were the main criteria for selection of the Pilot projects? How were these identified? Were the possible options vetted with stakeholders at city/state level and then shortlisted from a list?	Explain the rationale behind the decision. The pilot project or sector of intervention, was whose choice/ priority? Specify, it was a result of which step in the process? (Whether this is arising from the community or climate projections or outcome of risk and vulnerability assessment?)

City's buy-in		
1	What in your view are the perceived and apparent drivers for the city's engagement in the process? Why did they get interested in supporting your programme?	Was it about money? Did the cities see a potential funding opportunity for some of their infrastructure projects? Was it the possibility of pilot project funding by the Rockefeller foundation? Was it the larger vision of the city, aligning with state and /or national level policy/scheme? Was it a completely proactive initiative from the city itself?
2	What were the challenges experienced in engaging with the city? What steps did you take to meet the challenges? What was the level of continued the city's continued support? Are cities interested in implementation of the entire resilience strategy? What is the city's vision to take this work forward? Has there been a dialogue with the city/state on this?	Before the process and during the process.
3	Was there involvement and support from the private sector as well? If yes, then what and to what extent?	Provide details of the private sector entities that provided the support.

Opportunity for replication		
1	Do you think that the methodology and time frame adopted by you can be replicated in other cities? Is your methodology flexible enough to be modified by the cities in view of the information available to them and the capacity to analyse/ conduct such exercises?	Please consider the following criteria in answering this question: 1. Ease of methodology 2. Data intensiveness of methodology 3. Level of community /stakeholders engagement 4. Others (if any)
2	If yes for question no 1, then why do you think so? What are the potential benefits and ease for the city using your methodology?	Is it simple, robust, less data intensive, quick and dirty calculations, consultation and community participation driven?

Opportunity for replication		
3	Please point out some of the demerits of your methods when used as generalised methods by cities without any external influence and support orpartial support? (In case of partial support, please elaborate how?)	
4	What are the changes that you will propose if your methodology has to be used in other cities?	How to generalise the methodology for universal applicability
5	Do you see city to city contextualisation as an important and indispensable component to this exercise? If yes how would you propose this can be done?	
6	Do you see the feasibility of replication?	
7	Do you see the feasibility of introducing toolkits/ capacity building programmes to build capacity of the cities to take up such an exercise and plan for their climate resilience?	
8	What should the city do to start planning for climate resilience? Can you give specific courses of action/ steps that the cities could follow?	
9	With climate modelling being a very specialised field, and with the absence of any data at the central level on modelling results for cities and regions how will the cities know about climate impacts?	

Policy		
1	Please suggest your opinion on the need for a policy on climate resilience planning in India? And why?	
	In your view should such planning be made an integral part of urban planning process? If yes, what kinds of policy changes are needed to make climate resilience planning as a part of statutory city/town planning?	
2	What is the learning from your engagement with the ACCCRN process that has policy relevance?	
3	How can some of the challenges faced by you be addressed through policy changes?	Specify any existing policies where this can be introduced
4	What kind of governance instruments (regulatory, policy, institutional) have the potential to bring in action on urban climate resilience in India?	
5	What is the best platform to start/initiate climate action in urban areas?	Community, city, state, national government, or all and how?
6	How can the city government, private sector, community, urban poor come together to plan for climate resilience/climate action?	

Policy		
7	What do you see as your role (as academics, researchers, experts) in furthering the cause? What inputs can we provide for bringing in policy change?	

Finance		
1	Were there any financing mechanisms available to the cities (where you worked) for urban climate resilience planning (UCRP)?	Before and after the ACCCRN initiative
2	What kind of financing instruments would be available for implementation of the Resilience Strategy after phasing out of the ACCCRN programme?	

Annex C
Questionnaire for city stakeholders

What motivated you to get involved in this project?

Answer with respect to your experience

☐ Cities saw a potential funding opportunity for some of their infrastructure projects

☐ Matched with the larger vision of the city

☐ The city understands the need to climate proof itself

☐ Displays proactive and forward image of the city

☐ Deals with existing problems and challenges of cities

☐ Availability of funds (From RF's side) for pilot projects

☐ Technical and capacity building support/backing offered by external agents

☐ Perceived/envisioned benefits that the city may receive (funding for infrastructure projects)

What was your role?

☐ Advisory

☐ Facilitator

☐ Data provider

☐ Subject expert

☐ Other: _____

Since how long have you been engaged in the ACCCRN project?

What were the challenges experienced in engaging in the process?

☐ No policy backing or support from centre/state

☐ Inter departmental coordination and time constraints

☐ No mandate at ULB level

☐ No background/understanding of the climate change impacts on cities (or need for adaptation)

☐ No nodal agency to coordinate the activities

Was the study supported by national/state government? If yes what was the nature of the support?

☐ Yes

☐ No

Nature of support _____

If no, how would you want your state government to support this?

☐ Policy

☐ Regulation

☐ Budget allocation

☐ Other: _____

Method

According to you, how technical was the methodology adopted for the following in terms of ease of methodology: a. Risk and vulnerability analysis b. Sector studies conducted c. Development of resilience strategy

	Very easy	**Needed explanation**	**Tough**	**Cannot do on our own**	**Other**
Risk analysis	☐	☐	☐	☐	☐
Vulnerability analysis	☐	☐	☐	☐	☐
Sector studies	☐	☐	☐	☐	☐
Development of Resilience Strategy	☐	☐	☐	☐	☐
Quantitative analysis	☐	☐	☐	☐	☐

What were the challenges encountered while following the methodology?

☐ Understanding the methodology and concepts

☐ Interdepartmental coordination

☐ Other: _____

To counter them, what solutions do you suggest?

Please elaborate upon the data challenges faced by the city government departments while engaging in the process

☐ Data was readily available

☐ Data was available only for select few sectors

☐ Partners did individual assessments

☐ Other: _____

Would you like to propose any changes in the methodology in view of the data constraints or skill levels available at the ULBs?

☐ Yes

☐ No

Which components of the methodology would you like to alter or strengthen?

☐ Climate modelling/projections part

☐ Sectoral studies

☐ Participatory components

Who were the stakeholders / officials involved in the process?

☐ City engineers

☐ Urban planners

☐ ULB officials

☐ Local experts

☐ NGOs

☐ Academics, local universities

☐ Other: _____

Stakeholder engagement

What was the frequency of these engagements?

For steering committee and for sub groups (Wherever applicable)

☐ Monthly

☐ Once in three months

☐ Once in six months

☐ As per study requirement or intimation

What was your experience from the City Advisory Committee (CAC)/City Steering Committee (CSC) meetings? Give details of their functioning.

☐ Good experience (timely, useful meetings)

☐ Average experience (gaps in coordination)

☐ Bad experience (conflicts in decision-making)

How successful were the SLDs?

☐ Successful and useful

☐ Useful but did not have enough participation

If not useful, cite reasons and demerits. In which way should they have been organised?

Community engagement

Was community engagement a part of the exercise (SLD-Community)?

☐ Yes

☐ No

☐ Partially

If yes then at what stage of the programme and to what extent were they involved?

☐ Initial stages

☐ Risk analysis and vulnerability stage

☐ Sector studies stage

☐ Resilience strategy preparation stage

☐ Post the entire programme for dissemination of outcomes

How did the process benefit from these engagements?

Were these engagements adequate?

☐ Yes

☐ No

☐ Partially

If not, then why? How can this be improved?

Interdepartmental (Cross sectoral) engagement

How was interdepartmental communication achieved?

Frequency

Did the departments also have a chance of interaction within themselves in the presence of the project team?

☐ Yes

☐ No

☐ Partial

What are the challenges to sustain this cross-sectoral dialogue?

☐ People in the municipal corporation are very busy

☐ Only an external agency can do it

☐ This is not sustainable in the long run

☐ Other: _____

Outcome

Is your city interested in implementing the entire resilience strategy?

Is there a city's vision to take this work forward?

☐ Yes

☐ No

☐ Interested but need external support

☐ Interested but need a policy back-up

How will your city use the city resilience strategy and other outcomes of the ACCCRN initiative?

☐ Will adopt it partially

☐ Will adopt it completely

☐ Need more consultations

☐ Cannot go beyond pilot projects

☐ Cannot adopt in absence of state/national policy regulation

☐ Other: _____

What kind of financing instruments should be available for implementation of the Resilience Strategy after phasing out of the ACCCRN programme?

Any suggestions for the state government? What should be done to attract their attention to this crucial issue?

Replicability

In absence of external support, will your city be able to implement this methodology on its own?

☐ Yes, certainly

☐ Maybe

☐ Not sure

What support will cities need to initiate action?

☐ Capacity building

☐ Policy mandate

☐ Skilled manpower

☐ Financial support

☐ Community participation

☐ Technical expertise

☐ Other: _____

Has there been any dialogue with the state on this?

☐ Yes

☐ No

How do you think the cities should start planning for climate resilience?

This is a new sphere/subject with limited knowledge, do you think cities will be interested in entering this arena? In absence of the NMSH, how will you then take it forward?

Please locate the most important institutions/department that would play a major role in resilience planning in a city context

☐ Municipal Corporation

☐ Development Authority

☐ PHED

☐ Health

☐ PWD

☐ Jal Nigam

☐ Disaster management

☐ Revenue department

Do you see a larger role of ULBS in deciding how urban development/climate change should be addressed in the city?

Do you see the feasibility of introducing toolkits/ capacity building programmes to build capacity of the cities to take up such exercise and plan for their climate resilience?

What are your expectations from such toolkits and programs?

☐ Yes, definitely

☐ Maybe

☐ No, the cities are not prepared to take this additional responsibility

In case these activities are scaled up and replicated, will you be willing to share the knowledge generated in your city with other cities/ districts in your state (or other states)?

☐ Yes

☐ No

☐ Other: _____

Policy & Mainstreaming

In your view should resilience planning be made an integral part of urban planning process?

☐ Yes

☐ No

If yes, then what kinds of policy changes are needed to make climate resilience planning as a part of statutory city/town planning?

Specify any existing policies where this can be introduced

What is the best platform to start/initiate climate action in urban areas?

☐ Community

☐ City

☐ State

☐ National government

☐ All

What kind of governance instruments (regulatory, policy, institutional) have the potential to bring in action on urban climate resilience in India?

Annex D
Approaches to climate modelling

Gorakhpur

The trend analysis for temperature was carried out for the annual average, maximum and minimum temperatures recorded for the last four decades till 2007. The same was also analysed for the monthly average, maximum and minimum temperatures (Wajih, et al., 2010:6-9). Apart from this, the rainfall trends for number of rainy days from 1976-2010 was also analysed to understand the trend of variation in precipitation patterns. For projection of future climate , global climate models like CGCM3,CNRM, CSIRO, MIUB were used to predict the future temperatures and climate models like CGCM3, CNRM and MPI were been considered to predict uncertainty in terms of rainfall. Besides this, a climograph analysis was also attempted to understand future temperature and humidity scenarios.

It may be noted that coarse resolution (110 Kms-300 Kms) results have been used here for the risk assessments (Stapleton; 2009:2). The projection was made for the A2 scenario, which is a CO2 intensive scenario using global climate models. The future model stimulation time period was 2046-2065 (2050s). For temperature analysis, the assessment was limited to the seasonal assessment and for the rainfall analysis, the assessment was carried out for JAS (July August September) and MAMJ (March April May June) and not JJAS (June July August September) which are accepted as Indian summer monsoon months by the IMD standards.

Guwahati

For climate projections, daily outputs from the PRECIS model were used at 25 km x 25 km resolution. Projections for A1B scenario for the time slice 1961-1990 referred to as ‘baseline‘, and 2021-2050 referred to as ‘2030s‘ were utilised to understand the likely changes in the key climate parameters including temperature (minimum, maximum and mean) and percentage change in precipitation from the baseline. The analysis was carried out using TERI’s in-house supercomputing facility.

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