

# Climate Change and Urbanisation:

## Building Resilience in the Urban Water Sector

– A Case Study of Indore, India





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– A Case Study of Indore, India

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**Eva Saroch, Meena Palaniappan, Dilip Singh, Laura Seraydarian**

## EXECUTIVE SUMMARY

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This is the story of Indore, a city in the center of India, but it is also the story of thousands of cities in the developing world. These cities face rising pressures on institutions and infrastructure due to population growth and urbanisation, and are now beginning to experience the added impacts of climate change.

This is also a story about water in urban areas: where it comes from, where it goes to and who uses it along the way. It is the story of the hundreds of thousands of people globally who wake up wondering where they will get water from that day, how long they will wait for it, how much they will pay for it, what the quality of that water will be and whether that water will be there tomorrow.

Unique to developing country cities is the predominance of informal actors in the water sector. The formal, or government sector, which often exclusively manages water access and distribution in developed country cities, is only one among many players in the water sector in developing country cities. In these cities, thousands of people directly access the water source itself from self-supply through private boreholes. There is also a private water market, where water vendors supply water to meet demand through water tankers and through treated drinking water, where the public sector fails. These multiple water managers are at the center of this story.

In this environment, with already existing pressures on water availability and use, the impacts of climate change on water will be strongly felt by all these water managers. Climate change is already having impacts on temperature and the hydrologic cycle, changing when, where, how much and how often water falls. This complicates planning for water supply and demand and increases water insecurity. For those, particularly the urban poor, who barely meet their water-related needs, climate change is likely to increase already high levels of water insecurity.

This report is the outcome of research in Indore carried out by the Institute for Social and Environmental Transition (ISET) and the Pacific Institute, supported by TARU, over a period of three years. The purpose of this research was to understand the complex dynamics of the water sector, to investigate the needs of urban water managers and ultimately to suggest strategies and tools that can help these managers meet ever growing needs in the face of climate change and increasing water insecurity.

Over three years, we conducted literature reviews, downscaled climate models for Indore, performed a vulnerability analysis and conducted intensive stakeholder engagement through one-on-one discussions, focus group discussions (with the formal sector, private providers and households) and Shared Learning Dialogues (where all sectors were brought together). We also conducted a survey of households and private water vendors to understand these two sectors in greater depth. The project team then brought together the research findings to suggest a set of resilience strategies and process tools that could assist managers in better managing and planning future water supply.

The four-step resilience planning process that we conducted in Indore can serve as a model for other communities integrating climate impacts into planning. The steps are (1) scoping to identify emerging problems; (2) synthesis and localised analysis of climate information; (3) vulnerability assessment focusing on the systems, the likely stresses on those systems due to climate and other change processes and the highly differentiated groups that depend on these systems; and (4) identification of potential strategies for building resilience.

## Climate Change Vulnerability

Climate change poses unique threats to the Indore water supply system. Downscaled climate information suggests an increase in surface temperature of 2 to 4 °C, and a range of rainfall amounts of -4% to +8% by 2046-2065. The uncertain and wide range of possible futures complicates resilience planning efforts.

In the absence of useful high-resolution climate change projections, we chose to focus on the potentially increasing variability in water availability. Because water resource variability is already an issue that is perceptible to stakeholders, we focused on water scarcity and variability and current approaches to addressing them as indicators of what is likely to be effective in addressing increased future climate variability.

Our analysis of Indore's formal and informal water sectors suggests that resource variability is exacerbated via climate-sensitive vulnerabilities in Indore's formal water supply system.

## Indore's Water Supply and Use

Indore is the largest and fastest growing city in the central Indian state of Madhya Pradesh (3.27 million population in 2010). Indore has grown into an industrial, educational and medical center, housing automobile, textile and information technology businesses (Government of India 2011). The city is managed by the Indore Municipal Corporation (IMC) and some surrounding regions are administered by the Indore Development Authority (IDA). Because of the inadequate and unreliable water supply situation, residents supplement their needs via household and community self supply, installing in-house storage, as well as supply from water tankers and packaged water providers. However, the ability to make such arrangements varies, and this has led to significant differences in water use between lower income and higher income communities. Our survey shows use of water ranges from 178 litres per day (LPD) per household in low-income Goma ki Phel to a high of 320 LPD in the upper income Sneh Nagar. Some low-income communities such as Nayapura were using a mere 31 litres per person per day

(LPCD). This suggests tremendous inequities in Indore's existing water supply conditions and also points to the absence of incentives for water conservation in areas that are well served.

Beyond this, many vulnerabilities were identified within Indore's water supply from single-source dependency and high energy usage to ageing infrastructure and insufficient and inequitable access of water in the city. These are discussed below for the formal water supply sector, the informal/private sector and households. Some of the governance issues that emerge are also briefly summarised.

## Formal Sector

The IMC provides water supply to the population living within the city, and is charged with four functions: capture the natural resource, treat the water to improve its quality, transport this resource to the city and deliver water to users through pipes. The IMC, however, has almost no authority to manage the local surface or groundwater resource base. The majority of the water supplied to Indore city is from surface water sources: the Narmada River, the Yeshwant Sagar Dam and the Bilawali water storage tank. These sources altogether provide about 170 to 200 million litres of water per day (MLD). With an estimated distribution loss of 25%, the current available water sources only yield 75-85 litres per capita per day (LPCD) even in a normal rainfall year.

Water is distributed to the residents of Indore through piped connections, standposts and municipal tankers. However, currently the IMC only serves 54% of the city population (Mehta and Associates 2006). About 16% of residents in Indore live in informal settlements that lack adequate water supply and receive less than the minimum 40 litres per capita per day specified by the government of India. Piped water supply in Indore has two problems. First, supply is insufficient and highly intermittent, typically available for less than an hour each day. Second, infrastructure is inadequate and piped supply does not reach much of the population. Municipal water supply in Indore is largely single-source dependent (75-85% from the Narmada River) and delivery is highly energy-intensive (leading to very high costs for water).

## **Informal/Private Sector**

The intermittent and unreliable supply of water from the IMC has led to the birth and the expansion of a private water market in Indore that sources its water primarily from privately-owned boreholes that directly tap groundwater resources in and around the city. These private water purveyors draw on the same groundwater resource that is also used by the IMC to provide water. These private providers are driven by profit motives and, while the resulting price signals to consumers contribute to inequitable water distribution use patterns, they also provide strong incentives for efficient water use. In addition there are thousands of households that use individual borewells to supplement their water supply, which also contributes to socially differentiated patterns of access to water. This reflects the current legal situation, as the rights to extract and use groundwater are attached to land under Indian law. This legal structure leaves a large poor population that has no land tenure rights bereft of groundwater access.

## **Household Sector**

Through a detailed household survey in eight diverse communities in Indore, we documented water supply and water use among households, the coping actions adopted by residents, the current and future information needs of the community as they relate to the coping actions, existing complaint and communication mechanisms and what residents identified as necessary improvements to their water services. Households take three types of action in response to unreliability of supplies from the municipal agency: Access – making arrangements to obtain supplies independent of the water supply agency; Voice – complaining to make the IMC water supply more reliable; and Manage – increase their ability to store and utilise available supplies as efficiently as possible.

## **Governance Issues in Indore Water Sector**

As the highly differentiated patterns of water supply access and use within the public system indicate, inequities are deeply entrenched. Overall, the functioning of both the municipal utility and private water markets raises questions of equity and equitable distribution of resources, especially given the scarcity of surface and

groundwater in Indore. The public utility has major governance problems that go well beyond cost recovery and finance and that directly contribute to this inequitable distribution of water. These governance issues are endemic throughout the public sector and are almost certainly as culpable as the functioning of private water markets in contributing to inequity and poor climate resilience. While these issues are noted, it is beyond the scope of this report to address fundamental issues of governance in the public as well as the private system and the lack of a comprehensive and equitable framework for managing the resources. Addressing this would require fundamental changes in legal structures (such as the disaggregation of groundwater rights to land ownership) and other institutions that are beyond the capacity of cities to undertake.

## **A Resilience Strategy for Indore**

The objective of this study was to identify a resilience strategy for Indore that could make Indore's water supply more sustainable and resilient in the face of urbanisation and climate change. Emerging from this comprehensive look at Indore is a set of core vulnerabilities. Based on the seven vulnerabilities identified through our process, the Project Team collated information from the Shared Learning Process in Indore and best practices in the urban water sector to identify resilience interventions. Together, these vulnerabilities and resilience interventions represent the first step in a resilience strategy for Indore's urban water sector and the first step in an iterative and ongoing Shared Learning Process to continually identify needs and vulnerabilities, evaluate previous efforts and identify and implement interventions that will improve the sustainability, equity and resilience of the Indore water sector. These vulnerabilities and interventions are shown in table 1.

What is unique about the water sector in developing country cities is the number of water managers that participate directly in sourcing and supplying water. The resilience interventions we identify and detail in this report are reflected through the prism of this complex water scenario, leading to approaches that can be useful for water managers in diverse contexts. Instead of providing tools for a centralised water utility to plan for and manage the impacts of climate change, we outline an



**Table 1. Vulnerabilities and interventions in Indore water sector**

	<b>Core Vulnerabilities</b>	<b>Interventions to Improve Resilience</b>
I	Demand-supply gap in water and dependence on a single distant surface water source	<ul style="list-style-type: none"> <li>• Diversifying water supply sources at the household and community scales</li> <li>• At the city scale: cleaning existing water bodies, sustainably managing groundwater resources (conjunctive use)</li> <li>• Increasing storage capacity</li> <li>• Water conservation and efficiency (greywater reuse, water-efficient fittings, reducing system water losses, etc.)</li> </ul>
II	Lack of access to water by the poor	<ul style="list-style-type: none"> <li>• Implementing credit mechanisms and strengthening local communities to help them demand better services and equitable cost structures</li> </ul>
III	Poor management of water utility: finances, infrastructure, complaints	<ul style="list-style-type: none"> <li>• Infrastructure improvements and leak detection programmes</li> <li>• Metering and volumetric pricing for wealthier consumers</li> <li>• Improved complaint redressal system</li> </ul>
IV	Lack of groundwater management	<ul style="list-style-type: none"> <li>• Increase groundwater recharge through rainwater harvesting, dug wells and artificial recharge</li> <li>• Monitor groundwater levels in and around the city</li> </ul>
V	Lack of water quality monitoring and regulation	<ul style="list-style-type: none"> <li>• Water quality monitoring at household and community level</li> </ul>
VI	Lack of information and understanding of climate change impacts	<ul style="list-style-type: none"> <li>• Sharing of climate information and data with water managers to build capacity of city water managers to understand and incorporate climate information in urban planning and development processes</li> </ul>
VII	Lack of networking and information flow between different water managers	<ul style="list-style-type: none"> <li>• Development of a Citizens' Water Forum</li> <li>• Water tanker registration</li> <li>• Education of formal water sector employees</li> </ul>

approach the variety of water managers in developing country cities could use to meet the demands of their shared water management future through communication, information exchange and transparency.

As documented in this report, processes for shared learning represent an overarching tool that can facilitate identification, refinement and implementation of many of the above strategies. The Shared Learning Process outlined in this report involves an iterative multi-stakeholder engagement process that would be suitable in most situations that need consensus-building and participation from all sections of society. This tool needs to be supplemented by other decision support techniques to improve communication, and generate and use information to build capacity.

## **Conclusion**

Climate change and rapid urbanisation are taxing the ability of urban water systems to meet the water needs of populations. This presents both a threat and an opportunity. Through three years of detailed engagement in one city in India, we have arrived at a set of key resilience strategies for water managers in developing country cities to cope with water insecurity as a result of climate change. Through these studies it became clear that the urban poor are the most vulnerable to climate change impacts and water supply variations, and have the least resources to cope. Giving all water managers the necessary tools to manage in a new water future will require efforts at national, state and local levels. Policies and tools are needed to diversify water supply, promote water storage at all levels, promote effective water management policies, implement equitable water rates, improve water quality, reduce energy dependence and improve connections among all stakeholders in the sector. Climate change adaptation presents another opportunity to implement a shared vision for a more sustainable and equitable water system.

This report contains seven chapters. Chapter 1 and 2 provide an introduction to the study, processes, approach and methodology used in the study, respectively. The resilience planning process called the Shared Learning Process used in this study is also described in detail in Chapter 2. Chapter 3 provides information about

Indore and its water supply situation, including a brief description of the climate forecast in and around Indore. The three water managers in Indore – Formal sector, Household sector and Private sector – are discussed in detail in the next three chapters: 4, 5 and 6, respectively. The results of the stakeholder consultations, vulnerability analyses and surveys for each of these water managers are also provided in these chapters. Finally, in Chapter 7 we discuss specific vulnerabilities within the water supply system in Indore city, the resilience interventions to address these vulnerabilities and tools to support overall resilience.





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