



INDIA

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# Harnessing Nature's Power for Urban Water Security





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# India Urban Water Blueprint

The Nature  
Conservancy 

The Nature Conservancy conducted an analysis of 53 Indian cities that highlighted the broad potential for increasing urban water security through the protection of India's urban water sources (catchments).

These cities represent more than 100 million urban residents and some INR 20 Lakh Crores (USD 300 billion) in annual economic activity.

The analysis highlights the importance of source catchments that serve as critical natural infrastructure to collect, filter and deliver water to these cities; and the threats faced by these catchments.

Of the 53 cities, 27 face high levels of sediment or nutrient pollution, 8 may face severe chronic water scarcity, and 24 could face seasonal depletion.

The analysis suggests that investments in India's natural infrastructure is needed and can be cost competitive: 15 cities could fully offset catchment conservation by savings seen in decreased water treatment costs due to higher quality intake water.

Even greater potential could be realized if the economic value of other benefits of natural infrastructure were included such as healthy soils, biodiversity, climate change mitigation and adaptation, increased tourism, and improved agricultural productivity and other enhanced livelihoods.

Through a strong partnership between various institutions/organizations, there is a potential to develop a strong source catchment program in India that supports rural development and helps government with its national schemes while providing water security to Indian cities.



# Indian Urban Centers—Engines of Growth

India is emerging as an economic superpower, with urban centers playing a greater role in a traditionally agriculture-based economy. It is expected that 50 percent of India's population will live in urban centers by 2050—that is 400 million new urban dwellers.<sup>1</sup>

By 2030, urban centers are expected to produce 70 to 75 percent of India's GDP, generate 70 percent of net new jobs, and drive a near fourfold increase in per capita income across the country.<sup>2,3</sup> Meanwhile, agriculture will continue to be critical for rural development and the country's food security. Water, which is pivotal to support this growth and development, will need to be managed better to meet both the urban and agricultural demands. Developing urban centers, along with rural areas, are critical for the country's progress and wellbeing and for India to meet its commitments to the Sustainable Development Goals (SDGs).

## The Water Challenge Ahead for Indian Urban Centers

Providing water to urban centers remains a challenge, with no medium or large-sized Indian water utility supplying round-the-clock water.<sup>4</sup> More than a third of urban households do not have access to water from treated sources,<sup>5</sup> and more than half of the urban households have implemented an additional step of water treatment before in-home use.<sup>6</sup> Further, about half of the water is lost due to inefficient distribution systems,<sup>7</sup> and only about a third of total sewage generated is treated.<sup>8</sup> Limited water supply and considerable distribution and monitoring costs are some of the reasons for the lack of provision of 24/7 water supply in the urban sector as envisioned under Jawaharlal Nehru National Urban Renewal Mission (JNNURM). As urban centers grow and agriculture intensifies, these challenges will be exacerbated due to increased competition for water and the negative impact of agricultural activities on water quality. The key water issues in India relate to quantity, quality and governance.

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### QUANTITY

With 16 percent of the world's population, India only has four percent of global fresh water. This is further exacerbated by the fact that half of India's annual precipitation is received in about 15 days.<sup>9</sup> The demand for water is projected to increase from 710 billion cubic meters (BCM) in 2010 to 1180 BCM by 2050.<sup>10</sup> Demand for domestic and industrial water is expected to increase two-and-a-half times. In addition, unregulated groundwater abstraction is leading to a decline in water tables and the problem gets even worse due to the absence of strict water aquifer recharge mechanism in the country.

### QUALITY

Nutrient runoff from agriculture lands, domestic and industrial waste, and upstream soil erosion are significant water quality issues that impact urban centers. Low-quality water creates a need for large water-treatment facilities and increases operation and management (O&M) costs for these facilities, as the water requires more intensive treatment. Currently, municipalities in India spend about INR 330 per capita annually for treating water.<sup>7</sup>

### GOVERNANCE

Urban local bodies responsible for managing water, sewage and sanitation face challenges due to highly inefficient distribution systems, large inequalities in access to water in urban centers, and limited individual water connections in urban households. Currently, many local bodies lack the resources, capability and capacity to meet these challenges.<sup>11</sup>

# Natural Systems to Meet the Challenges

Traditional water management approaches rely heavily on built (or engineered) infrastructure—such as dams, canals, pipes and treatment plants.<sup>12</sup> Natural ecosystems such as forests, wetlands, lakes, and ponds (collectively known as “natural infrastructure”) can affect the timing and condition of water flows, performing some of the same functions as built infrastructure.<sup>13,14</sup> Natural infrastructure can complement built infrastructure for an integrated, more robust and sustainable approach to water management. An analysis by The Nature Conservancy (TNC) highlights the broad potential for increasing urban water security through the protection of India’s urban water sources (catchments) by focusing on source catchments, which are one component of the natural infrastructure.

## Urban Source Catchments as Vital Natural Infrastructure

Source catchments is the land that surrounds the rivers and lakes where water runoff is captured for water supply. For many cities, the health of this land is critical for water security. In healthy catchments, forests, grasslands and well-managed agricultural areas help ensure the availability of clean and sufficient water for cities and other water users.<sup>14</sup> Similar to engineered infrastructure, these ecosystems function as a type of natural infrastructure with multiple benefits for people and nature (**Table 1**).

In India, many cities are dependent upon urban source catchments.<sup>16</sup> Information collected previously on water sources for 71 cities in India shows that 53 cities get more than half of their water supply from surface sources such as lakes, reservoirs and rivers (**Figure 1**).<sup>12,16</sup> These cities alone represent more than 100 million urban residents and some INR 20 Lakh Crores (USD 300 billion) in annual economic activity.<sup>12</sup> Their source catchments span an immense area—129 different catchments across more than 1.6 million sq. km (nearly half of India’s total land area). Besides collecting, filtering and storing water runoff, the condition of landscapes also impacts downstream water infrastructure.

**TABLE 1**

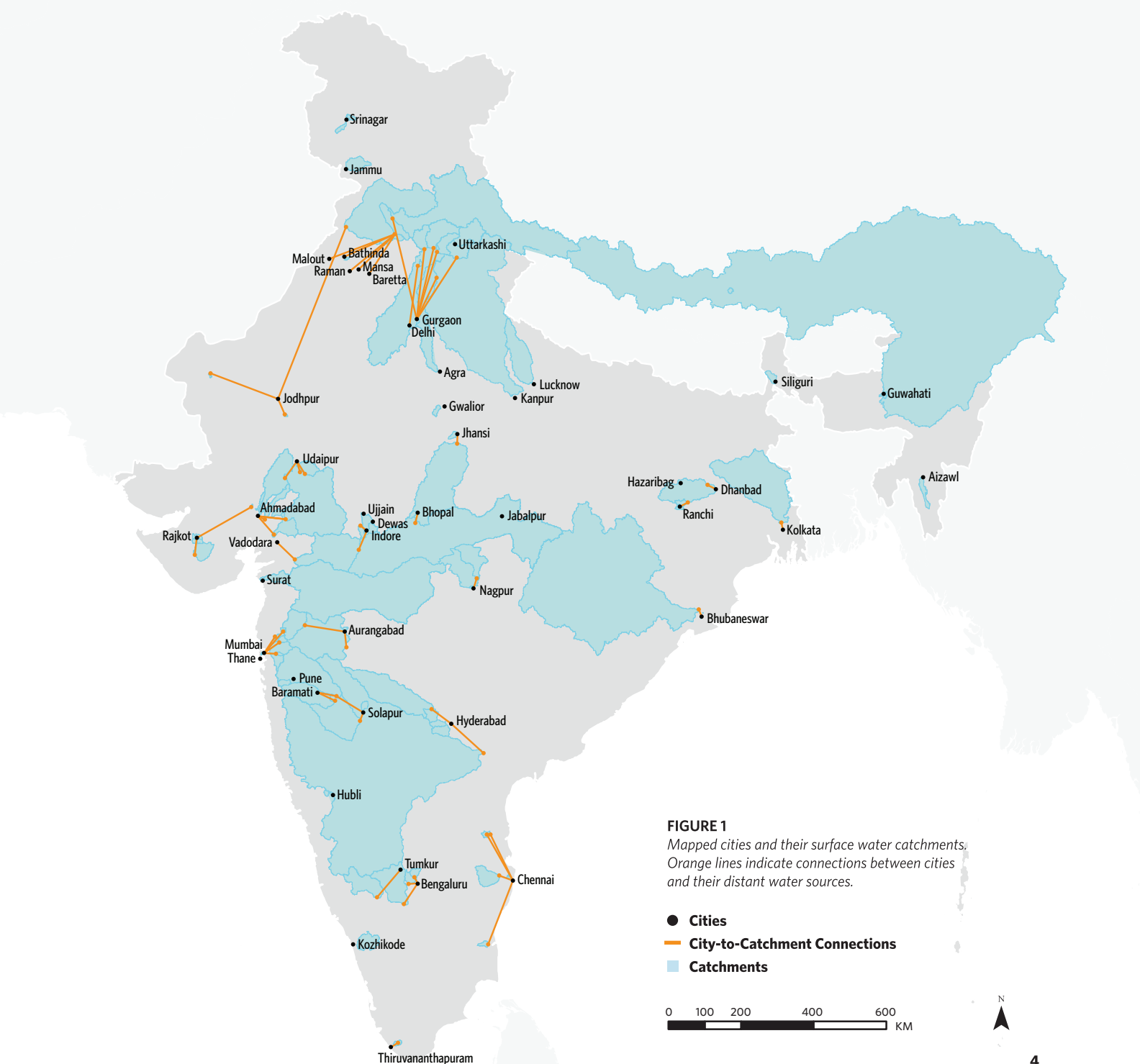
*Examples of water-related benefits provided by healthy landscapes within catchments. Adapted from Alliances for Green Infrastructure: State of Watershed Investment 2016.<sup>15</sup>*

<b>Water for consumptive and non-consumptive human use</b>	Healthy natural systems help ensure clean, reliable water for drinking, agriculture, hydropower generation, navigation and other uses.
<b>Aquatic productivity</b>	Healthy aquatic habitats and the species therein are important sources of food and medicine. Water quality in coastal fisheries can be strongly affected by condition of upstream catchments.
<b>Flow regulation and storm/flood buffering</b>	Healthy forests, wetlands, grasslands and mangroves act as natural “sponges” that absorb water – recharging groundwater supplies, reducing flood risk, and/or maintaining dry season flows.
<b>Filtration of nutrients and contaminants</b>	Ecosystems, including forests and wetlands, filter pollutants, improving water quality by trapping sediments and pollutants before they enter surface waters.
<b>Erosion control and soil fertility</b>	Healthy forests and grasslands help stabilize soils, preventing erosion and landslides. Natural areas also host critical nutrient cycling, maintaining soil health and productivity.





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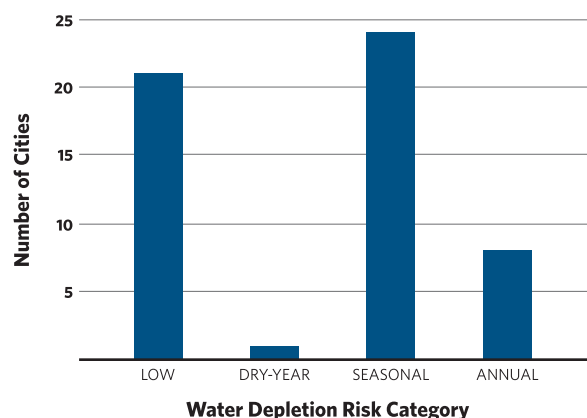
## Threats to India's Source Catchments

Where cities depend significantly on surface water, their water security is closely connected to land management within source catchments as these catchments collect, filter and deliver this water for them. Human-influenced landscapes—agricultural land, grazing land and urban areas—account for more than 80 percent of total land area in India.<sup>12</sup> Within the source catchments assessed, cropland accounts for 58 percent of land area. For these cities, it is imperative to manage the catchments that serve as critical natural infrastructure.

TNC has developed an approach for estimating the impact of land-use activities on sediment and nutrient (nitrogen and phosphorous) pollution.<sup>12</sup> Our analysis found that of the 53 cities primarily dependent on surface sources in India, 27 face high levels of sediment or nutrient pollution—impacting the water security of more than 57 million people living in these cities (**Figure 2**). Water pollution for these cities could be further exacerbated by annual and seasonal shortages of water flows. In addition, of the 53 cities, eight cities may face severe chronic scarcity while another 24 cities could face seasonal depletion<sup>a</sup> (**Figure 3**).<sup>12, 17</sup> For these water-stressed cities, the importance of protecting source catchments is even more pronounced. Future land use and climate change could further aggravate impacts, increasing threats to urban water security.

**FIGURE 3**

*Modeled annual, seasonal, and dry-year water depletion for urban source catchments. Depletion is defined as the ratio of consumptive use to water availability.*



<sup>a</sup> As estimated from the global hydrological model WaterGAP 3. Basins are annually depleted when average annual depletion is 75 percent or greater, seasonally depleted when monthly depletion exceeds 75 percent for one or more months per year on average, and dry-year depleted when the occurrence of monthly depletion is greater than 75 percent for at least 10 percent of years within the model period.





# Implementing Source Catchment Management in India

## Protecting and Restoring Urban Source Water Catchments

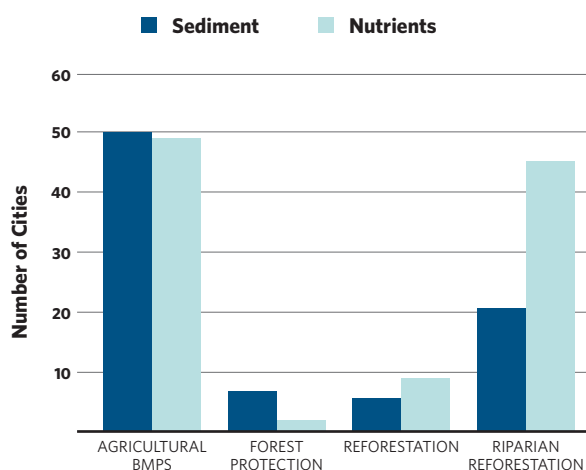
Beyond understanding risks for urban water security due to catchment degradation, it is vital to assess the potential for mitigating these impacts. TNC developed models to assess the potential for conservation activities to reduce sediment or nutrient pollution in catchments, including: forest protection, grassland reforestation, riparian buffers, and agricultural best management practices (BMPs). For 50 cities (of 53 primarily surface-water dependent cities), implementing agricultural BMPs could achieve at least moderate reductions<sup>b</sup> in sediment and/or nutrient (phosphorus) pollution. Implementation of riparian buffers—protecting and restoring river corridors—could also reduce land-based sources of pollution for 45 cities (**Figure 4**). Altogether, our results suggest that catchment protection has broad applicability for addressing elements of water security for India's cities.

These results further suggest that such investments in India's natural infrastructure can also be cost competitive. For example, water treatment operations and maintenance (O&M) cost savings can be realized through reduced material and energy inputs due to higher quality intake water. Out of 53 cities, one in four has the potential to generate a positive return on investment (**Figure 5**). In other words, for 15 cities, the costs of catchment protection could be fully offset by water treatment O&M savings alone. An additional 23 cities could potentially offset a significant proportion of conservation costs (at least 25 percent). Even greater potential could be realized if the economic value of other benefits of natural infrastructure were included such as healthy soils, biodiversity, climate change mitigation and adaptation, increased tourism, and improved agricultural productivity and other enhanced livelihoods.

*For 15 out of 53 cities, the costs of catchment protection could be fully offset by water treatment O&M savings alone.*

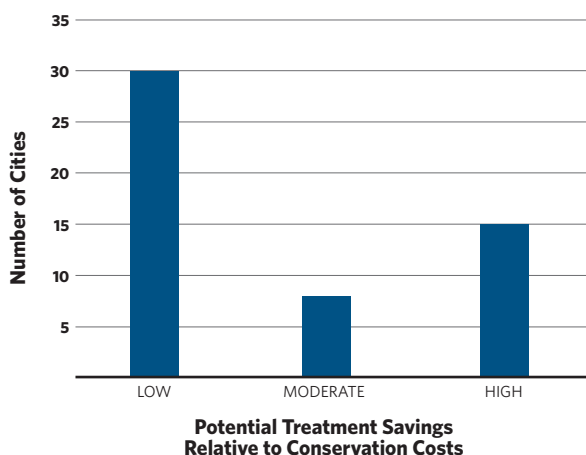
**FIGURE 4**

Scope of potential for modeled conservation activities to achieve a 10 percent reduction in sediment or nutrients (phosphorus).



**FIGURE 5**

ROI represents estimated cost savings from avoided water treatment O&M relative to estimated source water protection costs to reach a 10% reduction in sediment or nutrients. ROI categories correspond to values greater than 1 (high), between 0.25 and 1 (moderate) and less than 0.1 (low). These estimates are approximate and represent just one potential benefit from catchment protection.



<sup>b</sup> Defined as a 10 percent reduction in pollution.

<sup>c</sup> Potential is based on area of conservation action needed to get a 10 percent reduction.

High potential (< 1,000 hectares), Medium potential (1,000 hectares - 10,000 hectares), Low potential (> 10,000 hectares)



# Leveraging Benefits for Urban and Rural Development

The value of source catchment protection extends well beyond urban water security.<sup>14</sup> Investments in source catchment protection support multiple benefits, including climate change mitigation and adaptation through carbon sequestration and gas regulation, biodiversity protection, landscape values, flood control, soil erosion, agricultural productivity, and improved livelihoods and human health. Source catchments present opportunities to support multiple development priorities for India.

## Hand-in-hand with Rural Development

Investments in source catchments can complement existing GoI policies and programs to support both urban and rural development. India is a world leader in watershed development with at least 18 various watershed programs, policies and guidelines for rural development initiated by GoI since the 1970s.<sup>18</sup> Three central level ministries have been involved with India's watershed development program: Ministry of Rural Development, Ministry of Agriculture, and Ministry of Environment, Forest and Climate Change. An integrated approach to address water issues for urban centers will need to include strategies related to agriculture and rural development.

## Supporting Government of India's National Schemes

Source catchment management has the potential to strengthen and accelerate investments in support of multiple national goals and programs.

### *The National Mission for Green India*

One of the eight Missions outlined under the National Action Plan on Climate Change of India which has an integrated cross-sectoral approach aims at protecting, restoring and enhancing India's diminishing forest cover and responding to climate change by a combination of adaptation and mitigation measures. It envisages a holistic view of greening and focuses on multiple ecosystem services, including water provisioning.

### *Swachh Bharat Urban Mission*

By improving water supply to the urban sector, source catchment management will help meet water requirements for the new toilets required under this scheme.

### *Smart Cities Initiative*

Reliable access to water in the urban sector helps provide inclusive and a sustainable growth environment to cities as is required for smart cities.

### *Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), 2005*

The complementarity of work between this scheme and source catchment management will provide mutual benefit.

### *Sustainable Development Goals*

Source catchment management will also help India with meeting some of its SDGs targets by providing water security to urban dwellers and making watersheds more resilient.

## Path Forward for Water-Secure Cities

This initial analysis shows broad opportunity to catalyze source catchment management. Leveraging this opportunity will necessitate commitment from a broad coalition of partners and stakeholders: government organizations, academic institutions and agriculture universities, private sector, and civil society.

Strong catchment governance will require continued support from local, state and national government to create and reinforce needed policy conditions.

Catchment investment will demand the mobilization of sustainable funding streams, bringing together public and private financing from urban water users and other beneficiaries.

Effective implementation of catchment protection activities will depend upon science-driven approaches to smarter land management.

Bringing together diverse stakeholders for collective action will create benefits both upstream and down, for both people and nature.

Through strong partnerships across sectors, The Nature Conservancy in India plans to support each of these pathways. Building from its global expertise in conservation, the Conservancy plans to work collaboratively in developing nature-based solutions that address water security for India's cities and support the broader development goals of India.





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# Success Stories from Around the Globe

Cities and communities around the world have already demonstrated the potential of investments to protect source catchments. Working with partners, TNC has launched 29 catchment protection projects across 11 countries and three continents. Globally, there are more than 400 watershed investment programs, spanning 62 countries and accounting for INR 1,62,360 Crores (USD 24.6 billion).<sup>15</sup> Some of the examples are:

## Nairobi, Kenya

### ***Connecting urban water security, renewable energy and rural livelihoods***

Seeks to reduce sediment loadings while promoting sustainable food production and increasing household incomes in farming communities while improving water quality for Nairobi. A INR 66 Crores (USD 10 million) investment in Water Fund-led conservation interventions is likely to return INR 142 Crores (USD 21.5 million) in economic benefits over a 30-year timeframe.<sup>14,20</sup>

## Quito, Ecuador

### ***Bringing together public, private and NGO actors for catchment protection***

Brought together upstream and downstream stakeholders for shared management of investments in land protection and restoration for improved water security for Quito.<sup>14</sup>

## San Antonio, United States

### ***Protecting aquifer recharge areas for people and nature***

Local governments invest more than INR 3,300 Crores (USD 500 million) to protect more than 48,562 hectares (21 percent of the recharge zone) above the Edwards Aquifer, which supplies water to San Antonio.<sup>14</sup>

## New York City, United States

### ***Avoiding high treatment costs through land management***

Investments in land protection and restoration have enabled the city to avoid far greater expenses that would have been needed to construct additional treatment plants.<sup>12</sup>

## Beijing, China

### ***Supporting agricultural productivity and water security***

Shifted catchment farm practices away from intensive rice production towards corn cultivation to reduce pollution, decrease water use and support greater agricultural productivity—thus helping farmers and the city of Beijing.<sup>12, 21</sup>

## Bhopal, India

### ***Upstream land management for improved water for the city***

Build capacities of upstream agriculture landowners to encourage them to use better resource management activities to enhance quantity and quality of water for the city of Bhopal.<sup>19</sup>





## The Nature Conservancy (TNC)

Established in 1951, The Nature Conservancy is the largest conservation nonprofit in the world that works to protect ecologically important lands and waters for nature and people. The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We are a science-based organization that partners with governments, businesses and other NGOs to find solutions to the greatest challenges for nature and people. With 3,700 staff members, including 600 scientists, we are at work in nearly 70 countries (including China, Indonesia, and Brazil) on six continents. We address threats to nature and people involving climate change, oceans, fresh water, lands and cities. We are among the few organizations that pursue a shared nature-people agenda and have demonstrated across different economies that conservation and development can be pursued in tandem.

## Indian Institute of Forest Management (IIFM)

Established in 1982, the Indian Institute of Forest Management is a sectoral management institute, which constantly endeavours to evolve knowledge useful for the managers in the area of Forest, Environment and Natural Resources Management and allied sectors. It disseminates such knowledge in ways that promote its application by individuals and organizations. The mandate of IIFM is appropriately reflected in its mission statement, "to Provide Leadership in Professional Forestry Management Aimed at Environmental Conservation and Sustainable Development of Ecosystems."

Centre for Ecological Services Management (CESM) is a Centre of Excellence established in 2006 at Indian Institute of Forest Management with a mission to conduct action and policy research for ecosystem services management.

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## References

- <sup>1</sup> UN (United Nations). World Urbanization Prospects 2014: Highlights. (United Nations Publications, 2014).
- <sup>2</sup> Sankhe, S., Vittal, I., Dobbs, R., Mohan, A. & Gulati, A. India's urban awakening: Building inclusive cities sustaining economic growth. McKinsey Glob. Inst. (2010).
- <sup>3</sup> Bajoria, R. & Sanyal, S. Emerging Markets Research - Asia Themes: India, Assembling the building blocks. Barclays Bank (2015).
- <sup>4</sup> McKenzie, D. & Ray, I. Urban water supply in India: status, reform options and possible lessons. Water Policy 11, 442 (2009).
- <sup>5</sup> India, G. of. 2011 Census Data. (Ministry of Home Affairs, Office of the Registrar General and Census Commissioner, 2011).
- <sup>6</sup> NSSO. Drinking water, sanitation, hygiene and housing condition in India. Natl. Sample Surv. Off. Minist. Stat. Program. Implementation, Govt. India (2014).
- <sup>7</sup> Commission, P. Report of the Working Group on Urban and Industrial Water Supply and Sanitation for the Twelfth Five-Year-Plan (2012-2017). (The Planning Commission, 2011).
- <sup>8</sup> CPCB. Inventorization of sewage treatment plants. (Central Pollution Control Board, 2015).
- <sup>9</sup> Kumar, S.V., Bharat, G., 2014. Perspectives on a water resource policy for India. The Energy and Resources Institute, New Delhi.
- <sup>10</sup> CWC. Water and Related Statistics. Water Plan. Proj. Wing, Cent. Water Comm. (2013).
- <sup>11</sup> Shah, M. Urban Water Systems in India: A Way Forward. Indian Counc. Res. Int. Econ. Relations (2016).
- <sup>12</sup> McDonald, R. I. & Shemie, D. Urban water blueprint: mapping conservation solutions to the global water challenge. Washington, DC Nat. Conserv. (2014).
- <sup>13</sup> Postel, S. L. & Thompson, B. H. Watershed protection: Capturing the benefits of nature's water supply services. in 29, 98-108 (Wiley Online Library, 2005).
- <sup>14</sup> Abell, R. et al. Beyond the Source: The environmental, economic and community benefits of source water protection. (2017).
- <sup>15</sup> Bennett, G. & Ruef, F. Alliances for Green Infrastructure: State of Watershed Investment 2016. (2016).
- <sup>16</sup> Narain, S., Pandey, P., Banerjee, S. & Chaudhuri, J. Excreta Matters: How urban India is soaking up water, polluting rivers and drowning in its own waste. (Centre for Science and Environment, 2012).
- <sup>17</sup> Brauman, K. A., Richter, B. D., Postel, S., Malsy, M. & Flörke, M. Water depletion: An improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments. Elem. Sci. Anthr. 4, 83 (2016).
- <sup>18</sup> Gray, E. and Srinidhi, A. Watershed Development in India: Economic Valuation and Adaptation Considerations. World Resour. Inst. (2013).
- <sup>19</sup> Agarwal, C. & Mitra, K. Fair deals for watershed services in India. Int. Inst. Environ. Dev. (2007).
- <sup>20</sup> The Nature Conservancy. Upper Tana-Nairobi Water Fund Business Case. (2015).
- <sup>21</sup> The Nature Conservancy. China's Urban Water Blueprint. (2016).