1

SECTION

Introduction

The art and science of catching water where it falls is ancient wisdom, but one which is dying. Traditionally, most Indian cities had developed an intricate system of harvesting rainwater through tanks and lakes. Urban water bodies served to soak up rainwater in the cities and were the primary sources of water supply. In cities on riverbanks they served as flood cushions and in deltaic cities like Kolkata urban water bodies served as a means to treat wastewater.

The technology of rainwater harvesting has been used since ancient times but is today ignored in favour of modern systems, only a couple of hundred years old. There has been little effort to study and improve the technology despite its great potential to provide water on a sustainable basis. In urban areas, rainwater falling within individual houses, mainly using rooftops as catchments, can be harnessed.

If we can revive this traditional wisdom of catching and using rainwater and reinforce it with modern science and technological inputs, we can surely address modern day water problems. Rainwater can be collected from rooftops of buildings, playgrounds and parks, roads and flyovers and urban forested areas. These diverse forms of rainwater harvesting serve different purposes ranging from drinking, non-potable uses, groundwater recharge, to address flooding and to improve quality of groundwater.

- **Most cities in India have to deal with depleting water supply, marked by falling groundwater levels, vanishing water bodies, severe pollution and urban floods**

- **With their own supplies drying up, cities are forced to source water from further and further away. This is expensive**

- **City planners usually ignore a powerful source of water that they can have easy access to – rain**

- **Rainwater and run-off can be harvested on the simple premise of 'catching water where it falls'. It can be collected and stored, or conveyed to the aquifer to recharge groundwater**

- **Rainwater harvesting (RWH) is gradually being taken up by citizen's groups and municipalities aided by legislation that makes it mandatory. The first such legislation was laid out for the city of Chennai after the drought of 1992-93. Detailed specifications for structures were published by the Madhya Pradesh government as early as 1984**

- **A prospective rainwater harvester has help on hand. Many municipalities have RWH cells which provide information and technical advice. Financial assistance under the Jawaharlal Nehru Urban Renewal Mission is available. Small personal loans too can be availed**

- **A fresh multi-pronged impetus is necessary to take RWH forward: pricing incentives for RWH, disincentives to discourage water wastage, regeneration of water bodies, RWH in public buildings, colonies and green areas**

01

Urban India's water crisis

Water is what urban India is fighting for today. Cities across the country – from Chennai in the south to Shimla in the northern hills, from Rajkot in the west to Cherrapunji in the north-east – are facing the crippling effects of acute water scarcity.

There is hardly any city that can boast of a 24-hour water supply (see Table 1.1: *Water availability*). Groundwater tables are falling rapidly, centuries-old water bodies have disappeared or are severely polluted, and urban floods are becoming a regular phenomenon during monsoons. In addition to this, most of our rivers have become carriers of urban filth.

This scarcity-pollution tango is giving rise to a nightmarish scenario in which urban populations – mainly the urban poor – are at the receiving end. Let us take a look at the various facets and factors that are fanning this crisis.

Table 1.1: Water availability
Sharp fall in two decades across Indian cities

City	Early 1980s (hrs/day)	Early 1990s (hrs/day)	Early 2000s (hrs/day)
Chennai	10-15	8-10	1.5
Vishakapatnam	20-24	10-12	1-4
Hyderabad	15-24	1-5	1-2
Bengaluru	20-24	5-10	2-4
Delhi	10-12	8-10	1-2
Bhopal	8-10	4-6	1-2
Rajkot	1-2	1	Half an hour on alternate days

Sources: Administrative Staff College of India, Hyderabad & Centre for Science and Environment, New Delhi

A DESTRUCTIVE URBAN WATER PARADIGM

How do modern cities source and use water? Our planners don't make rain-friendly cities. Most of the rain that falls in cities is allowed to drain away as run-off; this rain could have recharged the groundwater, but with the increase in built-up areas within cities, the land available for recharge is getting drastically reduced, even as the groundwater is heavily abstracted.

This situation is worsened by the extraordinary value attached to real estate, resulting in the conversion of natural recharge areas such as lakes, ponds and wetlands into built-up areas.

While the rainwater is thus wasted, city administrations go to great efforts to bring water at a huge cost through pipes and tankers. Much of this water is abstracted from far-off areas – giving rise to potential points of conflict with the users of this water in those places (see Box: *Water from afar*).

RAPID URBANISATION

India's urban population has grown almost five times between 1951 and 2001. By 2026, an estimated 38 per cent of the total population will be urban.[1] As a result, there is tremendous pressure on all resources, including water. Cities are demanding and consuming more water, and also wasting a lot of it in the process.

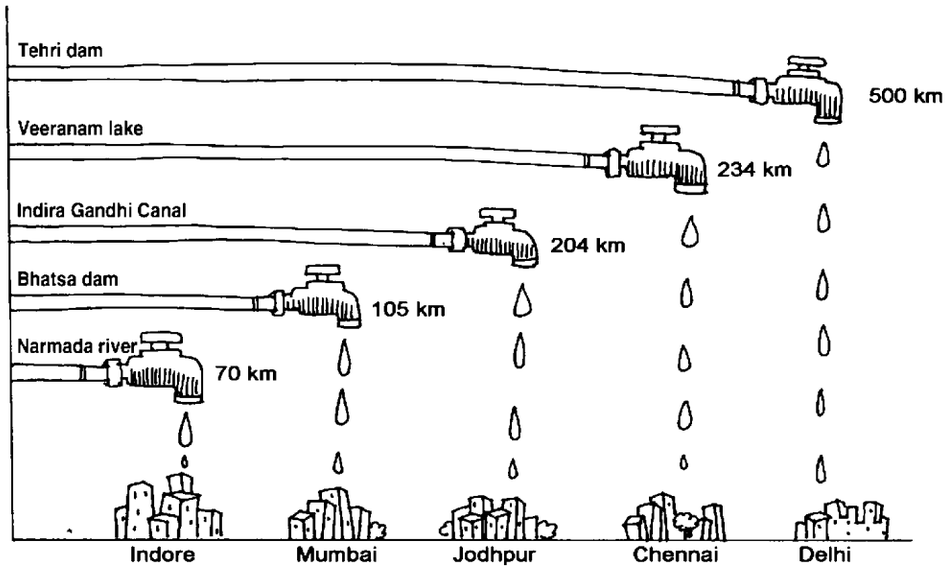
Water from afar

Metropolitian cities freeload on their hinterland

The Delhi government goes far into the neighbouring states in search of water. In addition to taking out all the water from the Yamuna that flows through the city, more Yamuna water is brought through the Western Yamuna Canal from Hathnikund/Tajewala in Yamuna Nagar district of Haryana state. Water is also obtained from the Ravi-Beas storage at Bhakra dam in the Punjab, from the Bhagirathi river storage at Tehri dam in Uttarakhand, as well as from the Ganga through the Upper Ganga Canal in Uttarakhand and Uttar Pradesh. All this is still not enough. Groundwater is also abstracted both by the Delhi Jal Board as well as by residents.

Similarly, Chennai brings water from Veeranam lake, Mumbai from Vaitarna and Bhatsa, Indore from the Narmada river and Jodhpur from the Indira Gandhi Canal.

Figure: Distant water sources



More consumption means generation of larger volumes of wastewater. An estimated 80 per cent of the water we use is discharged as wastewater. Governments are simply failing to keep up – both with the demand for freshwater and the need for treating wastewater. Unmet demand results in increasing withdrawals from the ground (*see section on groundwater below*), while untreated wastewater pollutes surface water sources as well as groundwater.

WATER POLLUTION IN URBAN AREAS

In 1978-79, India produced 7 billion litres a day (BLD) of sewage[2]. Within 20 years, this had increased nearly five-fold to 38 BLD. But the treatment capacity is a meagre 12 BLD[3]. The untreated sewage goes back into the rivers which are also the sources of water for the next city or town downstream. As a direct result of this, the quality of groundwater is also deteriorating, with problems ranging from excess of nitrate and total dissolved solids (TDS) to arsenic and fluoride contamination (see Box: *Potable groundwater*).

Besides rivers, most other surface water bodies – lakes, ponds, wells – have also become receptacles for urban sewage, and are disappearing. Researchers at the Indian Institute of Science, Bengaluru, have determined that their city had 51 lakes in the early 1970s; by the end of the century, this number had plummeted to a mere 17, of which only 14 could be considered 'alive'.[4] In Hyderabad, there were 932 water bodies in 1973; by 1996, 834 were left.[5]

In the case of Delhi, even determining the number of water bodies took some time, effort and coaxing by the judiciary (see Box: *Whither water bodies?*).

Potable groundwater

Rainwater is first collected and stored and subsequently used to dilute groundwater

At Kokawad Ashram in Jhabua, Madhya Pradesh, a residential school for tribals, rainwater harvesting has been used to dilute the high fluoride levels in groundwater. The rain falling on the rooftop of the school building is stored in a 75,000 litre ferrocement tank and used for this purpose. The groundwater as well as the stored rainwater is pumped to overhead tanks where they are mixed and used for drinking and cooking. The diluted groundwater is potable.

This is the simplest and most cost-effective way to address fluoride contamination. There are fluoride filters of various design, but these do not work on a sustainable basis since they require sustained monitoring and maintenance. In this scenario rainwater from storage tanks are increasingly being used to recharge shallow dugwells.

Whither water bodies?

Delhi found it hard to tally numbers

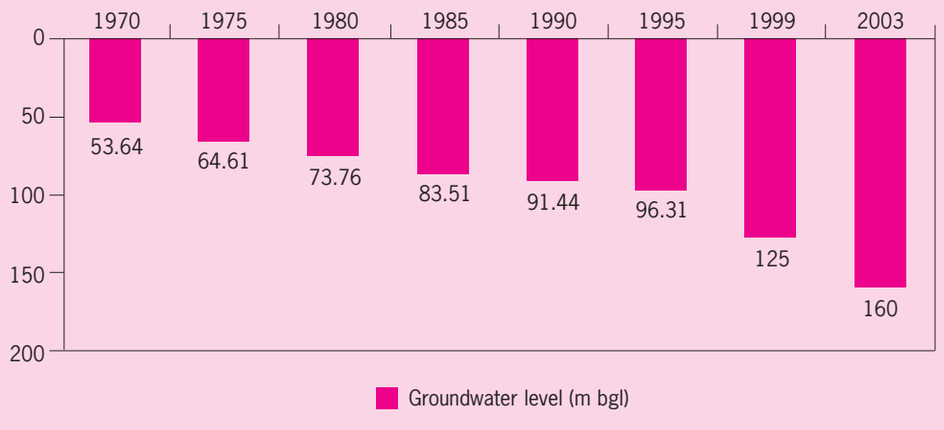
In 2001, the Delhi Municipal Corporation had come up with a list of 177 water bodies in the capital; this contention was challenged, since an earlier report had identified 355. Subsequently, the Delhi High Court ordered a survey, which came up with a figure of 508 water bodies in 2002. However, there were several discrepancies in this list too. A new committee was formed for yet another survey, which showed that there were 794 water bodies in Delhi.

But several prominent water bodies were missing even from this survey. A water body in Sainik Farms that was listed in 2002, for instance, was not included in the second list as the surveyors were unable to find it. A lake near the Indira Gandhi stadium was also missing. Over half of the natural lake of Mayapuri was found to have been taken over for construction of a common effluent treatment plant (CETP) even as the Public Works Department claimed that no such lake existed in its records.[1]

GROUNDWATER DEPLETION

In cities across the country – Chennai, Bangalore to Kolkata and Ahmedabad – rapid decline in groundwater levels have brought on unanticipated problems. In Chennai, over-extraction of groundwater in the Minjur well field has resulted in rapid ingress of seawater, which extended from 3 km inshore in 1969 to 7 km in 1983 and 13 km in 2007.[6] In Kolkata, reckless groundwater exploitation has changed the direction of the flow of the water and resulted in land subsidence in the central and southern parts of the city. In Ahmedabad, groundwater levels have declined from less than 20 metres below ground level (m bgl) in the 1960s to more than 160 m bgl in 2003 (see Graph 1.1: *Decline in groundwater level, western periphery of Ahmedabad*).[7]

Graph 1.1: Decline in groundwater level, western periphery of Ahmedabad



Source: Parth Shah 2005, 'Strategy to revitalise urban water bodies: case of semi-arid Gujarat', International Institute for Geo-Information Science and Earth Observation, The Netherlands, March

URBAN FLOODING

While on one hand there is severe water shortage, on the other, cities are increasingly drowning under swirling flood waters. In the last decade alone, a number of incidences of urban floods were reported – Mumbai (9), Ahmedabad (7), Chennai (6), Hyderabad (5), Kolkata (5), Bengaluru (4) and Surat (3).[8]

In many cities, water bodies and natural drainage channels have been filled up and encroached upon, thus leading to flooding. Besides this, the crumbling drainage systems in many towns, built many years ago, have not been expanded, modernised or maintained. This aggravates water-logging and flooding and leads to health hazards in its aftermath.

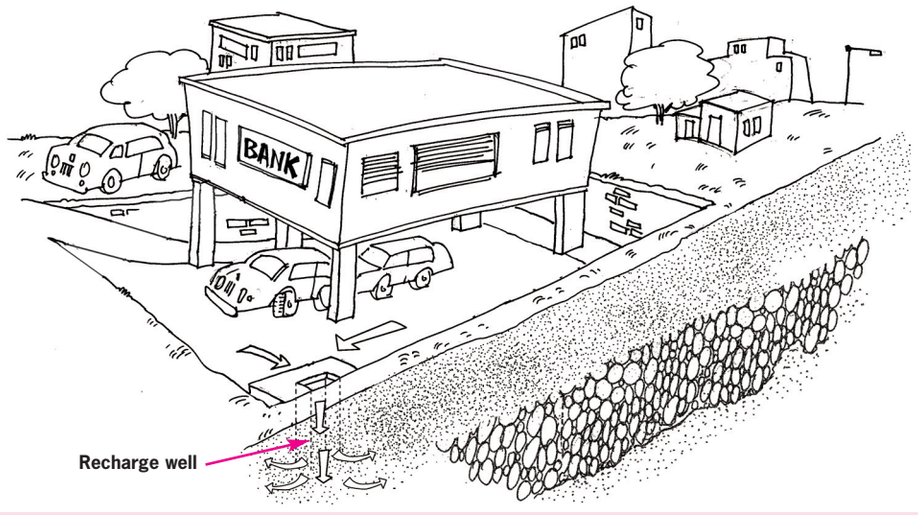
The flood waters can be harnessed and used (see Box: *No more flooding*).

No more flooding

A bank shows the way

The Karnataka Bank branch in Kuvempu Nagar, Mysore, used its basement for parking vehicles. In the rainy season, the basement would be completely flooded. To address the problem, the bank built an underground tank to collect the flood water which was pumped out into the stormwater drains.

To put the water to good use the bank authorities decided to recharge the aquifer with the collected rainwater and a recharge borewell was sunk within the tank itself. During the monsoon at least 10,000 litres percolates into the aquifer every day. As the water level in the aquifer rose, there was no flooding in the basement. The bank staff say that the quality of water from the borewell used by them has improved. The hardness has reduced.

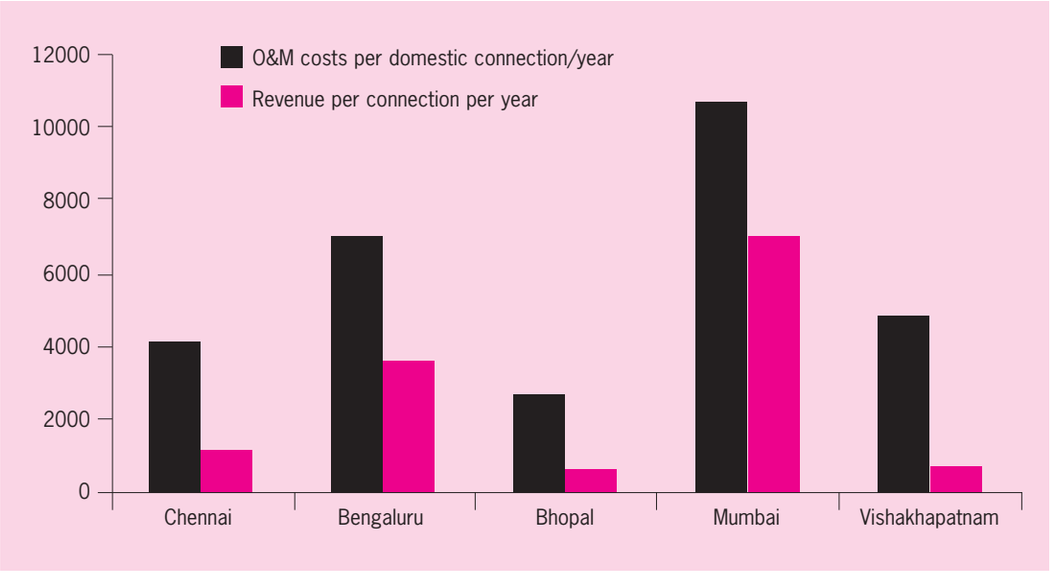


UNDERPRICING IN WATER SUPPLY

Supplying water to cities is an expensive proposition – especially when we pay a pittance for the water that we get. For instance, Chennai spends Rs 4,003 as annual operations and maintenance (O&M) cost per connection per year, but collects barely 25 per cent of that as revenue from every domestic connection per year.

Similarly, Bhopal manages to collect only about 19 per cent of its O&M expenditure from its domestic connections. Municipalities also spend substantial amounts on capital expenditure for each connection, but charge very little. Chennai has an average capital expenditure (between 2002-2006) of Rs 10,080 per connection, but it charges only Rs 1,930 for every new connection. Mumbai has a capital expenditure of Rs 3,790 per connection and charges a mere Rs 910 for

Graph 1.2: Cost-tariff shortfall



Source: Adapted from *Benchmarking and Data Book of Water Utilities in India*, Asian Development Bank, 2007

every new connection (see Graph 1.2: *Cost-tariff shortfall*).

The distribution is as skewed as the pricing. Official supply rarely reaches the poor, and the benefits of the low prices are usually reaped by the rich.

WAY FORWARD

Rainwater harvesting is an idea whose time has come. Today, there is a great deal of interest in society to take responsibility for their water. There are innovations in capturing and using rainwater in every city. The government too, is following the trend and has brought in legislation and measures to cajole or force citizens to harvest rainwater.

To cater to the modern day urban water demands of a growing urban population, cities have to use a variety of methods to harvest, store and use rainwater. From micro-catchments of

rooftops to macro-catchments of urban lakes, there a wide variety of urban water harvesting methods that cities need to employ and maximise their water supply. At the household level, water harvesting can supplement existing water supply and reduce dependence on municipal supply. At the city level, water harvesting will serve to maximise available water for supply, prevent flooding, and recharge the groundwater. Therefore, water harvesting in urban habitats can be practised by households, factories, institutions and the governments.

Rooftop water harvesting affords an affordable means of accessing good quality water at the point of consumption, where the control of the water supply lies at the user level. Rainwater can be stored for long periods without deterioration of quality as can be seen from the wide prevalance of storing rainwater in underground tankas in arid regions of Rajasthan and Gujarat. In urban cities of India today, where multi-storeyed buildings are becoming the norm, rainwater can be collected from the roof, paved and unpaved areas and recharged to the aquifer.

The acute urban water scarcity has forced the government and the people to act. The public response to water harvesting has been positive all over the country. Concerned citizens across the country have also come together to protect urban lakes and water bodies in many cities. State governments and city municipalities have enacted laws and introduced incentives and other measures, which have served to encourage citizens to harvest rainwater. The city of Chennai, for instance, was the first to put in place systems to ensure large-scale rainwater harvesting. Other cities have followed suit with similar legislation.