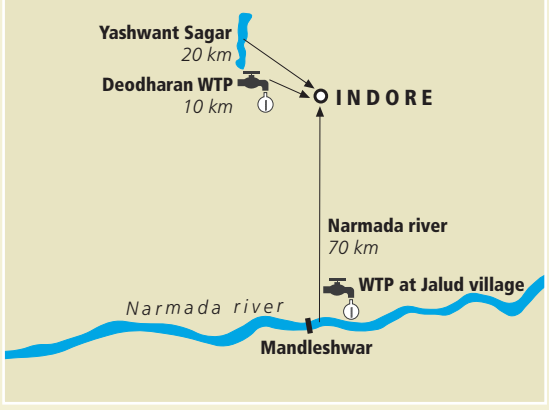
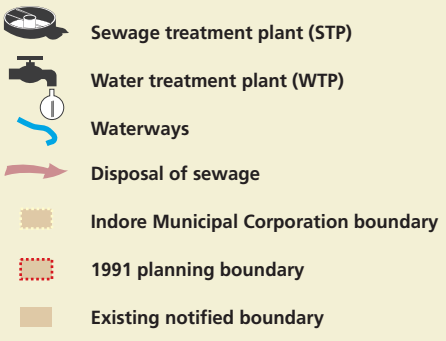
INDORE

THE WATER-WASTE PORTRAIT

With the Malwa region receiving meagre rains, Indore became the first city in India to declare a water emergency. Conflicts over water have become the order of the day

WATER SOURCES





Source: Anon 2011, *71-City Water-Excreta Survey, 2005-06*, Centre for Science and Environment, New Delhi

MADHYA PRADESH

Indore

Indore is the commercial capital of Madhya Pradesh. The city can no longer meet its water requirement through its traditional lakes and borewells, and has now turned to the Narmada. Pipelines draw water from the river for the city at exorbitant costs. In spite of this, Indore, like most cities of India, has not learnt its lesson. It continues to discharge its wastes into the Khan river, which has been converted into an open sewer. In its turn, the Khan pollutes the water source of another city: Ujjain, located in its downstream.

WATER

DEMAND AND SUPPLY

Currently, Indore has to bear with a 16 per cent gap between its demand and supply of water. Official demand estimations do not match the figures put forward by the CPHEEO: they are almost 23 per cent lower. With the city's high leakage losses, the supply reduces further (see Table: *The water*).

The governing agency, Indore Municipal Corporation (IMC), draws water from the Narmada river, the Yashwant Sagar Lake, Bilawali tank and a few local borewells. Besides the Bilawali, the city has two other large tanks – the Piplyapala and the Shirpur. But constructions in their catchments have drastically reduced their water inflow. The contribution from groundwater is minimal – in 2005-06, there were some 1,500 public tubewells fitted with power pumps, 446 handpumps and 125 open wells supplying about 17.5 million litre a day (MLD).[1]

Though the city gets 210 MLD of water from the Narmada, 11 MLD is provided to the military headquarters at Mhow town, while about 2 MLD goes to villages near the city. Another 9 MLD is sent directly to Dewas town through a separate transmission pipeline. Thus, only about 160 MLD of treated water is available from the Narmada to the IMC.[2]

Given the poor state of supply, a virtual scarcity is not hard to imagine. The crisis appears deeper by the fact that about 46 per cent of the city residents do not have access to piped water.[3] In fact, with the entire Malwa region receiving less than half the average rainfall in 2008, Indore became the first city in India to declare a water emergency in the following year (see Box at the end of this chapter: *A state of emergency*).

THE SOURCES

In the 1930s, Indore had got its water from the Bilawali and Limbodi water tanks, as well as from the Yashwant Sagar Dam. The dam was built on the Gambhir river 20 km from the city in 1938, by the then ruler of Indore, Yashwant Rao Holkar.[4]

THE CITY	
Municipal area (Indore Municipal Corporation)	134 sq km
Total area (total planning area)	504.87 sq km
Population (2005)	1.8 million
Population (2011), as projected in 2005-06	2.4 million
THE WATER	
Demand	
Total water demand as per city agency (IMC)	243 MLD
Per capita water demand as per IMC	135 LPCD
Total water demand as per CPHEEO @ 175 LPCD	315 MLD
Sources and supply	
Water source	Surface* and groundwater
Percentage of water sourced from surface sources	94%
Percentage of water sourced from groundwater	6%
Total water supplied	204 MLD
Per capita supply	113 LPCD
Leakage loss	35%
Actual supply (after deducting leakage losses)	133 MLD
Per capita supply (after deducting leakage losses)	74 LPCD
Population served by water supply system	54%
Per capita supply to the served area	NA
Demand-supply gap (after leakage loss)	110 MLD
Treatment	
Number of WTPs	3
Total treatment capacity	185 MLD
Actual treatment	182 MLD
Future demand and supply	
Demand (2011), as projected in 2005-06	329 MLD
Augmentation needed to meet 2011 water demand	125 MLD
Required increase in supply	61%
THE SEWAGE	
Generation	
Sewage generated as per CPCB	239 MLD
Sewage generated as per city agency	80 MLD
Collection	
Length of sewerage network	600 km**
Population covered by sewerage network	55%
Area covered by sewerage network	10%
Treatment	
Number of STPs	2
Total treatment capacity	90 MLD
Actual sewage treated	78 MLD
Disposal	Khan river***

Source: Anon 2011, *71-City Water-Excreta Survey, 2005-06*, Centre for Science and Environment, New Delhi

Notes: *The Narmada river, Yashwant Sagar Lake and Bilawali tank; **80 per cent of the sewers are under-utilised due to lack of maintenance ; ***The Khan joins the Kshipra river, Ujjain's water source; IMC: Indore Municipal Corporation

TABLE: **INDORE'S WATER SOURCES**
The city's dependence on the Narmada is now overwhelming

Source	Distance (in km)	Capacity (in MLD)	Supply (in MLD)
Bilawali	5	9	4
Yashwant Sagar	21	38	27
Tubewells etc	–	27	13
Narmada river	70	210	160

Source: Based on data received from Indore Municipal Corporation, 2005-06

In the 1970s, with these water bodies unable to meet Indore's growing demands, a master plan for water based on projected population growth was developed for the region. Under this plan, the Narmada water supply scheme was installed in 1977; it started providing 86 MLD, which was augmented to 172 MLD in 1990 (the CSE survey, however, had put supply from the scheme at 160 MLD.[5]

As said before, the city depends heavily on the Narmada today (see Table: *Indore's water sources*). A 1,200 mm-diameter pipeline brings the river's water over a 110 km distance. Because of the single pipeline, any break in supply – due to power failure or maintenance work – wreaks havoc in the city. Moreover, it has to be remembered that Narmada water is supplied to only 80 per cent of the city; Indore's fringes, where the poor live, do not get this water.[6]

During days of crisis, especially in summer, the IMC supplies water through its 30 tankers. Another 250 tankers are hired to carry water from the Yashwant Sagar Dam. There are also private tankers which charge at least twice the amount asked for by the IMC's tankers. In slums and other poorer areas, plastic water tanks have been made which the IMC fills up free of cost.[7]

TREATMENT AND DISTRIBUTION

The raw water from Yashwant Sagar is conveyed through a 13-km pipeline to a water treatment plant (WTP) at Deodharan; there, it is treated in a conventional rapid sand gravity system. The installed capacity of the plant is 40 MLD, but because of the limited yield from Yashwant Sagar, a mere 27 MLD is produced. The scheme was

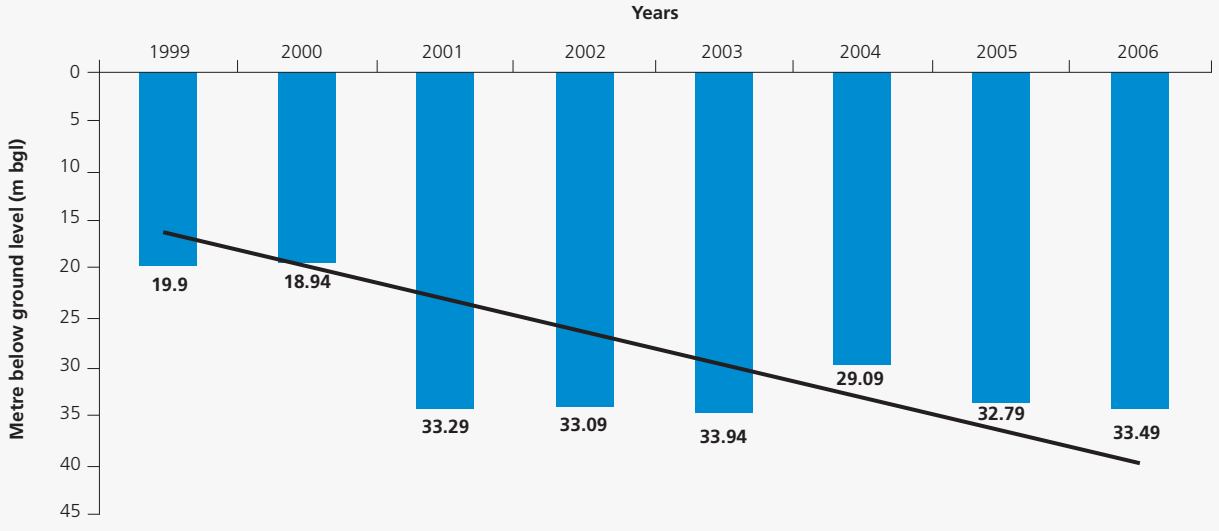
GROUNDWATER IN INDORE

Studies find worrying trends

Low per capita supply and lack of water connections to most parts of the city puts immense stress on groundwater. In 1998, a study of 200 borewells in the city by Deepak Khare, senior lecturer, Shri GS Institute of Technology and Science, Indore, found that wells were drying up at an alarming rate. In 1988, 0.5 per cent of the population had faced a reduced yield of groundwater due to the depleting aquifer – by 1998, about 40 per cent of the population was facing reduction in yield.[1]

The Central Pollution Control Board's 2004 study of groundwater quality in the city (25 samples) had found more than 80 per cent of the samples to be above the desirable limit for total dissolved solids, or TDS (but within the maximum permissible limit of 2,000 mg/l). Almost all the samples exceeded the alkalinity level, while 40 per cent had high nitrate content.[2]

GRAPH: **DIPPING LEVEL**
According to CGWB, the water level in the city has depleted by 14 m between 2000 and 2006 at the rate of 2.5 m per year



Source: National Data Centre, Central Ground Water Board (CGWB), Faridabad

installed in 1936. Although repair works have been undertaken, what the plant needs is a complete overhaul.[8]

The water from Bilawali tank goes to a filter plant near Indrapuri by gravity. Earlier, this water used to be treated in five pressure filter units, which have since become defunct. The water undergoes a three-fold test every day: a physical test of around 30 samples a day, a chemical test on around 17 samples and a biological test on 32 samples a day.[9]

The WTP for the Narmada project is 3 km away near Jalud; it has a total capacity to filter 182 MLD. Because of the high sand content of Narmada waters around the project's intake wells, the problem of desilting and severe wear and tear of pumps is persistent.[10]

The treated water is distributed through a 1,500-km pipeline network, covering 54 per cent of the total population. The IMC has about 1,47,000 residential, 750 commercial and 1,320 industrial connections. Apart from these, water is also distributed through 7,263 public standposts. The number of beneficiaries per standpost is about 25, which is too low for supply management – each standpost should cover at least 10 houses or about 50-70 beneficiaries.[11]

The pressure of water in the pipelines is increased by five pumping stations. The water is carried over a hill, across 20-25 km. These pumping stations, fortified with horizontal and centrifugal pumps that work for 24 hours, lift water from one point to another, where the second point is higher than the ground level of Indore city.[12]

From the second point, the water mainly flows by gravity to Indore and fills up 33 overhead tanks. The capacities of these tanks range between 2,250 and 3,400 kilolitre (kl), which is not enough for the whole of Indore city. About two-thirds of the city receives water through gravity, and some areas complain of low pressure.[13]

There are an estimated 20,000 illegal connections. The total estimated loss of water due to these unauthorised connections as well as leakage and wastage is to the tune of 50 per cent, says the IMC.[14]

THE ECONOMICS

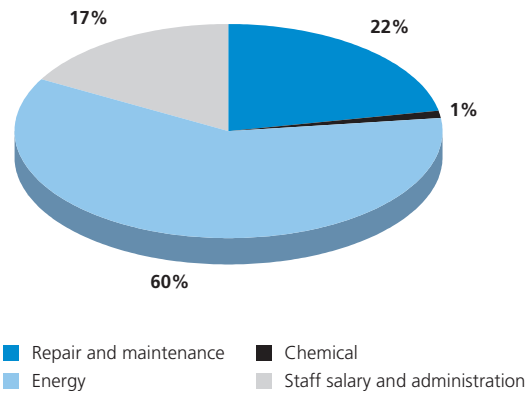
In 2004-05, the IMC spent Rs 82 crore for supplying water to the city. Of this, energy took up 60 per cent – or about Rs 49 crore (see Graph: *Expense heads*). It collected only Rs 12 crore. Thus, while the per kl production cost for supply of 204 MLD of water stood at Rs 10.96, the revenue per kl was only Rs 2.[15]

The water agency was over-staffed. As of 2005-06, there were 1,700 employees, including 38 engineers, which works out to over 50 employees per 1,000 connections.[16]

The municipality earns its revenues through water tax and water charges. Households in Indore are charged much higher compared to other Indian cities (see Table: *Tariff structure*). Domestic connections are not metered and are charged a flat amount; the tariff was raised from Rs 60 per month in 2005. Under the conditions of the ADB loan granted for the Narmada Phase-III project, the tariff will rise every year once the metering system is in place.[17]

GRAPH: **EXPENSE HEADS**

With pumping being a key activity, energy costs are high



Source: Based on data received from Indore Municipal Corporation, 2005-06

TABLE: **TARIFF STRUCTURE**

Indore charges heavily for the water it supplies

Flat rate (Rs/month)			
Size of pipe	**Domestic**	**Commercial**	**Industrial**
½ inch	150	300	600
¾ inch	250	600	1,200
1 inch	500	1,400	2,400
1½ inch	1,000	2,400	5,000
2 inch	2,000	5,000	10,000
3 inch	4,000	10,000	20,000
4 inch	8,000	20,000	35,000
6 inch	14,000	38,000	76,000
Metered connections for bulk connection – Rs / kl			
Bulk rates	Rs 11	Rs 14	Rs 24

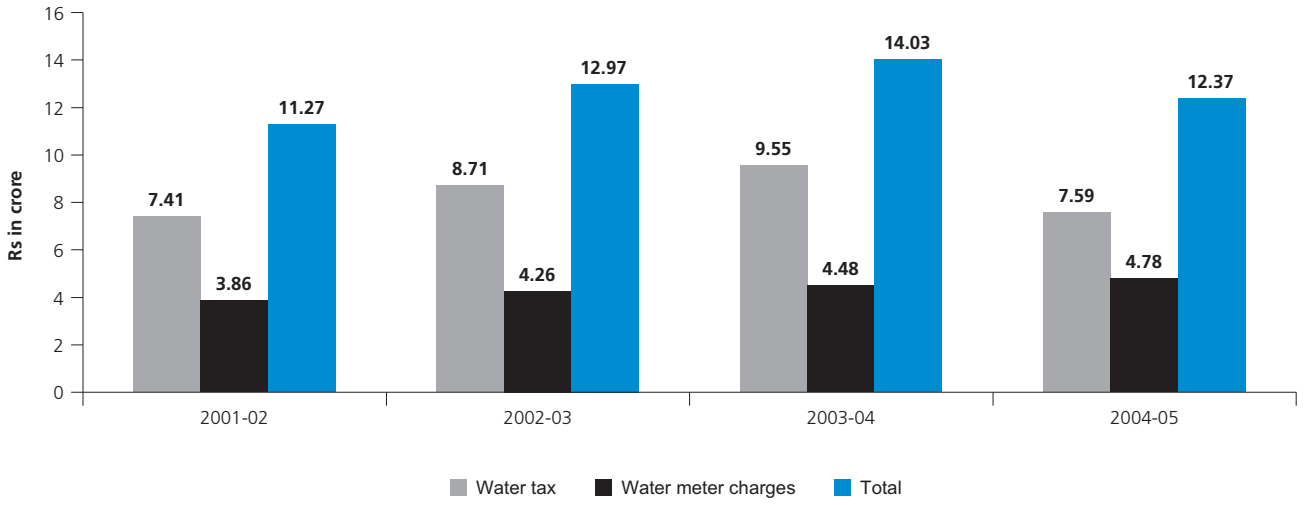
Source: Anon 2008, *2007 Benchmarking and Data Book of Water Utilities in India*, Union ministry of urban development and the Asian Development Bank

The commercial connections which are metered are charged Rs 14 per kl, while industrial connections pay Rs 24 per kl.[18] Considering low per capita supply, an average household consumes 11.09 kl per month and ends up paying Rs 5.41 per kl. Despite this, while expenses have increased over a period of time, the revenue income has remained largely stagnant (see Graph: *Revenue from water*).[19]

According to the ADB's 2007 survey, the average monthly consumption in the city is about 28.4 cubic metre (cu m) per connection, with per capita supply at 87 LPCD. The household water bill averages Rs 60.36 per connection. Of the bulk connections, only a few are metered – and not all are working. To most users, water is available on an average of 45 minutes a day.[20]

GRAPH: **REVENUE FROM WATER**

While expenses have increased over a period of time, the income has remained largely stagnant



Source: Anon 2006, *Indore City Development Plan*, Indore Municipal Corporation, with technical support of Mehta & Associates, Indore

SEWAGE

Indore does not know how much sewage it generates – wide disparity, therefore, rules its estimations (see Table: *The sewage*). As a result, its capacity for treating sewage is also off the mark: its two sewage treatment plants (STPs) at Kabir Khedi can only treat the amount (80 MLD) that the city claims to officially generate.[21]

The city does not have a proper sewage collection and disposal system. In 1936, its Holkar kings constructed a 30-km covered sewerage line over 10 per cent of the city's area; the system served a population of about 150,000. In 1990, the PHED prepared a sewerage master plan for Indore till the year 2028, which included the laying of 300 km of sewer lines in phases. The plan was technically approved by the CPHEEO, but could not be implemented due to lack of funds.[22]

Subsequently, the Indore Development Authority (IDA) – with financial assistance from the British government's Department for International Development – built a sewerage system in 183 slums: 47 km of sewer lines were installed. The IDA also constructed a 17-km sewage line on the banks of the Khan river and connected it to the city's STP.[23]

Of the city's road network of 1,710 km, only 600 km has drains; 90 per cent of the drains are open. This network collects 55 per cent of the sewage that is generated in the city; another 43 per cent is disposed off in septic tanks and ultimately discharged into *nullah*s. Of the city's 1.8 million-strong population in 2005-06, about 0.7 million used septic tanks. Besides, about 1,000 pit latrines were still in use, and about 5 per cent of the population resorted to open defecation. There were about 1,464 seats of public toilets in the city attached to septic tanks, all of which were poorly maintained.[24]

Most of the wastewater is drained into Indore's three major streams, which flow towards the north and meet at the city's municipal borders. These three are the Khan and Saraswati rivers, and the Piliyakhal *Nullah*. The IDA has laid interceptor sewers along these streams and the Plasiya *Nullah* to collect wastewater from the slums situated on their banks. The

R K SRINIVASAN / CSE

The 'sewer' of Indore: passing right through the city, the Khan is anything but a river

TABLE: **DOWNHILL**
The quality of the Khan river after it leaves Indore

	Location	pH	DO (mg/l)	BOD (mg/l)	Total coliform (MPN/100 ml)	Faecal coliform (MPN/100 ml)
	Khan river at Kabir Khedi	8.1	3.8	71.5	1600	120
CPCB standard	Outdoor bathing (organised)-Class B	6.5-8.5	5 or more	3 or less	500 or less	–

Source: Anon 2006, *Status of water quality in India-2004*, Central Pollution Control Board, New Delhi

interceptor sewers along the other *nullahs* discharge into the sewers along the Khan, which conveys the sewage to the STPs at Kabir Khedi.[25]

The eastern parts of the city are partially sewered. Wastewater from these parts flows through a brick arch sewer that finally discharges into the river Khan near Kabir Khedi. This brick arch sewer is now broken at various places – as a result, sewage bypasses it and flows into the Bhamori *Nullah*.[26]

Sewers laid under a British Overseas Development Administration-assisted project have collapsed as well; most are reported to be broken or choked at various locations. As a result, the sewage had been flowing directly into the Khan. As a temporary arrangement, a weir has now been built across the river to divert the sewage into the STPs. Since the STPs cannot handle all the sewage generated by Indore, about 73 MLD of untreated sewage goes directly into the Khan river. However, considering the poor condition of sewage drains, the actual amount of sewage reaching the STPs could be much less.[27]

The Khan river, naturally, is in a sorry state. It has also polluted the Kshipra river, which is the main water source for Ujjain, and is located downstream of Indore (see Table: *Downhill*).

LOOKING AHEAD

By the year 2011, as per calculations done in 2005-06, Indore would have needed an estimated 394 MLD at the rate of 135 LPCD.[28]

In 2005-06, the city got 45 minutes of water supply on alternate days, covering 54 per cent of the population, with average supply at 80 LPCD. According to its *City Development Plan* (CDP), it aims for a 24-hour supply, with 100 per cent coverage by 2010. *Amar Ujala*, a local newspaper, reported in February 2011 that the French Veolia and the Delhi-based SPMCL had come up through a seven-company pre-bid process as possible contenders for executing a 24x7 water supply project.[29]

As far as sewerage is concerned, about 55 per cent of the population has access to a sewerage network – but 80 per cent of these sewers are choked. By 2020, Indore wants 100 per cent of its

A CLOSE LOOK AT THE INDORE SLUM MODEL

Project receives awards and accolades, while people die due to its drawbacks

October 1987: Department for International Development, earlier known as the British Overseas Development Administration (ODA), proposes a slum project for Indore

March 1988: Assistance worth Rs 39 crore for the Indore Habitat Improvement Project for upgrading 183 slums (80,000 families) over five years

1990: Project gets underway

January 1993: The then prime minister of UK, John Major, visits the site and is "very pleased". The project's duration is extended to 1995 and the aid to Rs 42.4 crore.

Mid-1993: Complaints of water-borne diseases surface. Cross-contamination of drinking water and sewage lines and the first death due to jaundice reported.

July 1994: In UK, the Building and Social Housing Foundation presents the World Habitat Award to the project. Project duration is further extended to 1997 and funding to Rs 60.5 crore. Rains, meanwhile, compound the residents' misery.

June 1996: Indore's slum networking included in the national best practices and selected as a global best practice.

1997: ODA detects major sanitation problems in an assessment. The Indore Development Authority denies the scale of the problem and attributes it to a poor sample.

June 1998: Deaths due to malaria and water-borne diseases reported. Over half of the drinking water samples collected are found unsafe.

October 1998: Project bags the Aga Khan Award for Architecture for "transforming the environment and improving the quality of life by providing a clean and liveable habitat for its citizens"![1]

ARVIND YADAV / CSE

The Yashwant Sagar: Indore's planners are thinking of building a barrage here to meet the city's future needs

population covered under its sewerage system. About 35 per cent of the city's population lives in slums today; the CDP aims for a "slum-less Indore by 2015".[30]

What is the city doing to meet these targets it has set itself? The IMC has begun execution of Phase-III of the Narmada project with ADB assistance; the project, which was expected to be completed by 2009, has been planned to fulfil the water demand for the projected population in 2039. Narmada Phase-III envisages increasing the Narmada water supply by 365 MLD – thus taking the total supply to 585 MLD after implementation.[31]

The city is also thinking of utilising its old water sources such as the Yashwant Sagar (by building an RCC barrage) and the

A STATE OF EMERGENCY

In 2009, this is how Indore prepared for parched times

For the first time in India, a city was forced to declare a water emergency – thanks to the complete mismanagement of its water resources, said activists in Indore. Though there is no legal provision for declaring such an emergency, the move was validated by the fact that the city's mayor-in-council had passed the decision.

The emergency involved measures for preventing water loss, freeing public tubewells from encroachments, acquiring private borewells, tackling corruption in water distribution and preventing water misuse.

Indore had been facing a severe water scarcity for over two decades. Rainfall had dipped. Compared to the region's average annual rainfall of 1,092 mm, the city received only 517 mm of rain in 2008. Encroachments and filling up of its waterbodies had drastically reduced their inflow. The biggest locality in the city, Kathiwala tank, stands on land reclaimed by filling a waterbody. Another tank, the Piplyapala, is being developed into a picnic spot – over 100 ha around the tank will be covered in concrete, reducing the water inflow. The Harsiddhi and Khan rivers flowing through the city have been reduced to drains.

The city's planners are looking at the Narmada river to relieve them. But the Rs 670-crore Narmada Phase-III, financed by the ADB, is already delayed. Activists argued that the project, which is very expensive, will raise water tariffs beyond the reach of the majority and fail to deliver because of the large transit losses involving transportation of water over 85 km. They contended that the water emergency was just a ploy to divert attention from agitations against the proposed increases in tariffs.

Moreover, there is the question of whether the Narmada would have enough water for this third phase. The first two phases of the project are getting just one-third of the water projected in the original plans.[1]

MUCH ADO ABOUT A LAKE

The Krishnapura Lake has turned into a stink pot

Indore's Krishnapura Lake came into being as part of the British Overseas Development Administration (ODA) project with additional local funding to demonstrate the city-wide benefits of slum networking.

Under the ODA project, underground sewage lines were laid in slums, which meant that the sewage and sullage that used to flow into the Khan river was now contained in sewage pipes flowing on either side of the river. It was, therefore, possible to develop parts of the river as clean recreation areas. Hence, a proposal to do so all along the river in a phased manner, starting with the Krishnapura Lake, was put forward. The lake was to be created by building shutters in a small footbridge to stop the water, at a total cost of Rs 0.65 crore.

Work on the lake started in February 1991. In May 1993, the Indore Municipal Corporation (IMC) announced that the lake was likely to be filled up in the coming monsoons, but the rains only served to disrupt the work that had not yet been completed.

Meanwhile, some reservations were already beginning to be expressed about the fact that a lake was being developed in a part of the river without any attempt to clean the rest of it. The work on the lake finally came to a close in 1995. But the IMC did not or could not keep its promise of diverting fresh water from its water treatment plant into the lake.

By the end of 1995, the quality of the lake's water had deteriorated. A report in a local newspaper criticised the IMC for having reduced the lake to a stormwater drain, after spending more than Rs 0.05 crore on it. In 1996, boating facilities were launched, but had to be soon stopped because of the stinking water. By March 1997, the danger of vector-borne diseases originating from the contaminated lake waters had become serious. The administration, of course, continues to pretend that the "lake" is fine and does not stink.[1]

Bilawali tank. There is also a proposal to clean the city's old *baori*s at a cost of Rs 59.80 crore. However, a project to double the capacity of the Yashwant Sagar to 90 MLD will help only if there is good rainfall – something the city has not had for some years.[32]

The Public Health and Engineering Department is executing a Rs 26 crore project which involves the construction of eight overhead service reservoirs, about 20 km of feeder and distribution mains, and a 9-MLD treatment plant for the Bilawali tank. The project was almost complete when the CSE survey was being done. However, since the source had been unable to supply the required water for the past few years due to poor rainfall, the newly built treatment plant had remained under-utilised.[33]

On sewage, Indore's plans are limited. The city has a Rs 346.87 crore scheme, which includes construction of a 245-MLD STP at a cost of Rs 61.25 crore.[34] It will also invest in extension, augmentation and rehabilitation of the existing systems, replace old blocked lines (mainly in slum areas), and connect the new lines to the main trunk sewer line. This will enable 100 per cent of the generated sewerage to reach the STP.[35]

Out of the total Rs 588.17 crore approved for Indore under the Jawaharlal Nehru National Urban Renewal Programme (JNNURM), Rs 23.75 crore is meant for augmentation of the Yashwant Sagar water supply system. Of this money, Rs 2.97 crore was released in February 2009. The JNNURM has allocated Rs 307.17 crore for sewage management, of which Rs 38.39 crore was released as first instalment in February 2009.[36]