

# Building a water secure India

---



Policy-practice of water  
management must change

Sunita Narain, Centre for Science and  
Environment, New Delhi

Water crisis is India's imperative.  
Determinant of our future.

---



**Drought is becoming more or less permanent.**  
Even in “good” rainfall years, there is water stress.

Even after **flood** there is a **drought**  
Many cities get water once in 3 days.  
Dirty water is the largest **killer of babies**.

**Why?**

Is this because of a lack of governmental programmes?

Or do we need a new way of managing water?



# Water-maths not adding up

---

**Spent funds on water resource development.**

**But investment is **not** sustainable.**

**Take drinking water**

**Water maths: 200,000 problem villages in 1970s **minus** 200,000 problem villages in 2003 **=** 200,000 problem villages.**



# Stress leads to conflict

---

**Water skirmishes increasing: Flashpoints**

- § **Tonk**
- § **Sriganganagar**
- § **Falla village in Jamnagar**

**Conflict within village**

**Conflict between states**

**Conflict between cities and villages**

# Water wars. Or water peace.....

---



....**in our hands**. In our minds to secure a new vision of water management.

Need change in **approaches** to water management;

Need **political leadership** on water;

Need water to become **everybody's concern**.



# Water challenges

---

1. **Increase supply** of water – augment our resources;
2. Use the available water **prudently** – maximise its yield and minimise its waste;
3. Ensure the available water is **not polluted** and unsafe for drinking.



# Take water policy for irrigation:

---

Agriculture uses **70-80 per cent** of available water.

Have invested in surface irrigation systems – dams and canals

## **But:**

- a. **Rainfed** areas still comprise more than 60 per cent of India's cultivated land.
- b. **Groundwater**, provides bulk of the irrigation.
- c. **Small surface bodies** have declined – ponds and tanks. There is no recharge for groundwater;
- c. **Wheat-rice** use bulk of irrigated water. No value for crop-per drop.



# What policy did not notice

---

## Simultaneously

Surface irrigation projects suffered from cost overruns; cost per ha increased; irrigation water use became more inefficient.....

So

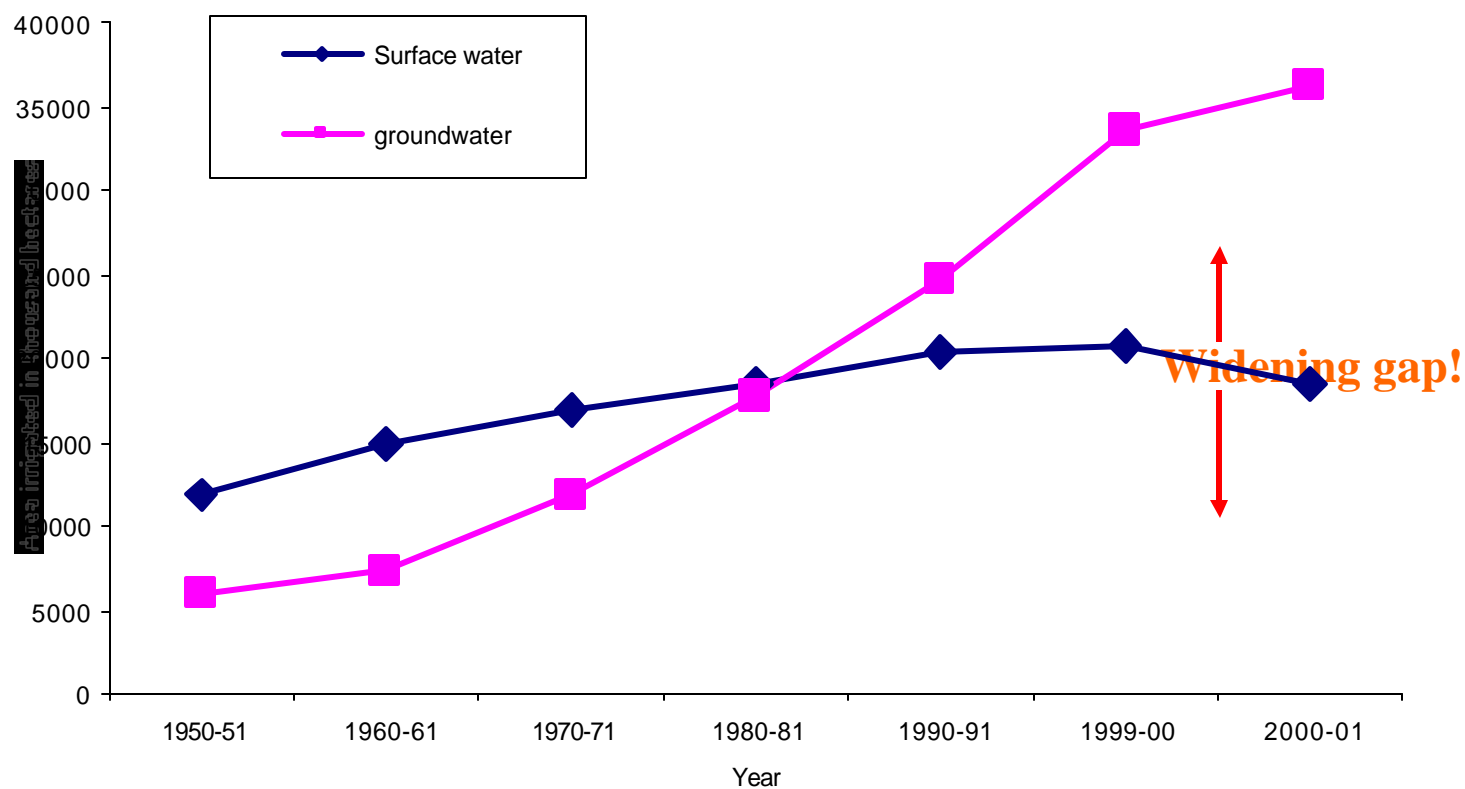
Even as we invested in large surface irrigation, and destroyed small irrigation systems of the people, groundwater use grew.

Even as government took control of water from communities, private ownership over water grew.

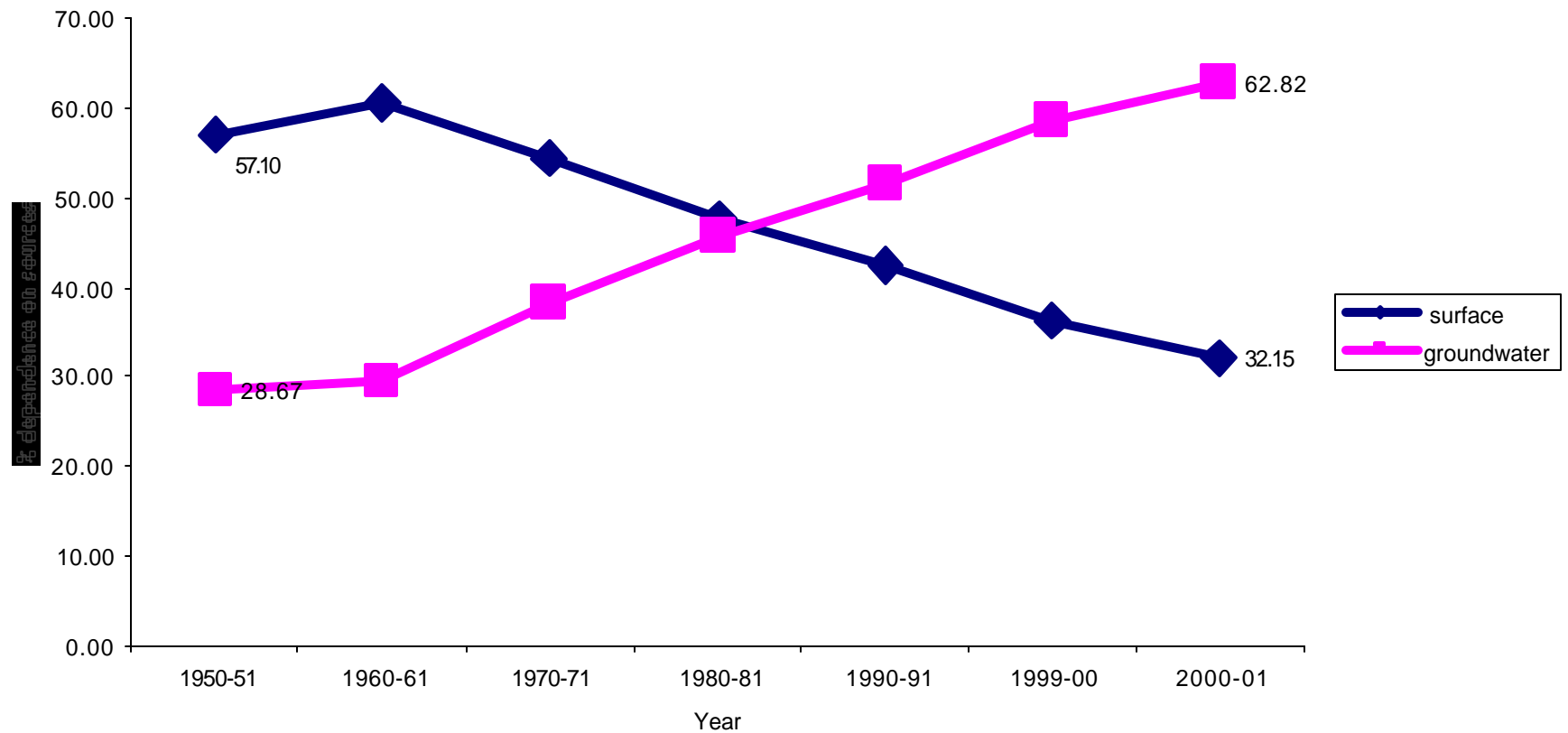




# Groundwater use grows

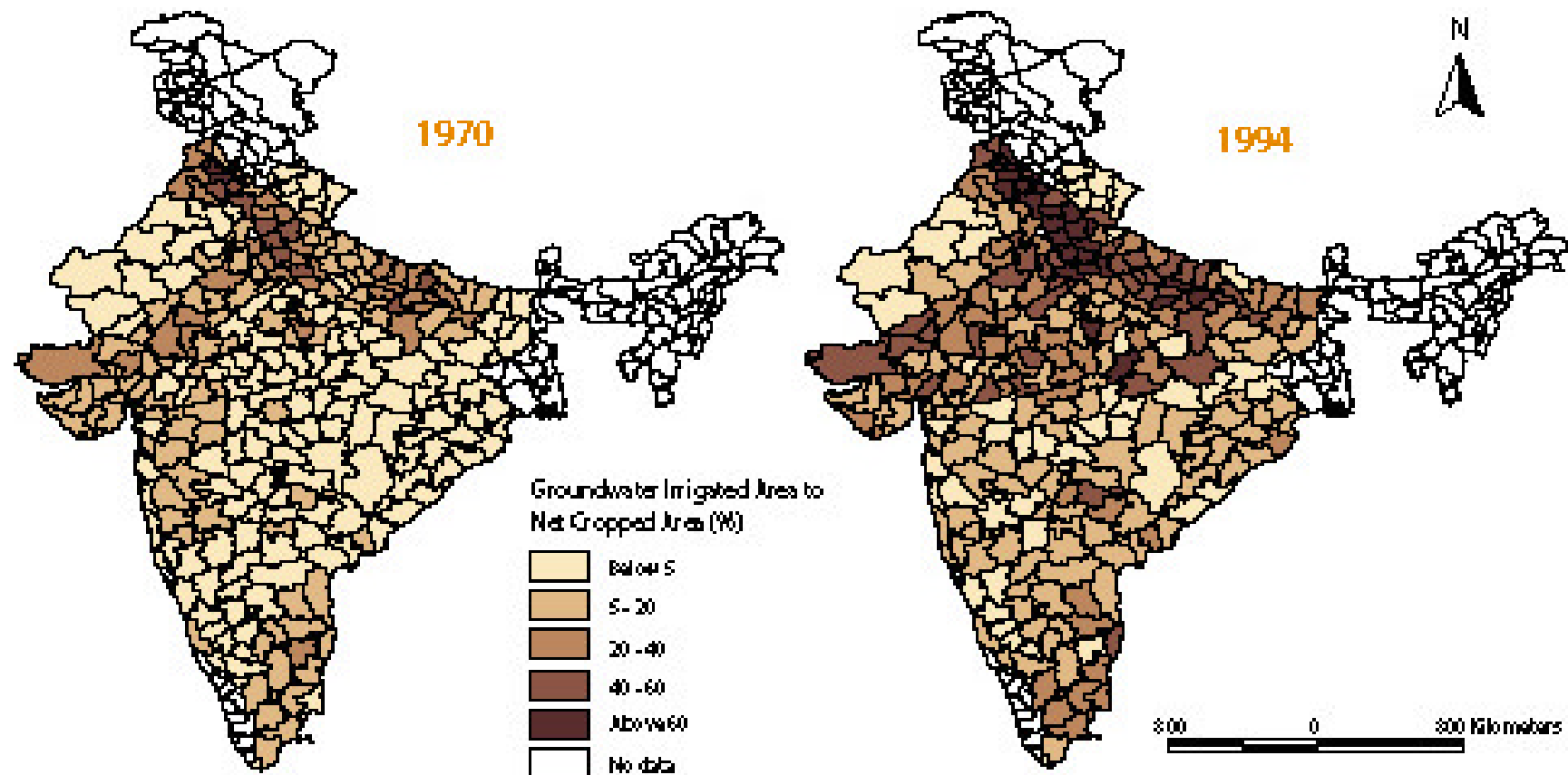


# Groundwater overtakes surface water irrigation





# Growing groundwater use



Source: IWMI, 2003



# Groundwater-rainwater banks

---

**80 % of agricultural output** today is dependent on groundwater.

**90 % of drinking water** is dependent on groundwater.

There are estimated 22 million well-users. Impossible to regulate.

## **Result:**

Groundwater levels declining. **CGWB says 65% districts overexploited**. But underestimate. Nobody really knows local groundwater levels.

## **Remember:**

Groundwater a bank. Live off the interest we recharge annually.  
Otherwise capital will be depleted.



# What do we do?

---

Most of it 'rainfed' groundwater: it is recharged by rain.

The **lakes and ponds and tanks** were the recharge systems for groundwater.

Rainwater harvesting a key. Hold rainwater when it falls.

Build the sponges for groundwater.  
Recharge individual wells.

# Recognise: water most fluid substance on earth

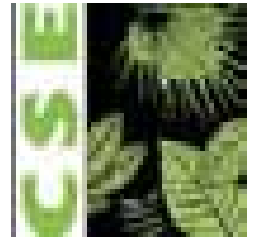
---



**Out of 8760 hours in a year, most of the rain in India falls in **just 100 hours**.**

**The solution is capturing, storing, recharging and then using the rainwater over the dry periods.**

**Our ancestors understood this.**



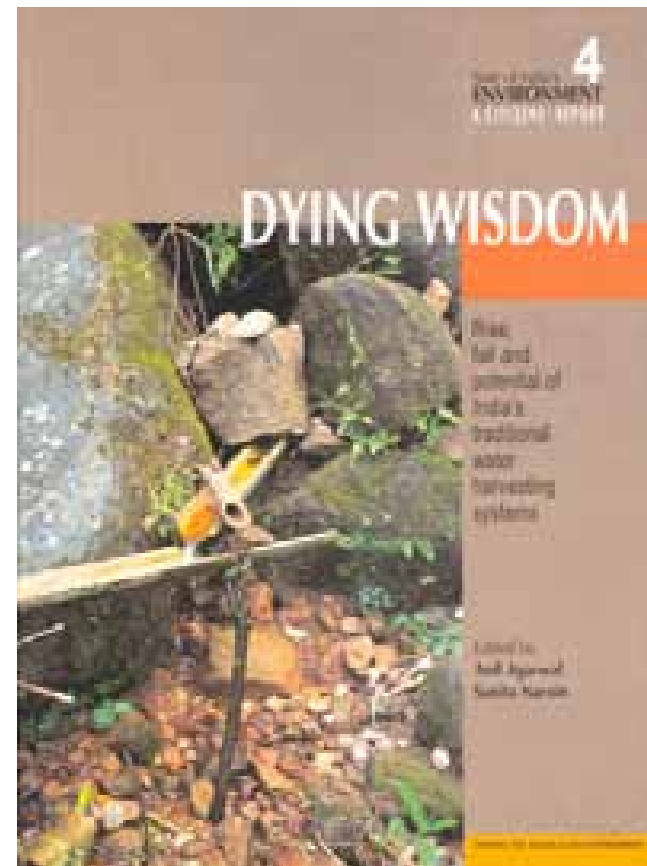
# Learning from traditions...

---

In 1997 we published Dying Wisdom:

Rich learning of our traditions.

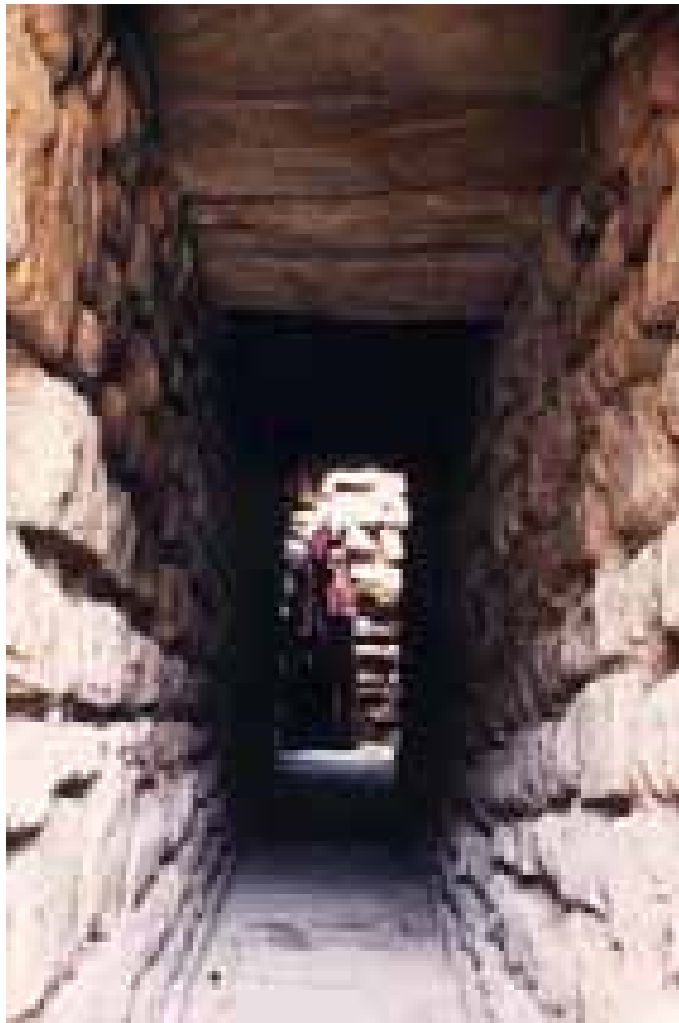
Enormous diversity, technological sophistication. Each region had its own system to hold, capture rain. *Zings, ahars, johads, tankas, phad.....*





# Traditional arithmetic

---



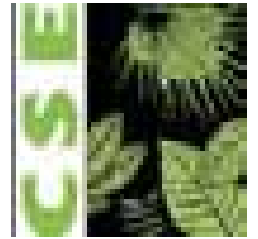
Indians learnt this water arithmetic as far back as 5,000 years. The city of Dholavira of the Indus Valley Civilisation was harvesting runoff in the dry Thar desert.





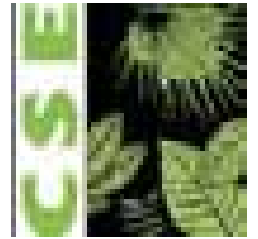
# Catch water where it falls A water harvesting structure

---



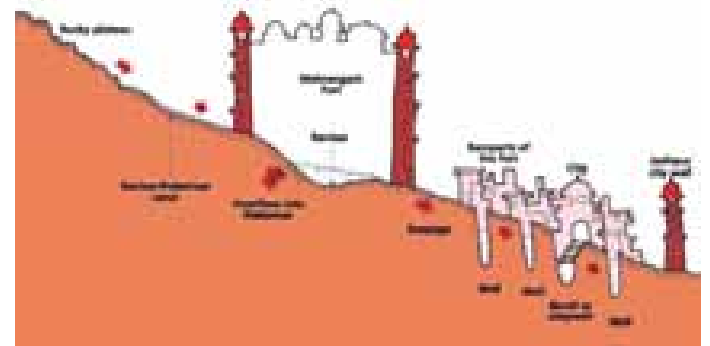
...tanks in hill forts  
in Rajasthan and cities like Jodhpur

---



...to integrated surface  
water and groundwater  
harvesting systems in  
cities...

(Jodhpur, Rajasthan)



# Cascade tanks in the district of Ramanathapuram in Tamil Nadu





# Enormous potential

---

**100 mm rain falling on 1 ha of land  
means 1 million litres of water.**

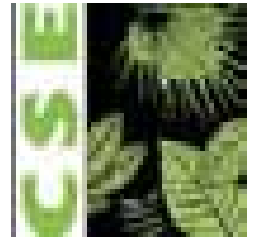
**There is no village in India which cannot  
meet its drinking water needs through its  
own rainwater endowment.**



Five years of  
drought.

Agriculture in  
Jaipur-Tonk  
district.





100 wells..water at 50 feet..note 5 years of drought...no canal irrigation...no government





**How? By painstakingly harvesting every drop of water for past 7-10 years**

---

Key

Village Laporiya.

Green: catchment

Blue: tanks

Rest: agriculture







# Need old-new culture of water

---

**There is never enough water.**

Cherrapunji in India gets 11,000-14,000 mm of rain. Water stressed.

Jaisalmer get 100 mm of rain. No recorded history of evacuation.

Drought not about scarcity of water. But about relationship of society with water.

Need culture of **prudence** and **careful use**.



## But water is not about water.....

---

....about decentralisation.

All watershed-pond-tank projects look at water.

Not the land from where water will be harvested.

All watershed-pond-tank projects look at

bureaucracies. Not the people who will manage

Need new approaches:

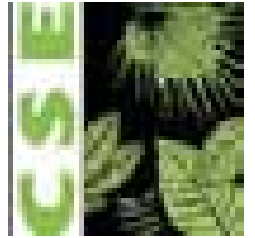
Involve panchayats in water management

Give rights over watershed to panchayats-gram sabha.

## Sukhomajri Village 1985

**Degraded watershed of a small reservoir built by the villagers**

---



## Sukhomajri Village 1998

**Well protected catchment of the village reservoir  
managed by villagers**

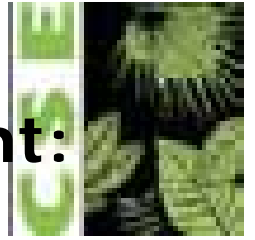
---



Sukhomajri Village 2004

**Forest of *Acacia catechu* in the catchment:  
estimated value of Rs. 90 crore**

---



**But under law they cannot cut. It is forest department property**



# What we suggest:

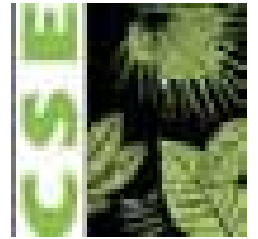
---

1. Launch a national **water conservation programme**;
2. Make water central to employment guarantee programme;
3. Put water assets in control of panchayats-gram sabha.
4. Make coordination-agency for common land at village level. Catchments of waterbodies – forest or revenue -  
- must be under this agency.
5. Launch a **million well recharge** programme. Provide grant or rebate in interest for well recharge-farm pond programme.

**Rain is decentralised. So is the demand for water.  
Why can't we decentralise supply?**

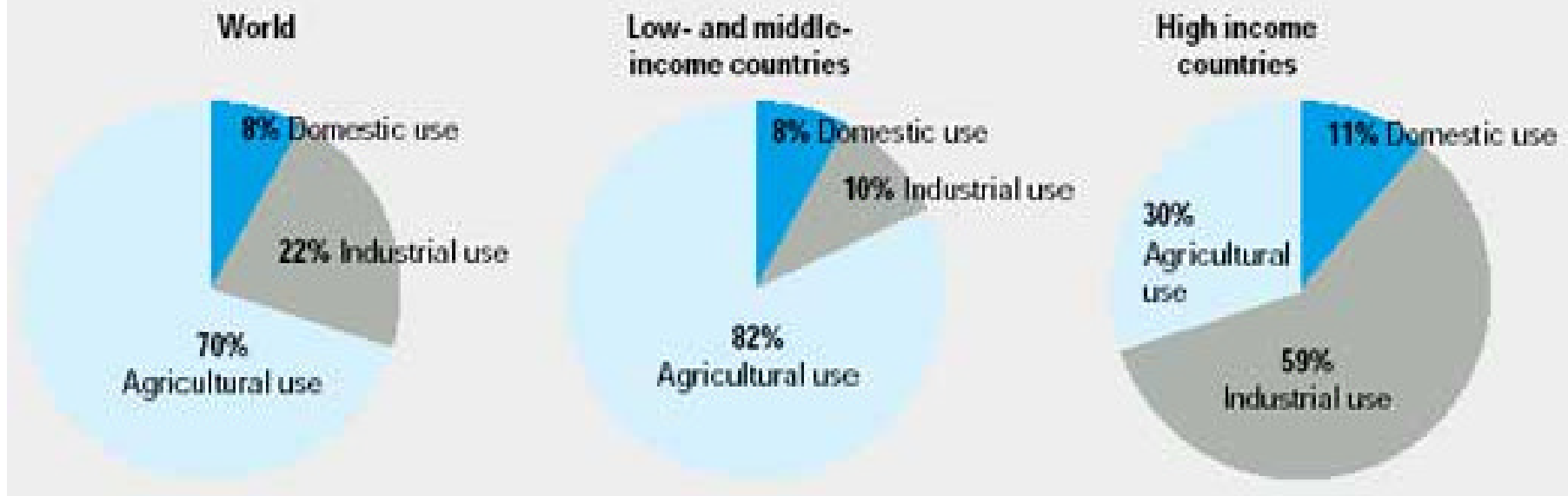
**Catch water where it falls**

# Can we afford the modern water economy?



## Water use worldwide

What if developing countries follow their developed counterparts?



**Our problem: becoming modern but remaining traditional**



# Urban water crisis: frightening. Will put pressure on rural water

---

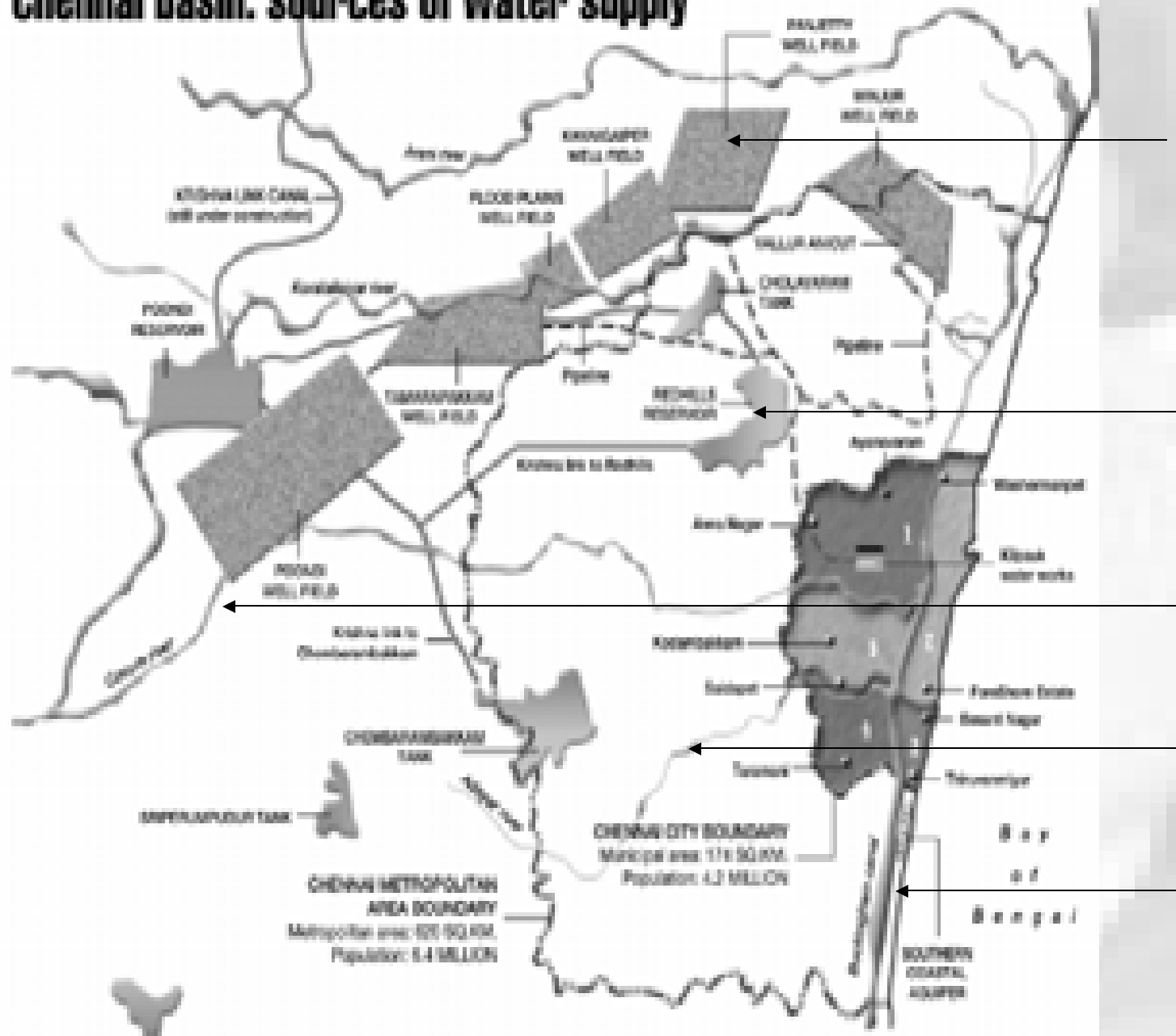


The gap between demand and supply increasing.  
**Powerful cities. Can get water.**

**Chennai** water from 200 km ;  
**Bangalore** pumps from 95 km (Cauvery)  
**Delhi** will get water from Tehri dam.  
**Hyderabad** from 100 km (Manjira+Krishna)

Smaller towns even more desperate situation.  
Each summer it is getting worse.

# Chennai basin: sources of water supply



**Well Fields**

**Reservoirs**

**Cooum River**

**Adyar River**

**Coastal  
Aquifers**

Source : Chennai Metro Water Supply & Sewerage Board



# Political economy of water

---

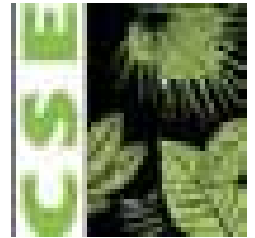
Cities do not plan for water recharge.

Every monsoon leads to floods (Mumbai++)

Cities are water wasteful.

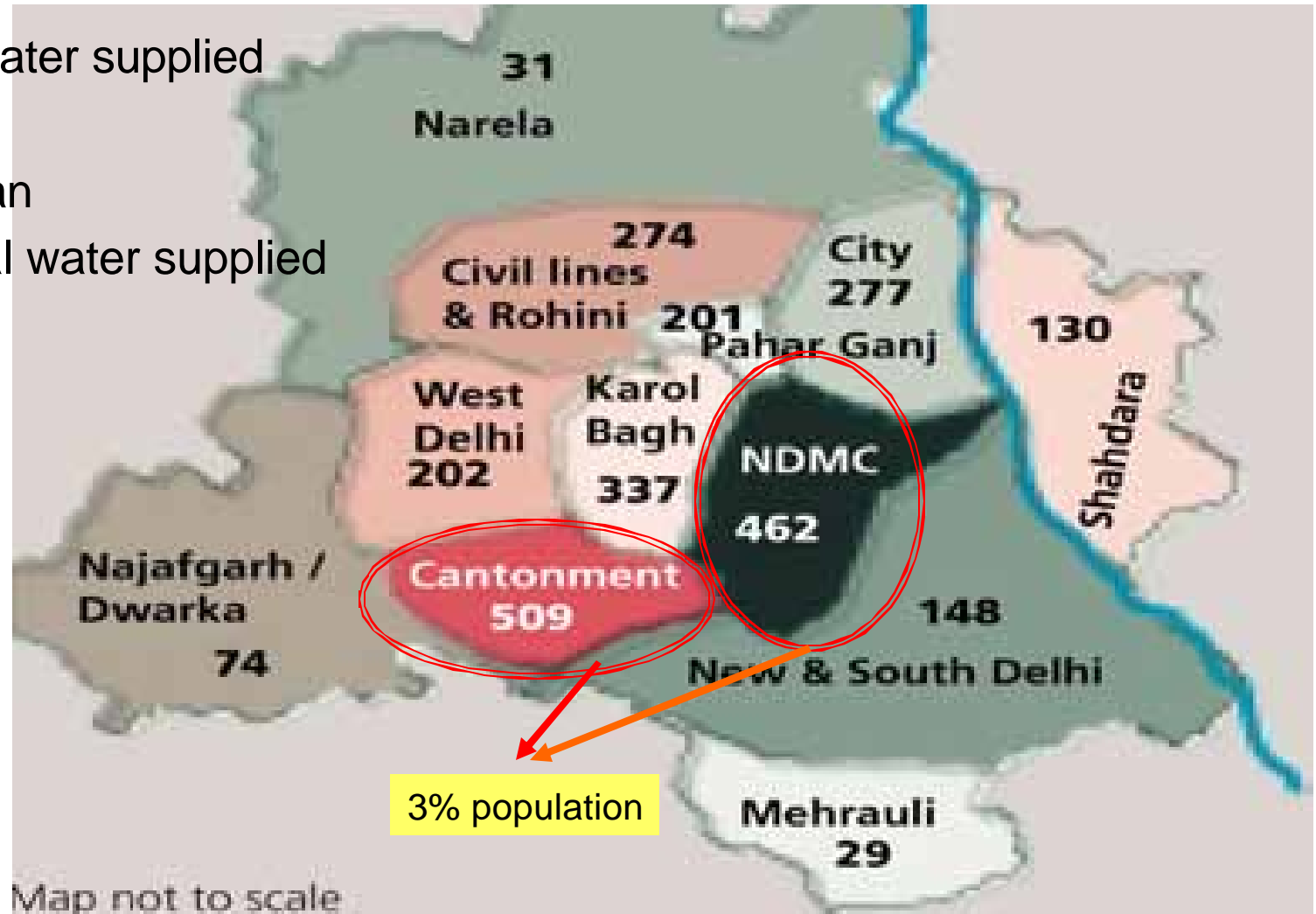
Cities are water inequitous. Parts have more. Most have less.

# Who uses more water, generates more waste.

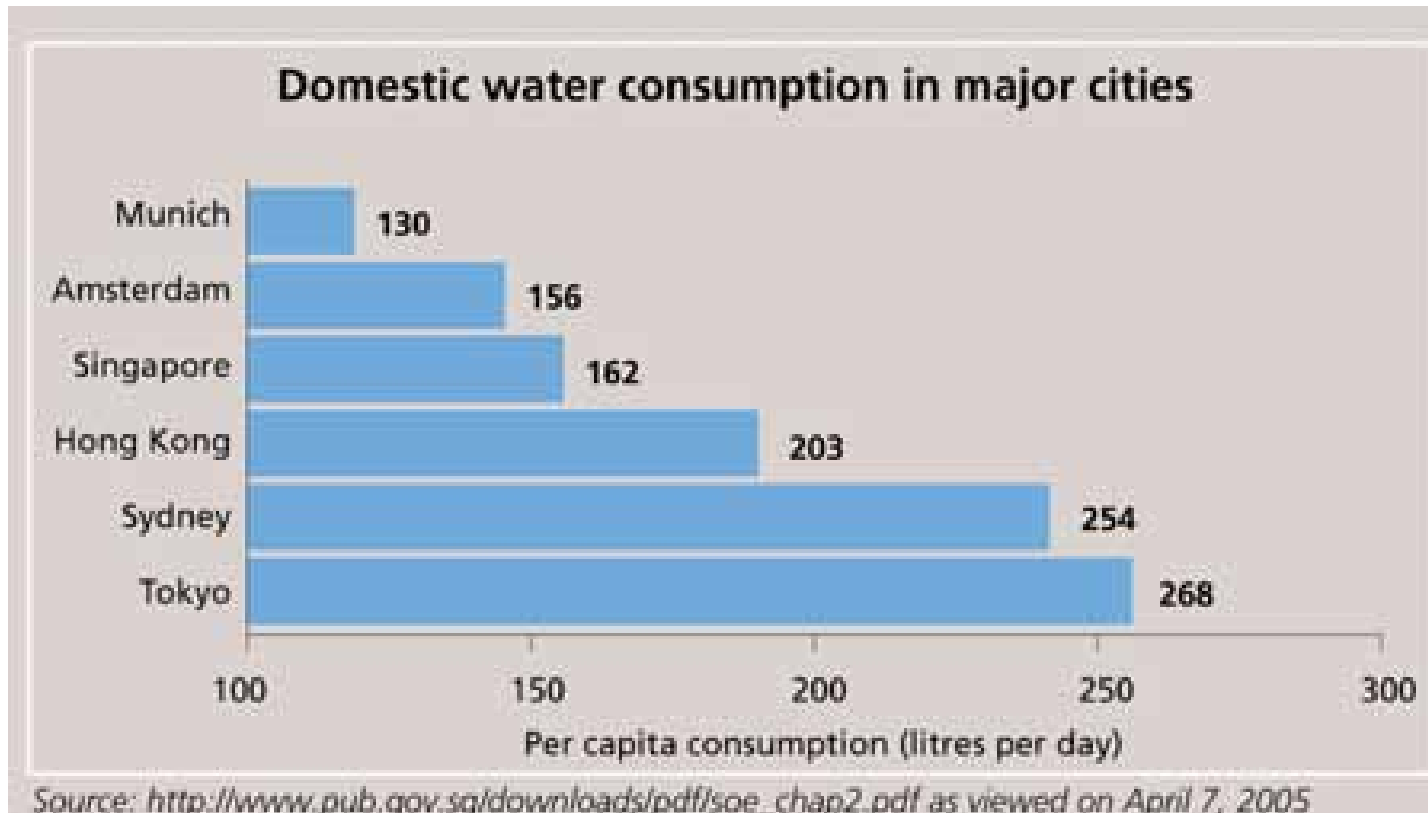
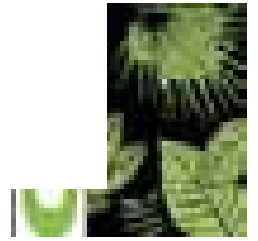


3 % gets 11% water supplied

70 % get less than  
5 per cent of total water supplied



# More water is not the answer

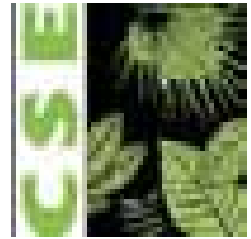


## DELHI

♣ Per capita  
**availability**  
211 lpcd

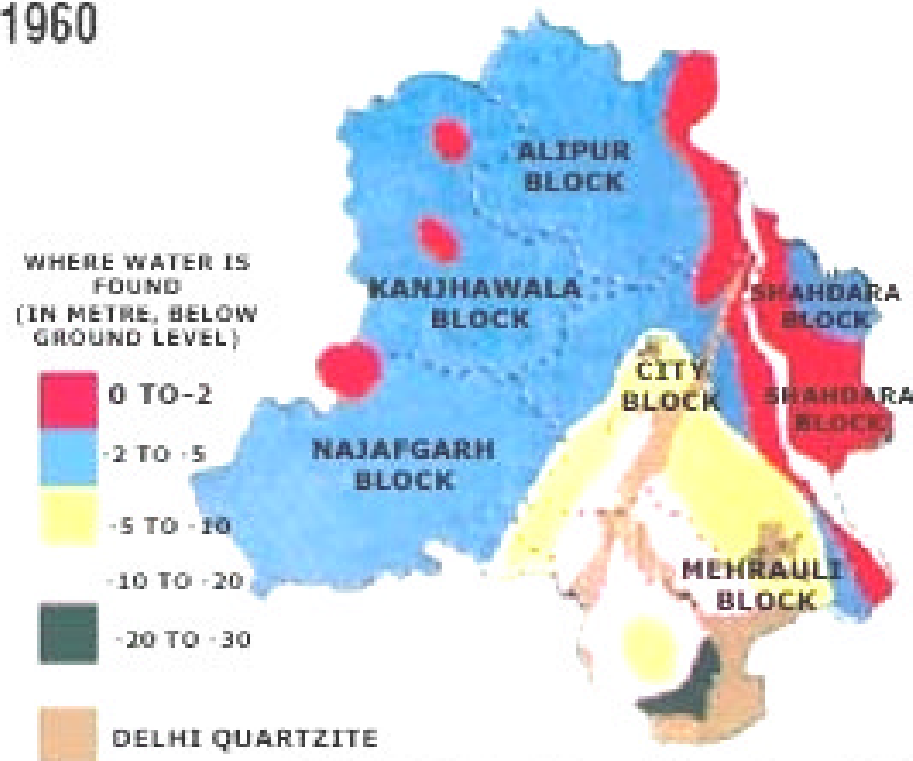
♣ 2011  
Master plan  
targets 363  
lpcd

**Need answers that are different. Less wasteful.**



# Use groundwater. Do not plan for recharge

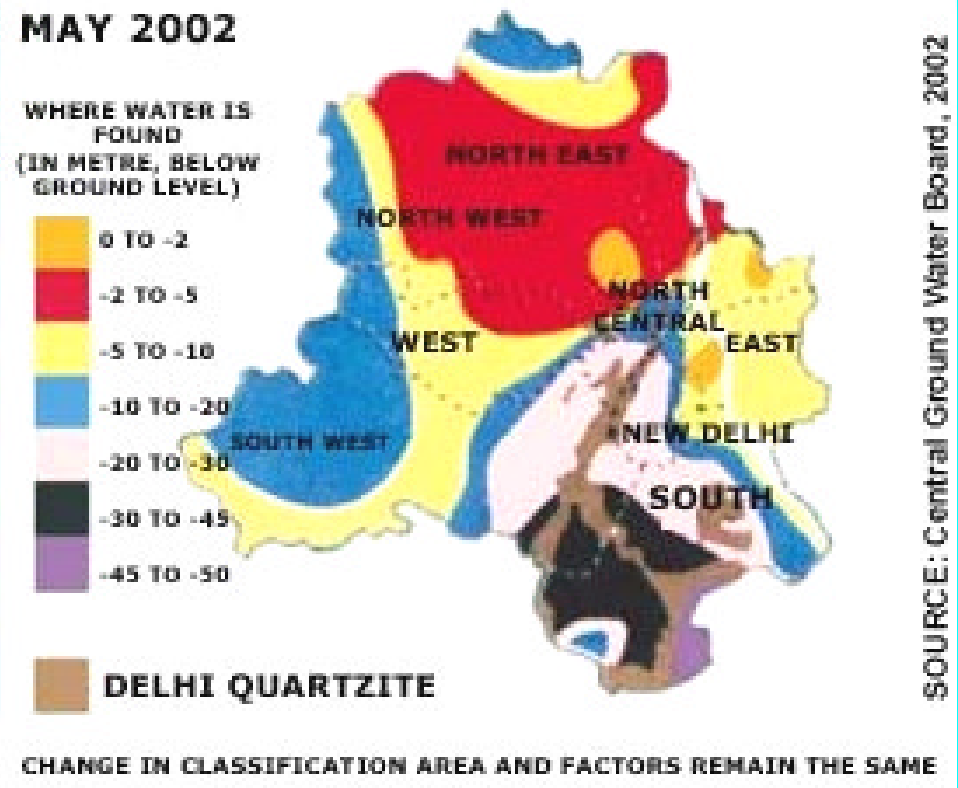
1960



SOURCE: Central Ground Water Board, 2002

Dipping watertable

MAY 2002



SOURCE: Central Ground Water Board, 2002

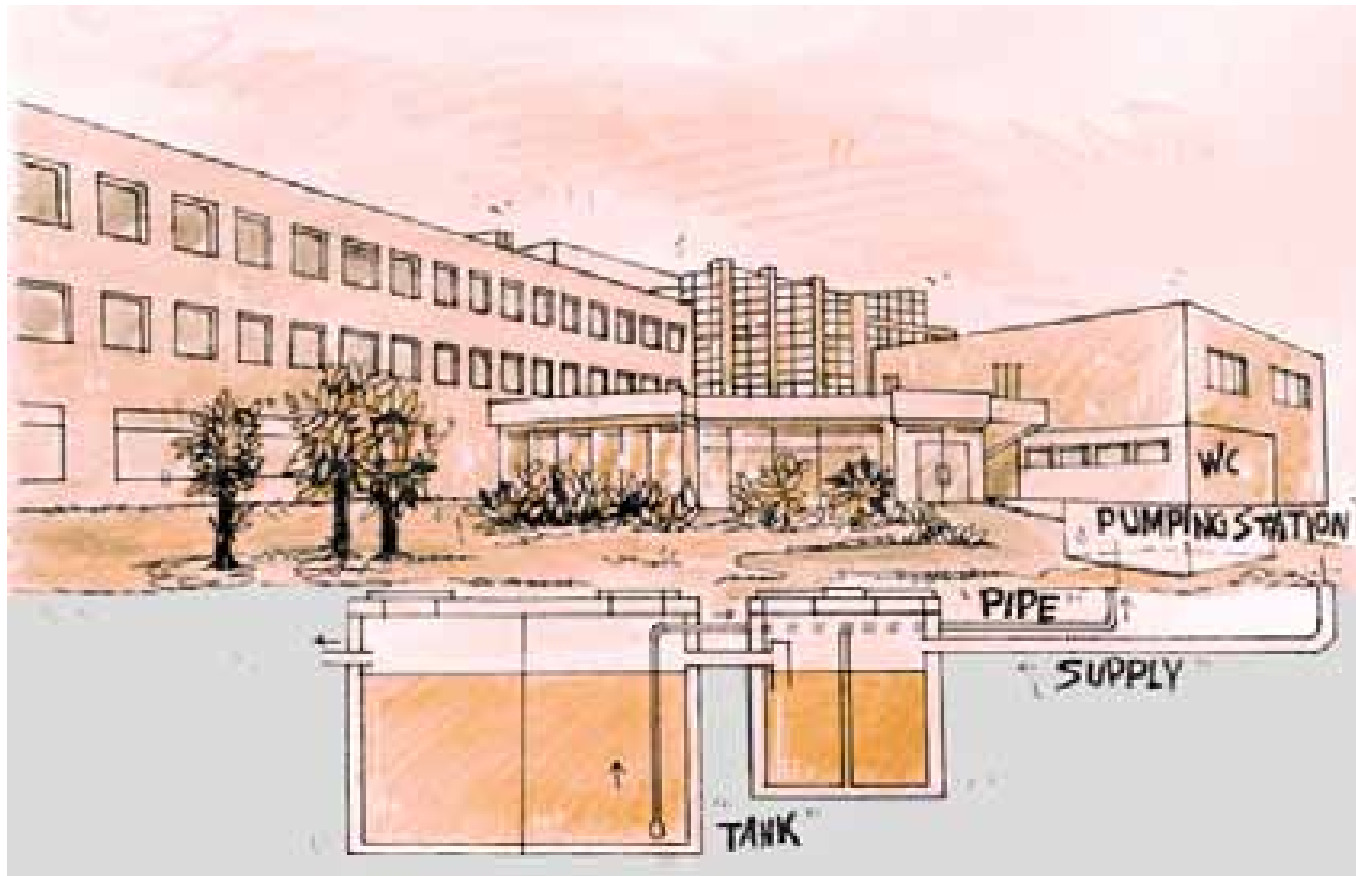
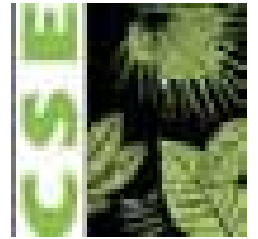


**Waterbodies are sponges. To hold water, recharge groundwater. Dirty.**  
**— Dead. Forgotten. Builders lobby**



World is learning from our traditions  
Germany: water collected used in toilets.

---







# Singapore: catches water for needs

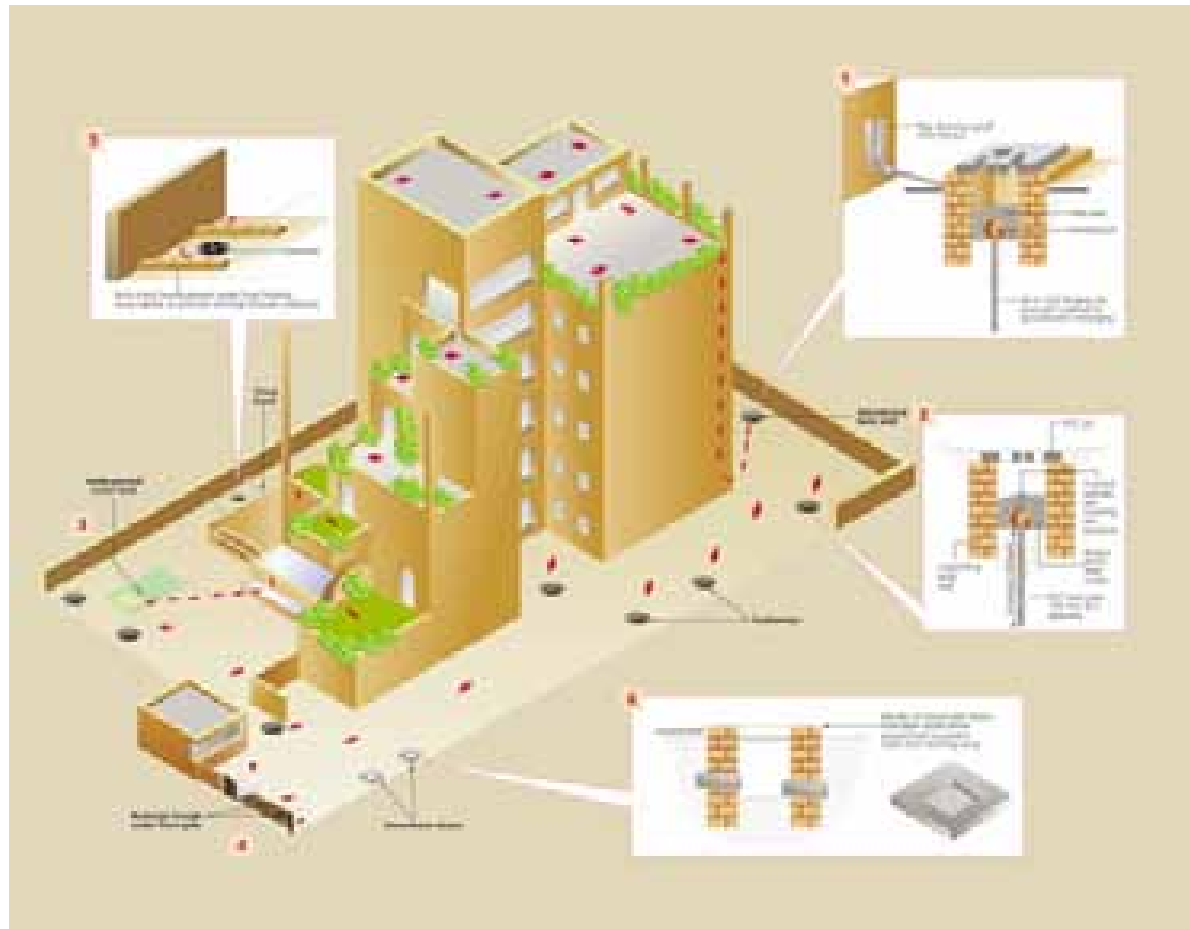
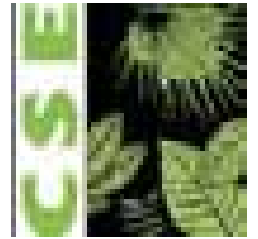
---

Singapore harvests rain. Highest population density in the world

**About 50 per cent of the land area is used as catchment for water.**

In Changi international airport runoff is collected from rooftops and runways. Treated and used for fire fighting and toilet flushing. Annual savings amount to US \$ 243,000

Has to be done. Many such examples today...Rashtrapati Bhawan..must be mandatory in every city, every house





To replicate these models: Strict **LEGISLATION** required;  
Relearning required. Forgotten wisdom.

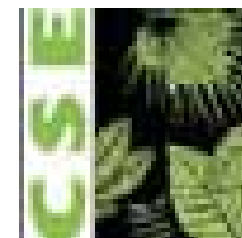
---

NAME OF THE CITY	EXISTING LEGISLATION	STATUS OF IMPLEMENTATION
<b>NEW DELHI</b>  (ORDERS OF DELHI GOVERNMENT AS WELL AS THE CGWB)	<ul style="list-style-type: none"><li>NEW DEVELOPMENTS IN A PLOT AREA MORE THAN 1000 SQUARE METRES</li><li>NEW BUILDINGS WITH AN AREA OF 100 SQM OR MORE</li><li>ALL INSTITUTIONS AND RESIDENTIAL COLONIES IN NOTIFIED AREAS</li><li>ALL THE BUILDINGS HAVING A TUBEWELL</li></ul>	AVERAGE  <b>(DEADLINE OF CGWB EXPIRED LAST YEAR. BUT NO ACTION AGAINST DEFAULTERS)</b>



Required legislation: will need more..

NAME OF THE CITY	EXISTING LEGISLATION	STATUS OF IMPLEMENTATION
INDORE	<ul style="list-style-type: none"><li>NEW BUILDINGS WITH AN AREA OF 250 SQM OR MORE</li><li>A <b>REBATE OF 6 PER CENT ON PROPERTY TAX</b> FOR IMPLEMENTING RWH SYSTEMS</li></ul>	SOME IMPLEMENTATION
HYDERABAD	<ul style="list-style-type: none"><li>ALL NEW CONSTRUCTIONS WITH AN AREA MORE THAN 300 SQM</li><li>TENTATIVE DEADLINE WAS JUNE 2001</li></ul>	POOR
RAJASTHAN	<ul style="list-style-type: none"><li>RAINWATER HARVESTING IS MANDATORY FOR ALL PUBLIC ESTABLISHMENTS AND ALL PROPERTIES IN PLOTS COVERING MORE THAN 500 SQM IN URBAN AREAS</li></ul>	



## Rainwater harvesting: needs will

NAME OF THE CITY	EXISTING LEGISLATION	STATUS OF IMPLEMENTATION
<b>CHENNAI</b>	RWH MADE MANDATORY IN THREE STORIED BUILDING IRRESPECTIVE OF ROOF TOP AREA ALL NEW WATER AND SEWER CONNECTIONS TO BE PROVIDED AFTER THE IMPLEMENTATION OF RWH SYSTEMS	GOOD
<b>MUMBAI</b>	<ul style="list-style-type: none"> <li>Ø SINCE OCTOBER 1, 2002, RWH MADE MANDATORY IN ALL NEW CONSTRUCTIONS COMING UP IN A PLOT OF MORE THAN 1,000 SQM</li> <li>Ø THE BRIHANMUMBAI MUNICIPAL CORPORATION HAS MADE WATER RECYCLING AND TREATMENT MANDATORY FOR ALL HOTELS, INDUSTRIES AND HOUSING SOCIETIES</li> </ul>	-
<b>HARYANA</b>	ALL NEW BUILDINGS WITH A ROOF AREA GREATER THAN OR EQUAL TO 100 SQM	

# Techniques.....

## HOW TO HARVEST RAINWATER

Broadly,  
rainwater can  
be harvested  
for two  
purposes:

RAINWATER

Stored for ready use in containers  
above ground or below ground

Charged into soil for withdrawal  
later (groundwater recharging)



RAINWATER CAN BE STORED IN TANKS



RAINWATER CAN BE  
RECHARGED INTO THE  
GROUND



# Potential...

---

Type of catchment	Runoff coefficient
Roof catchments	0.80 –0.90
Paved areas	0.60 –0.80
Untreated ground catchments	0.00-0.20

## An example

$$A=100 \text{ m}^2$$

$$R = 100 \text{ millimeters}$$

$$C=0.80$$

**Rainfall endowment**

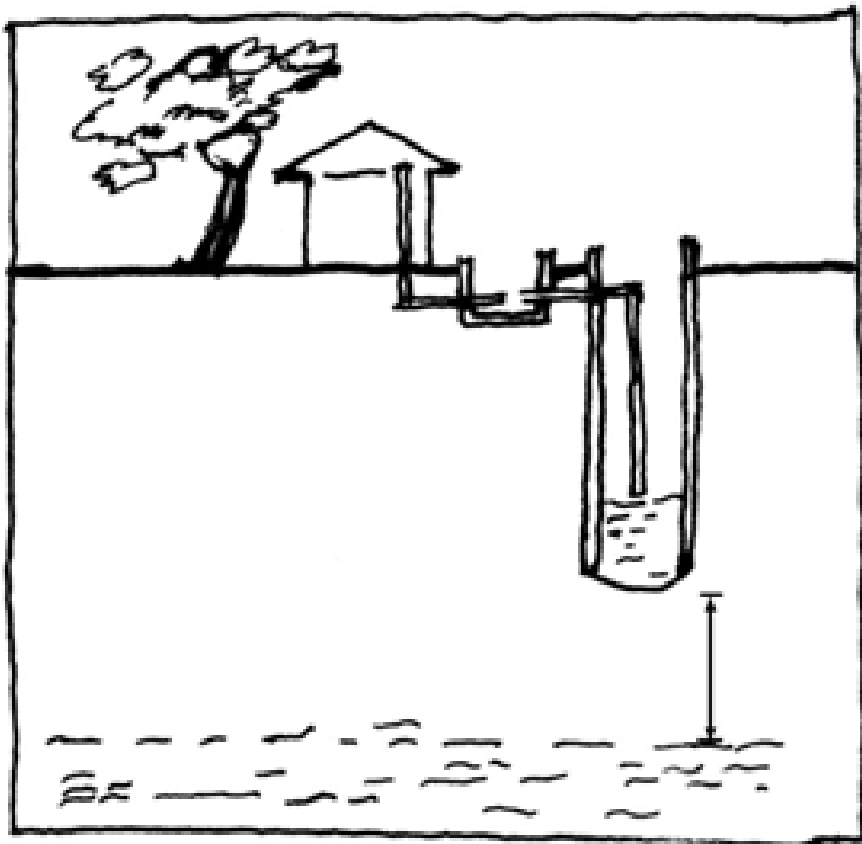
**=10,000 Litres**

**Rainwater harvesting  
potential = 8,000 liters**



# Quality control

---



Keep catchments clean

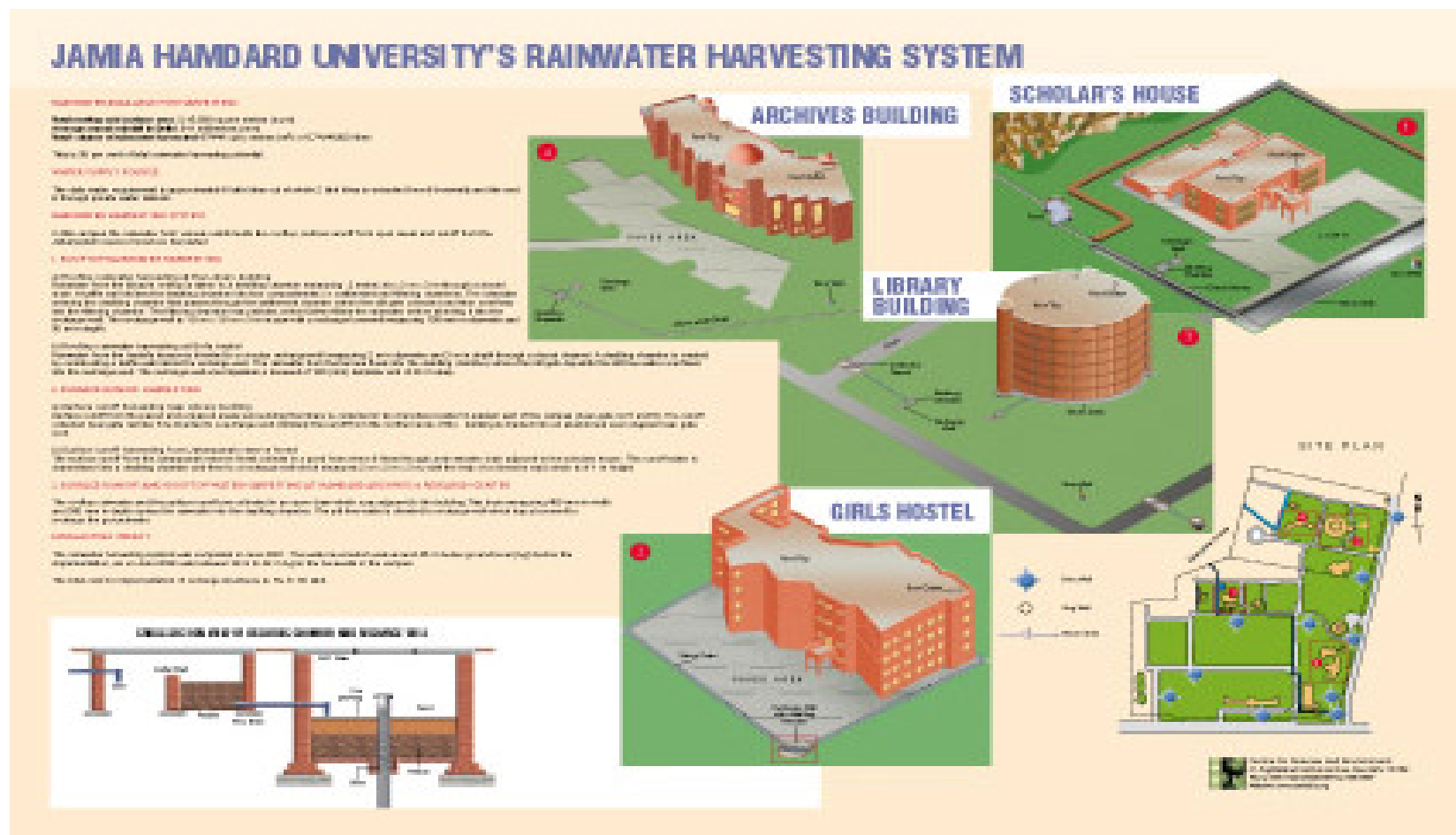
Avoid polluted runoff from  
entering into the recharge  
structures

Do first flushing

Make available a layer of  
soil beneath the recharge  
structure to ensure  
filtration



# Jamia Hamdard University



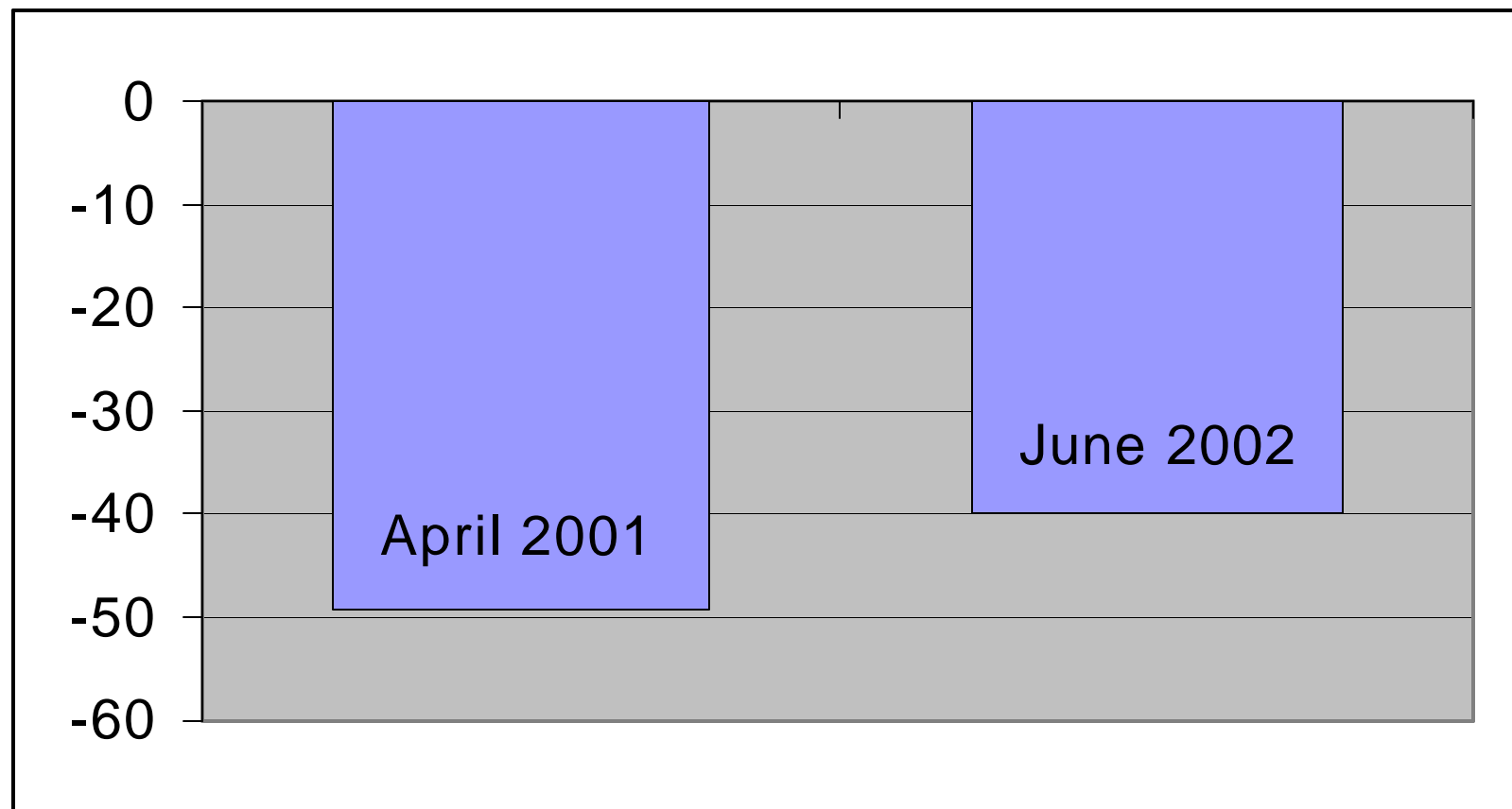


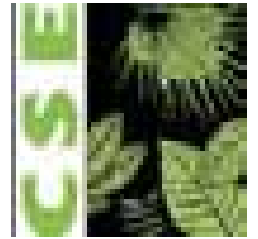
Total rooftop and surface area – 3,15,380 square meters (sq m)

Total volume of water available from rainfall – 57,800 m<sup>3</sup> or 5,78,00,000 litres (35 per cent of total rainwater harvesting potential)

# Hamdard girls hostel

---





## **Water literacy in cities**

---

**Create rain-centres in every city**

**Train engineers-plumbers in our traditions.**

**Restore tanks-ponds.**  
**No builder allowed to destroy tanks.**





## The quality challenge: sewage

---

**Sewage systems do not exist in our cities – waste pollutes the ground or pollutes the river and stream**

**But also:**

**Sewage systems exist but treatment does not and sewage still pollutes rivers, streams**

**But also:**

**Sewage systems exist and treatment exists but there is no money to run it or sewage is not connected to plant, sewage still pollutes rivers and streams..**

**Sewage-excreta biggest challenge for modern India**



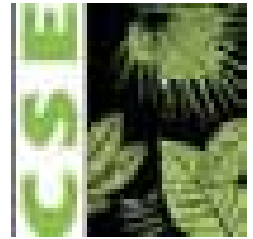
# Quality-health challenge

---

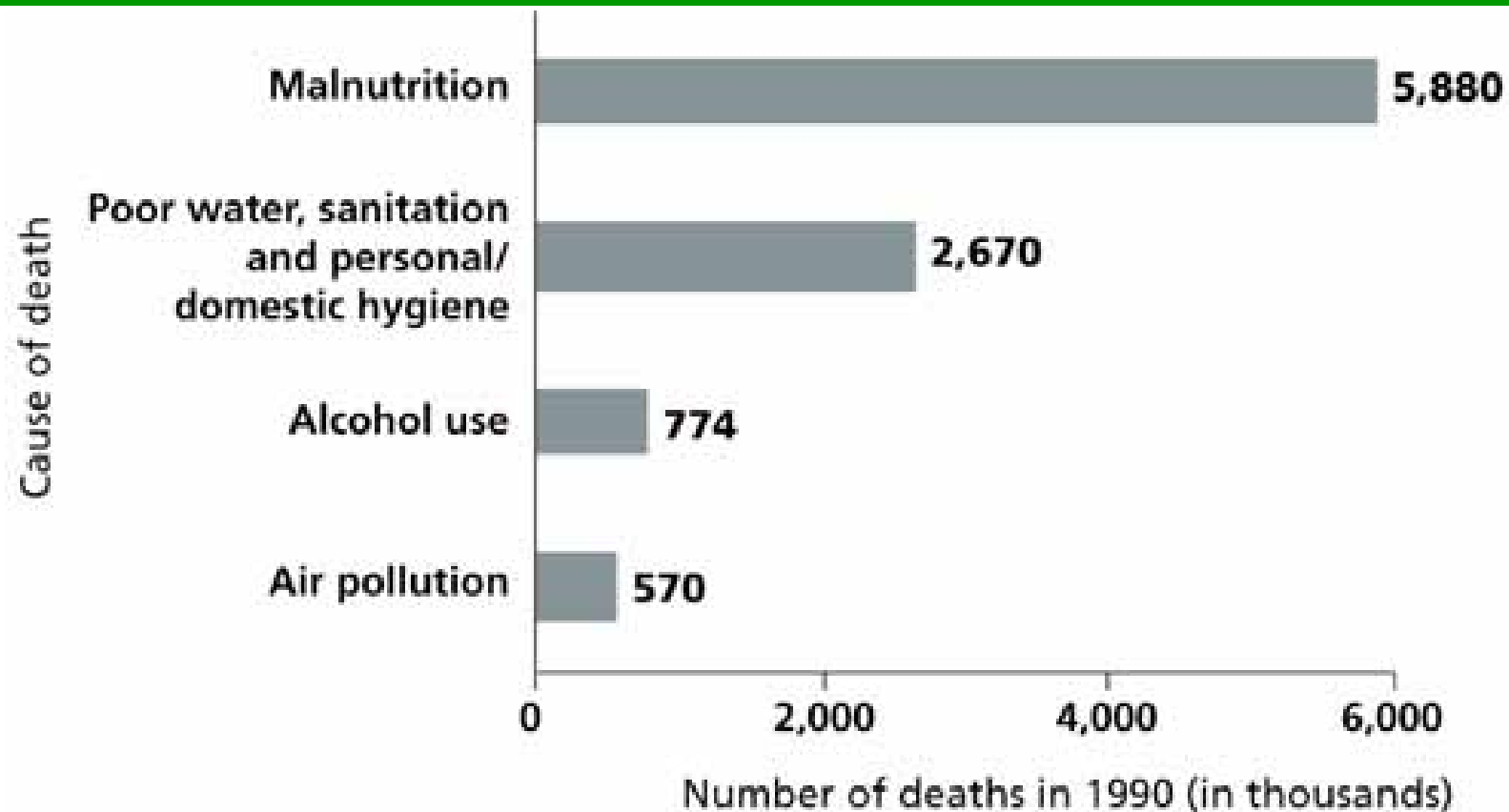
Tremendous costs to health of poor.

Dirty water still the biggest killer in India.

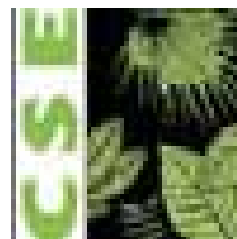
Study estimates 2.06 million deaths of children in 1999 in India. 90% in poor rural households. **If all household had clean fuel, private (clean) water, private toilet would reduce infant child mortality by roughly 1 million (half the deaths). Criminal. Shameful.**



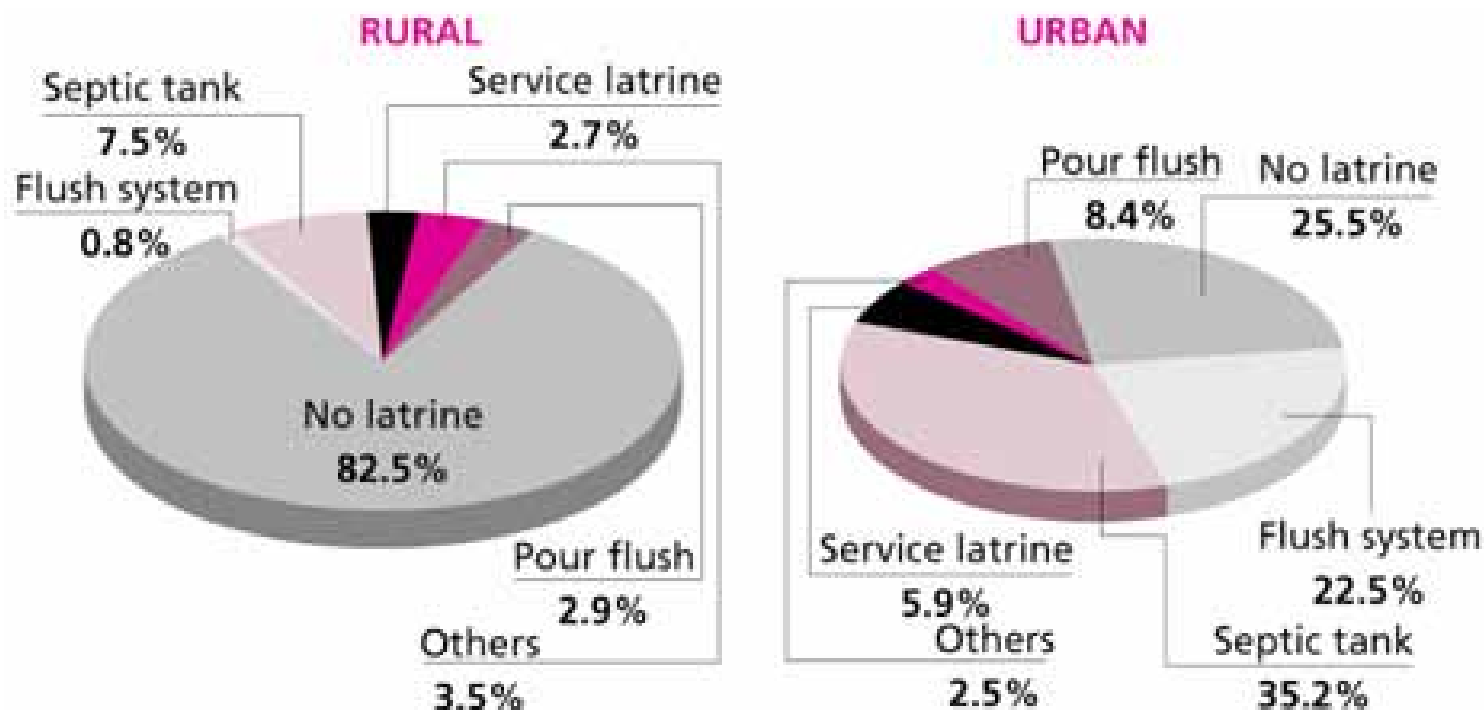
# Without treatment is the second-largest killer



Sources: Peter H Gleick, The World's Water, 2000-2001, p11; Abstract Volume, First International Conference on Ecological Sanitation, November 5-8, 2001, p7; Status of water supply and waste water generation, collection, treatment and disposal in metrocities (1994-95), CPCB, August 1997, p32-33; Anon July 1999, Drinking water, sanitation and hygiene in India, NSSO, p40



## The urban-rural divide: the urban-water divide



Sources: Peter H Gleick, The World's Water, 2000-2001, p11; Abstract Volume, First International Conference on Ecological Sanitation, November 5-8, 2001, p7; Status of water supply and waste water generation, collection, treatment and disposal in metrocities (1994-95), CPCB, August 1997, p32-33; Anon July 1999, Drinking water, sanitation and hygiene in India, NSSO, p40





## Sewage: technology cannot afford

---

Only 20 per cent of the water is used for drinking, cooking;

Over 60 per cent is used for bathing, washing and flushing down the toilet. Important that our water toilets are still 10-12 litres per each pull of the chain.

Literally, water down the drain....80% potable water ends up as waste-water

# Sewage systems cost the earth

---



We do not pay the cost of cleaning and distributing water.

Sewage and treatment costs are estimated to be 5 times higher than cost of providing water.

Who will pay?



# Political economy of defecation

---

More water-more sewage

Water used as carrier

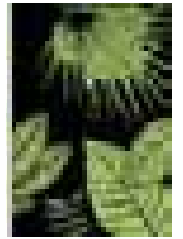
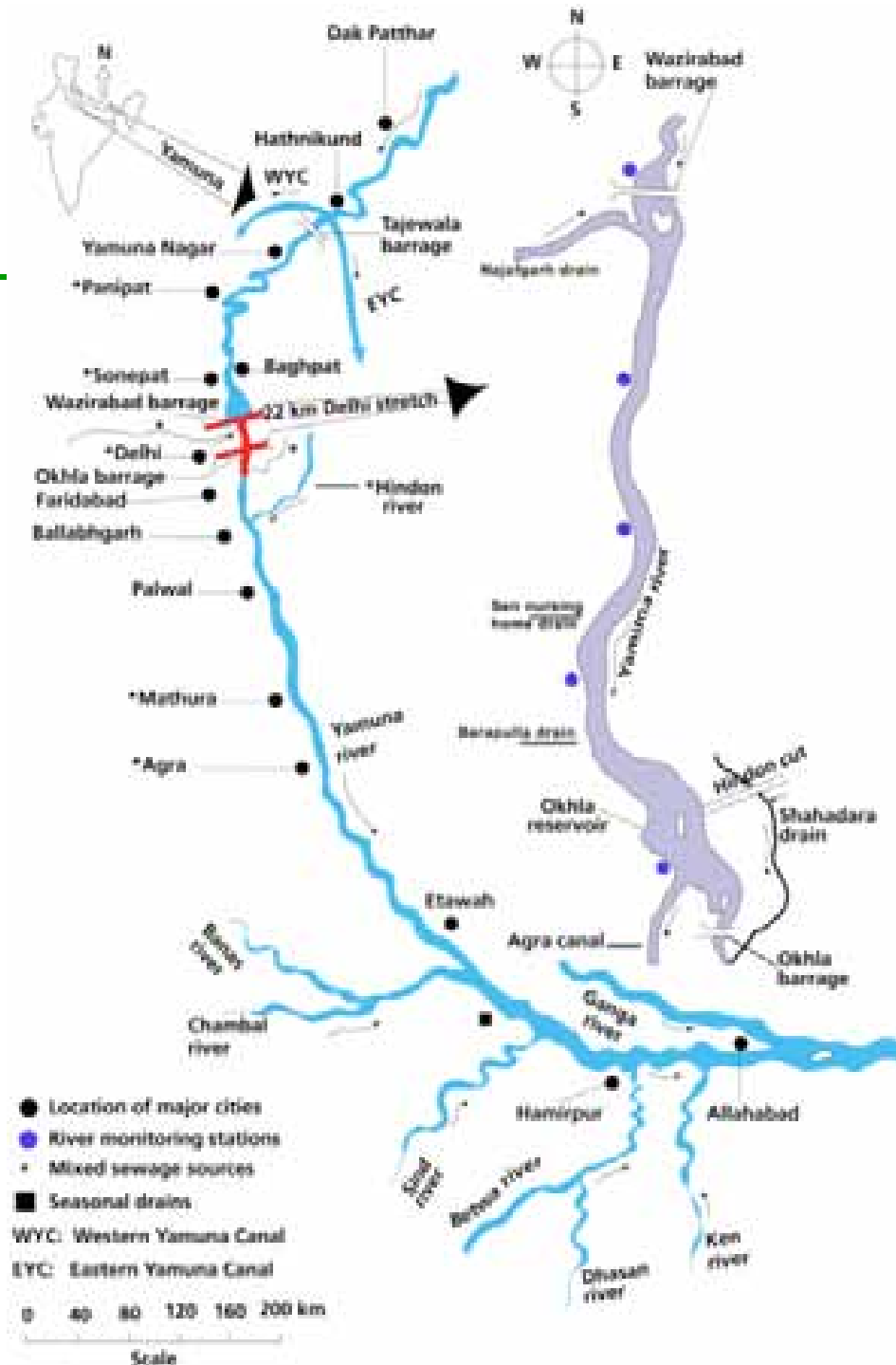
Water used as disposal point

Cheap water, unpaid sewage costs and then water treatment costs.

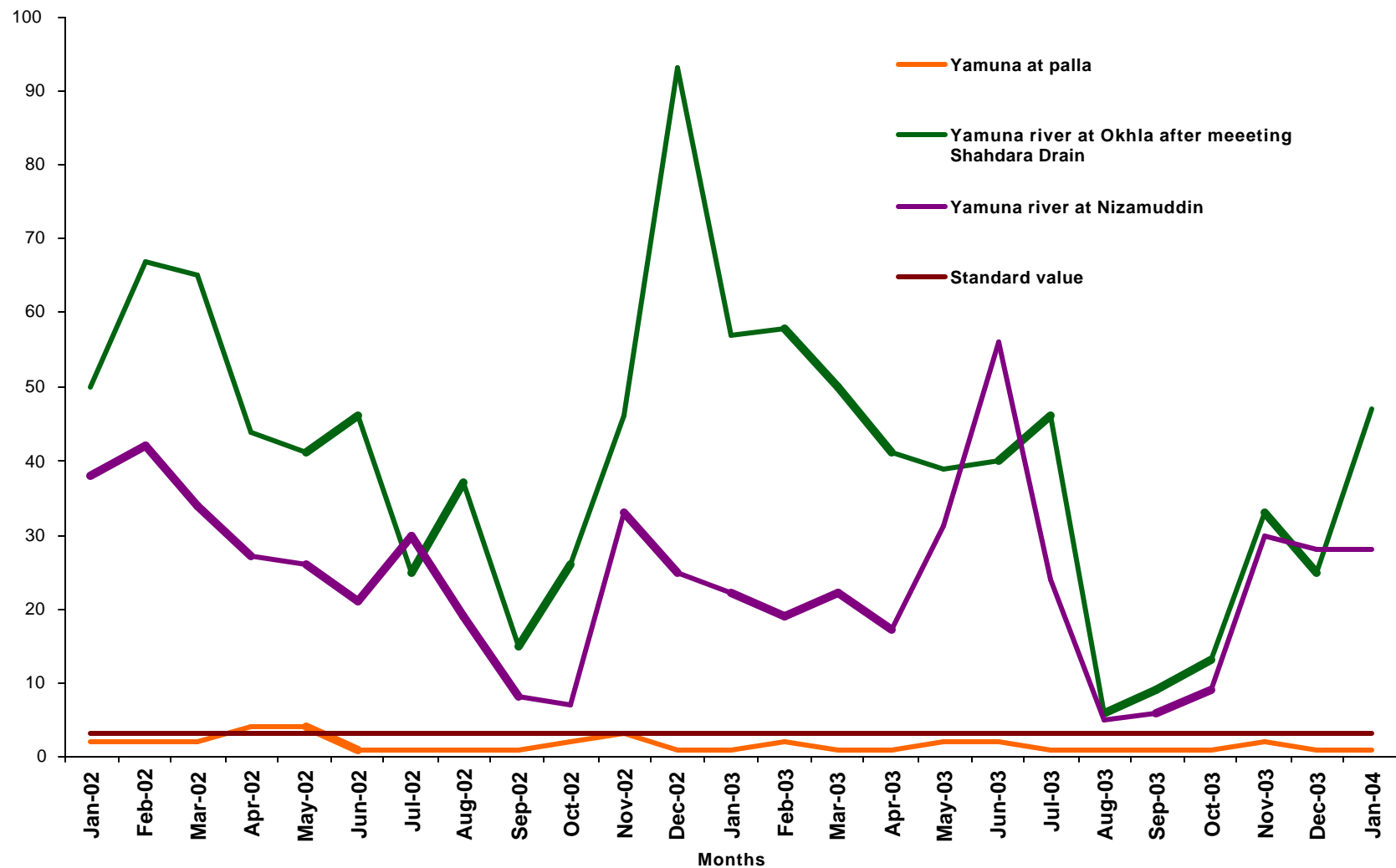
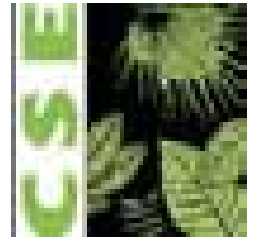
Only 7 per cent sewage treated in the country.

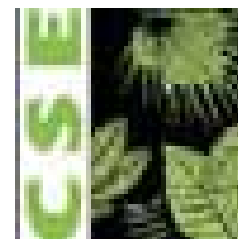
**In this situation: rich are subsidised to defecate.**

22 Km  
stretch in  
Delhi  
contributes  
70 per cent  
of the total  
pollution  
load of the  
river.



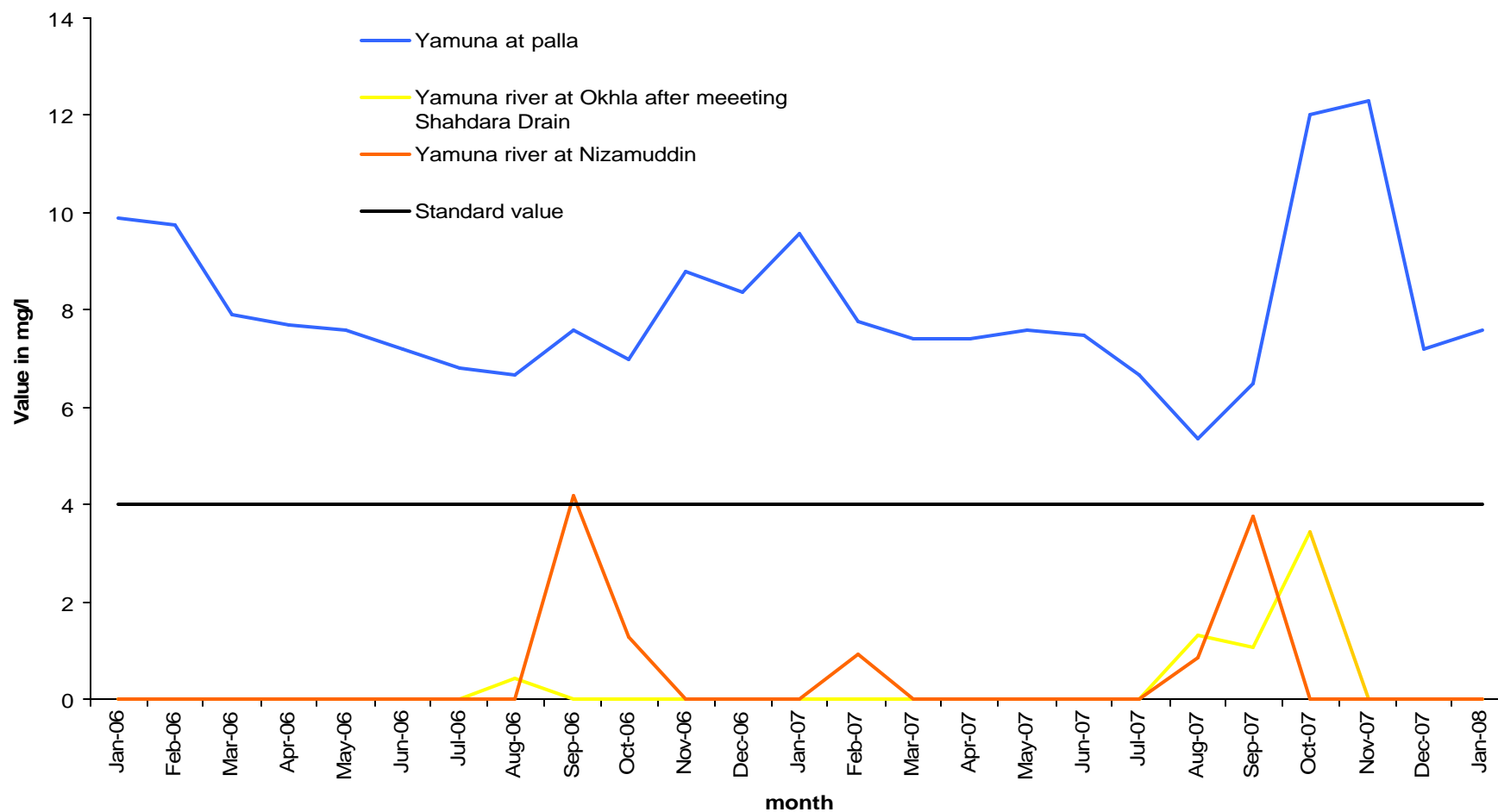
# Water pollution: Yamuna a dirty drain of Delhi (BOD levels)



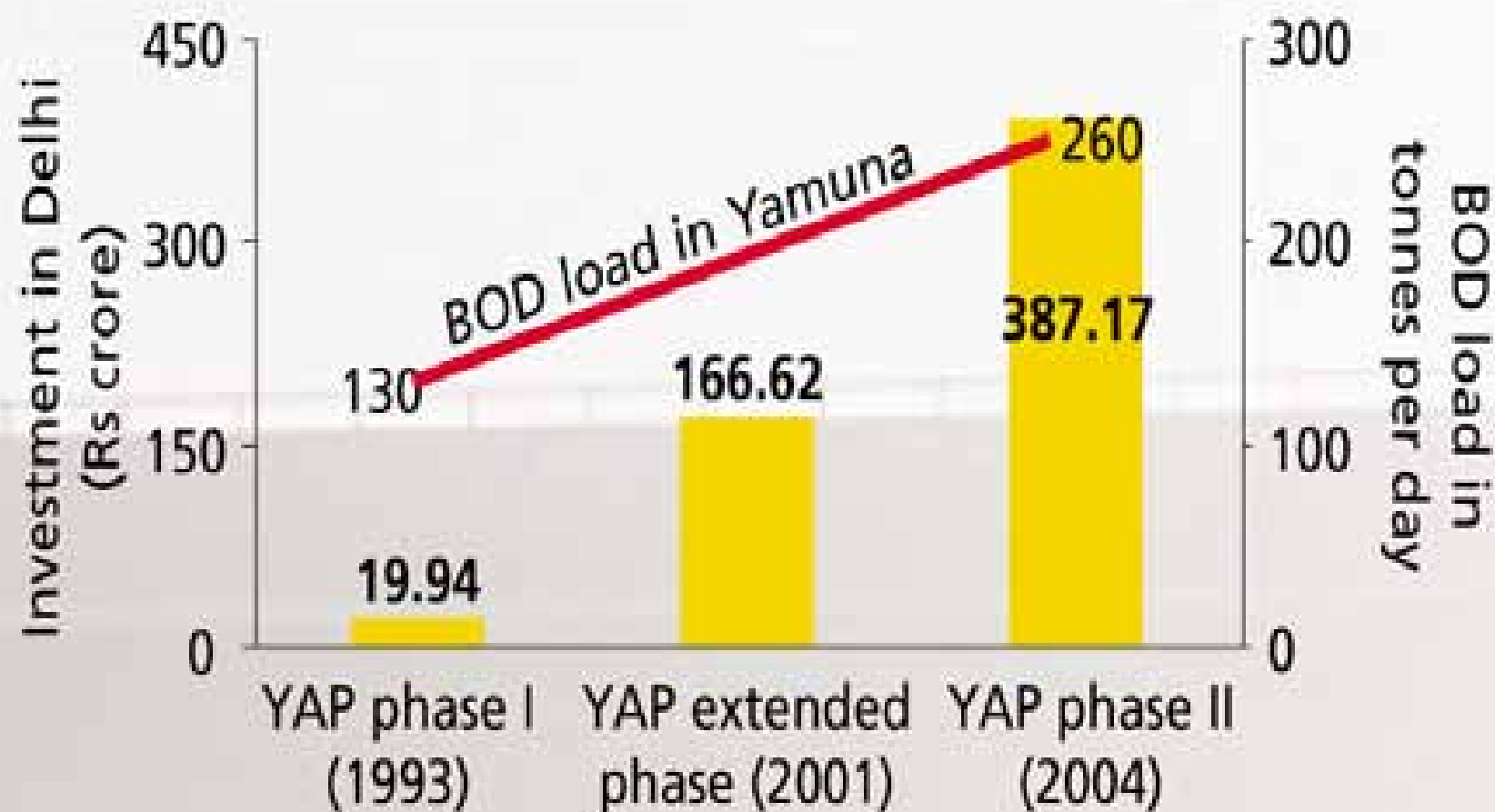


# DO levels: Yamuna is dead.

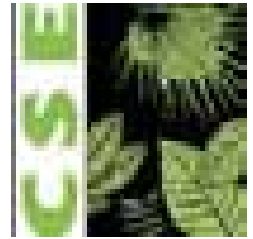
Dissolved Oxygen levels in Yamuna at various points



## THE MORE DELHI INVESTS THE DIRTIER YAMUNA GETS

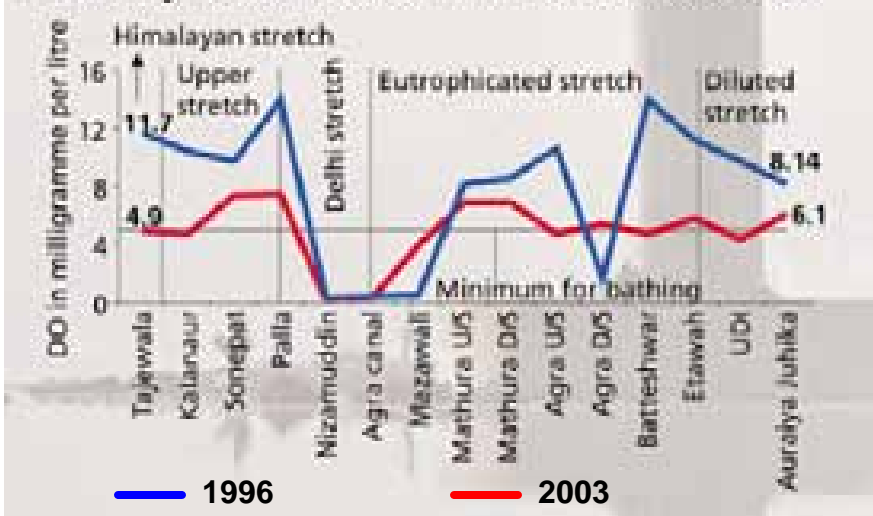


Source: 1. National River Conservation Directorate, 2004; 2. Central Pollution Control Board



# Delhi is not unique: All stretches are dirtier today

1996-2003: Levels of Dissolved Oxygen (DO) have drastically reduced, even in the cleaner stretches



1996-2002: Levels of faecal coliform increased all round, indicating greater bacterial contamination



But at a huge **cost!**



# Environmental imperative: national toilet mission

---



Challenge to science

Flush toilets that do not destroy the  
country's hydrological systems;

Flush toilets that do not destroy the world's  
nitrogen cycle;

Flush toilets that are hygienic and equitable.

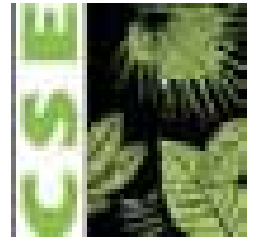
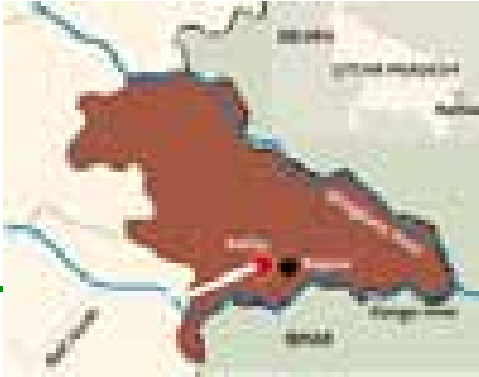
## Water contamination growing: Arsenic-fluoride increasing in country

---



Cant find answers to arsenic-fluoride till we find answers to contamination of water.

Important to understand this link. Still not part of arsenic-mitigation strategies.



Dinanath came to AIIMS to confirm his cancer.

His doctor called us. Wanted to know, why her patient, from Ballia, would suffer from arsenic poisoning. His blood confirmed 34.4 ppb of arsenic. Reference dose is 1-4 ppb.

Why? We wanted to know.

What we found has shocked us.

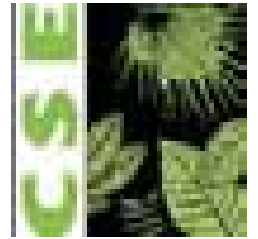
Found visible signs of arsenic toxicity.

Found people suffering. All asked:

why? Tell us if my well is poison.

Tell us if I should drink the water.

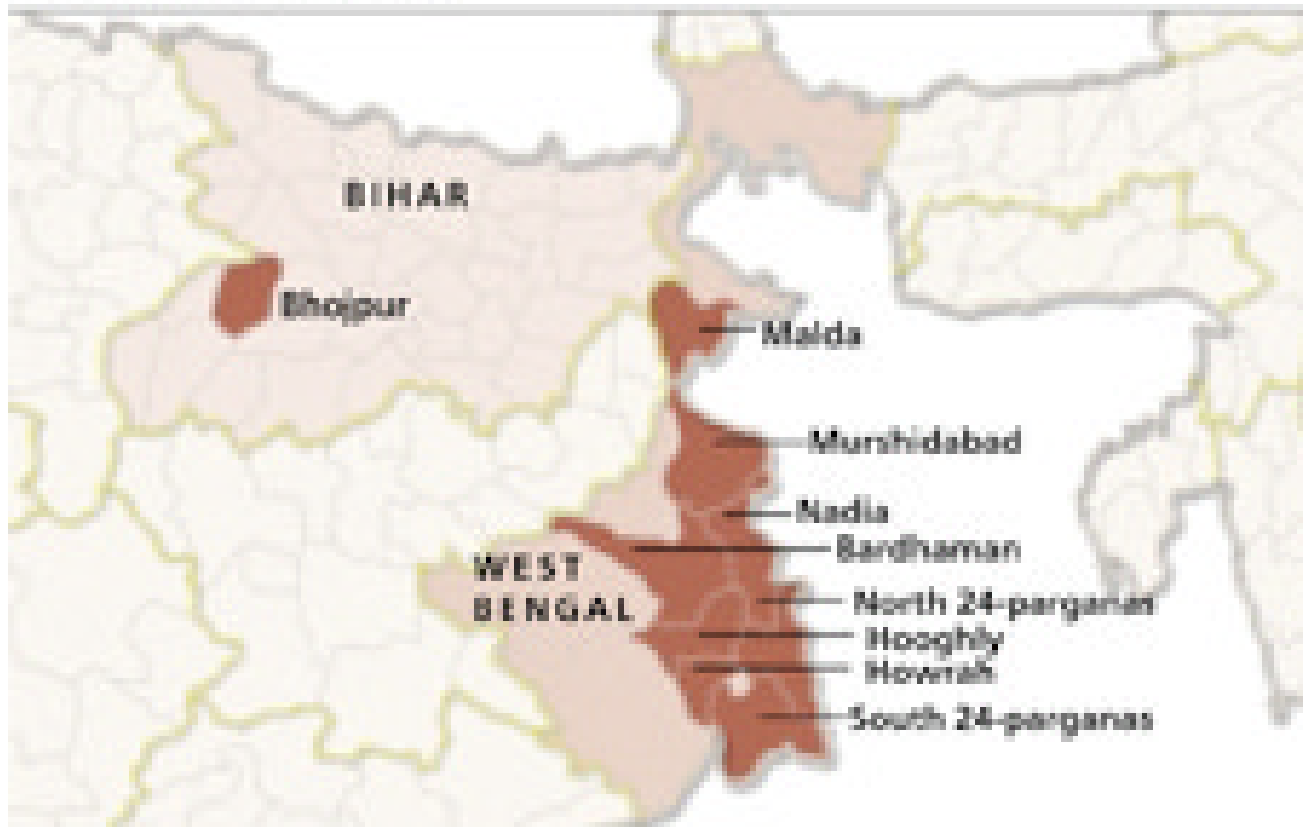




# What is extent of arsenic?

## Unbelievable

Government believes only West Bengal and Bhojpur are contaminated



Is this correct?

What do we know?



# Water management options

---

Problem is that we have contaminated surface water with sewage. Leads to disease.

So we have increased dependence on groundwater. Going deeper and deeper. Finding arsenic-fluoride.

Answers:

Clean up ponds, tanks. Put filters to clean microbial contamination.

Rainwater harvesting to recharge aquifers so that we do not dig so deep.

# Challenge of new contaminants

---

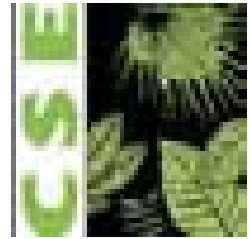


Cannot deal with old problem: sewage.

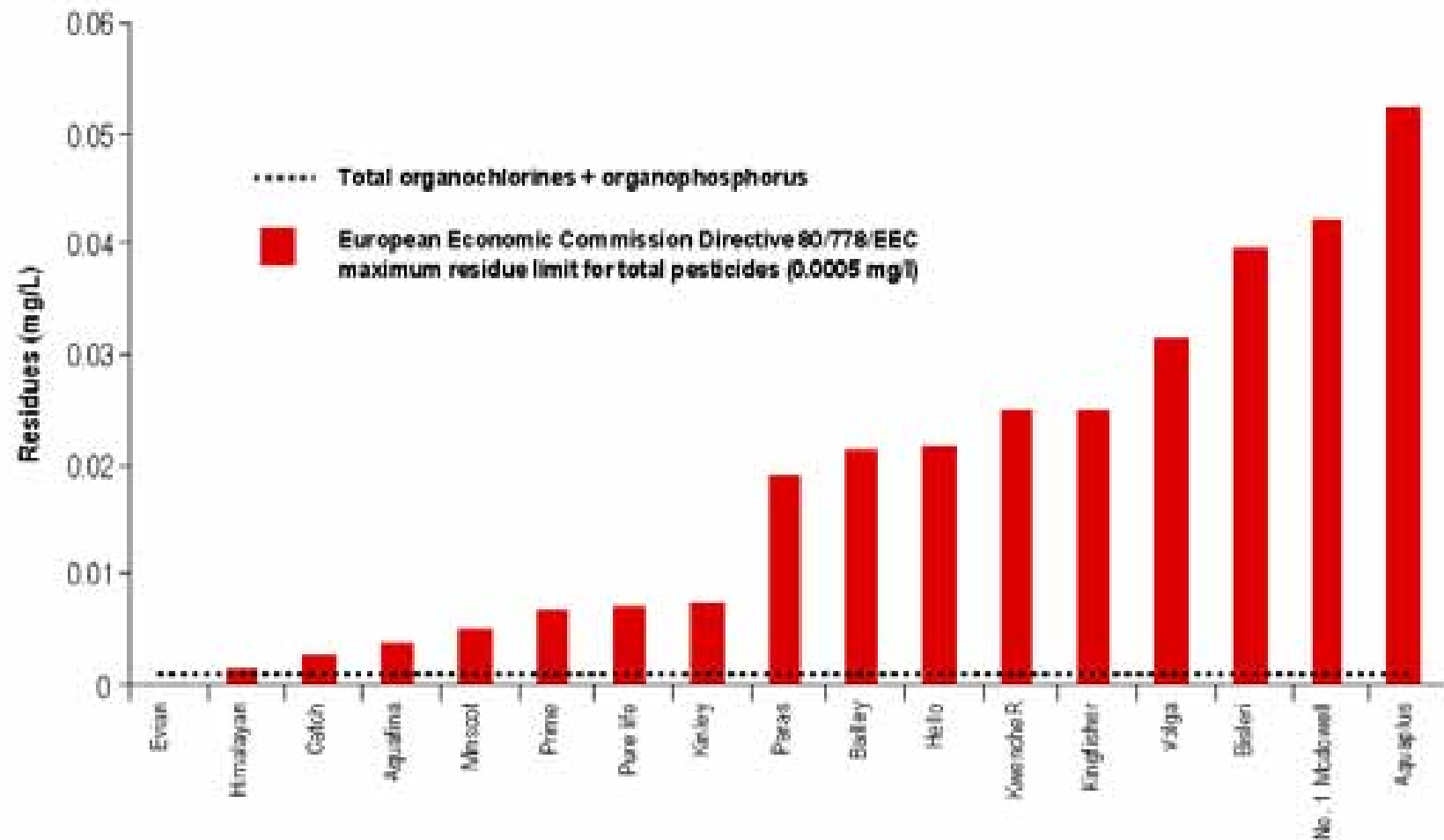
Now new toxins – pesticides, heavy metals..

Toxic and deadly load in our bodies.

The problem is that we are rich enough to use; poor when it comes to clean up.

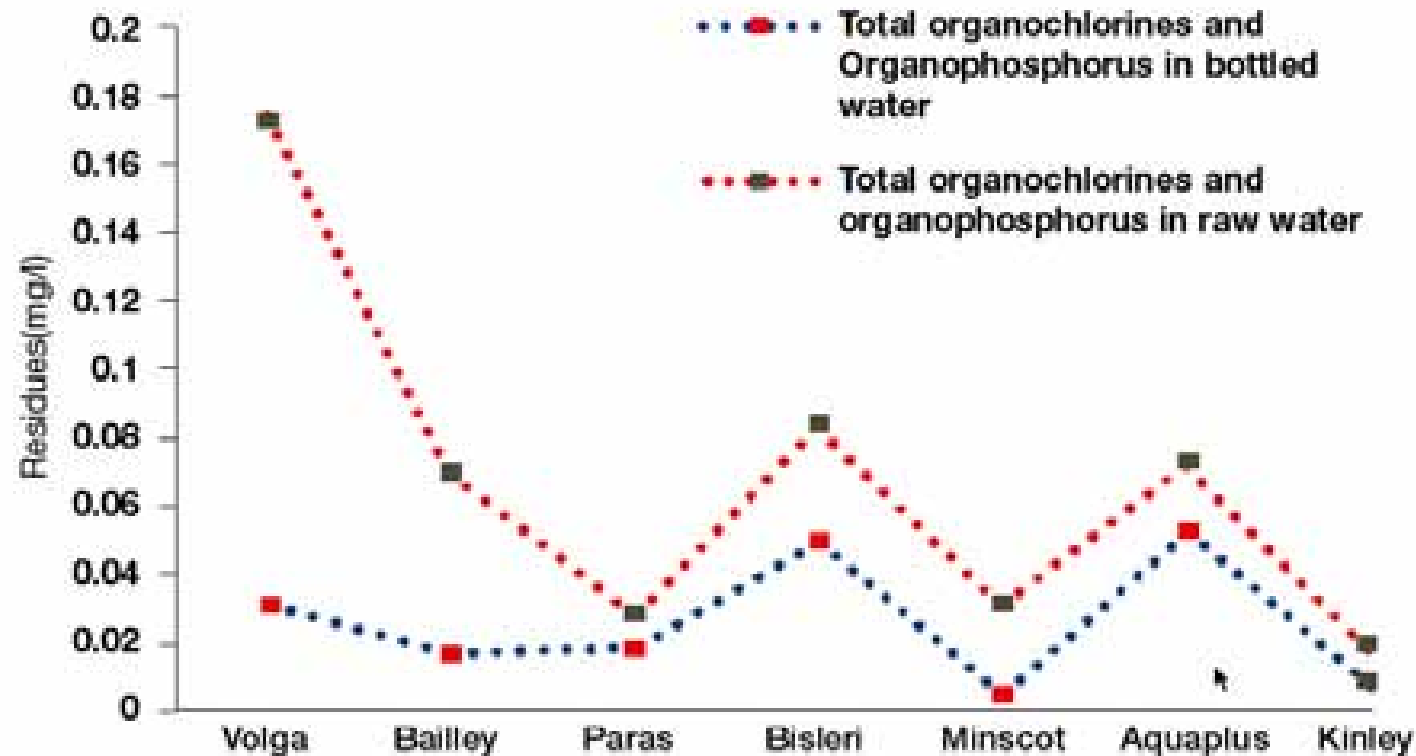
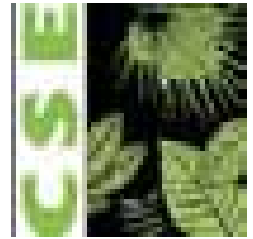


# Pesticides in bottled water





# Found pesticides in groundwater



Letters, emails, messages asking: **WHAT ABOUT SOFT DRINKS? They use the same water.**

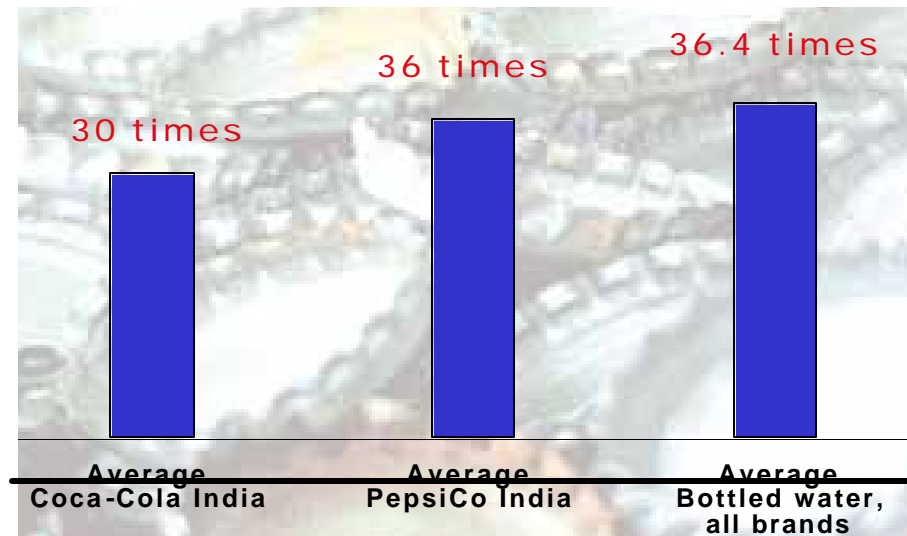
# Soft drinks: what did we find?



Same pesticides as bottled water:  
DDT, lindane, chlorpyrifos, malathion.

Same level as bottled water.

But poorer (in fact non-existent) regulations compared to bottled water





We want...

---



**Standards for pesticide residues in soft drinks.  
Companies still fighting....powerful...**

**We want standards for quality of drinking water.  
Remember: expensive to clean up after  
contamination. Need to regulate **now**.**

## No legal rights to clean water



---

55 years after Independence we do not have 'right' to 'clean' water.

Why? Because standards for what is "clean" water are not legal.

Then we need a law that enforces standards so that agencies supplying water are held responsible. Citizens then have the "right" to clean water.

# In India..

---



The Central Public Health and Environmental Engineering Organisation (CPHEEO) under the Union ministry of urban development and poverty alleviation sets **guidelines** for drinking water quality.

BIS has also set standards. But these are “voluntary”.

These are “guidelines”. Municipalities and other agencies are “expected” to follow these. But there is no requirement that they **must**.



Municipal acts therefore are vague.

---

Section 234 of the Calcutta Municipal Corporation Act, 1980 also says, “as far as possible”.

Tripura Municipality Act says it will “try to supply”.

Rajasthan does not even say it will supply in all times.

# Safe drinking water

## No law

---



1996; parliamentary committee on subordinate legislation says, water should be brought under “food” as the agency responsible for supplying drinking water to the public has to ensure purity and the statute should bind it to do so.”

But ministry of urban development says no. It would mean that a “legal commitment to adhere to standards”.



# We want:



---

Biggest killer of babies in India.

Death and diseases because of dirty water shame India...

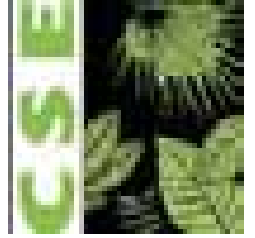
**We say we are too poor to afford clean water.**

Rich pay peanuts for municipal water they consume. Drink bottled water.

This industry uses free water. Charges more than milk. We pay.

Poor do not get municipal water. Pay more. Pay with their health. No options.

**Unacceptable.**



## **Water reform needs political interest**

---

**Cannot happen without you.**

**Water is about life. It is about health. It is about livelihoods. It is about wealth.**

**Water has to become everybody's concern.**

**Have to build water-prudent society.**

**Can only happen with **political leadership**.**