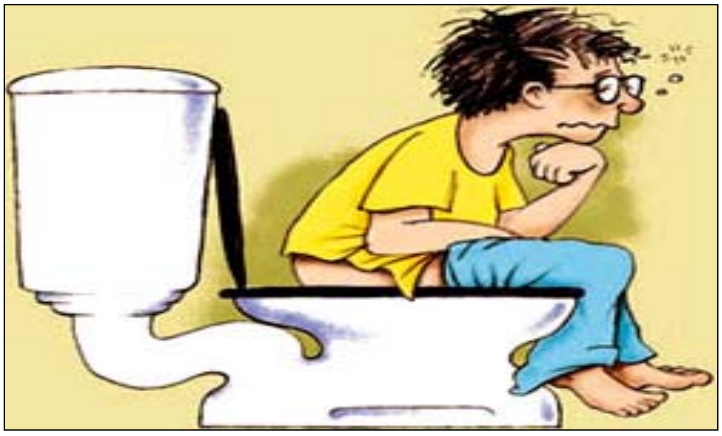
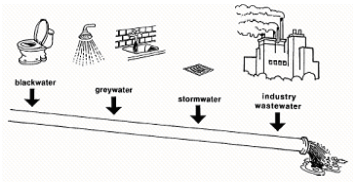
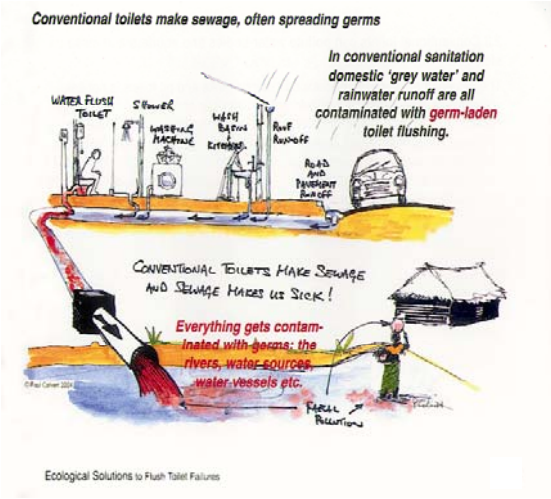
Wastewater as a solution for Meeting the Future Demands in Cities



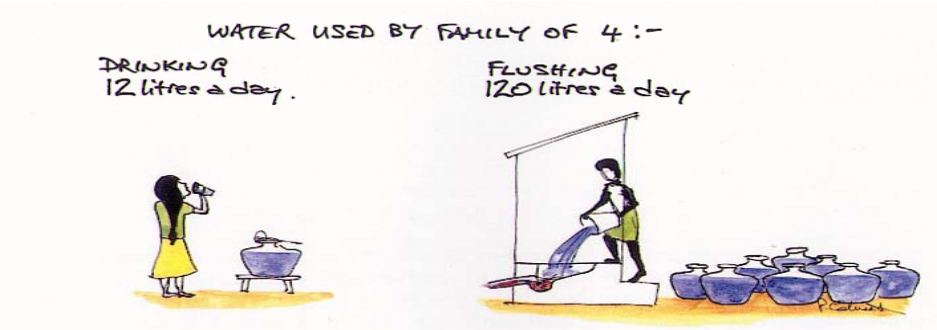
R K Srinivasan, Centre for Science and Environment, New Delhi

Source >From where it comes





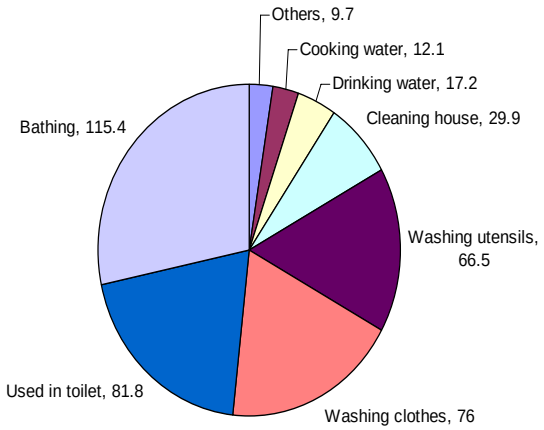
Source >Toilets and Bathroom contributes more



A family of 4 drinks about 12 litres of water a day.

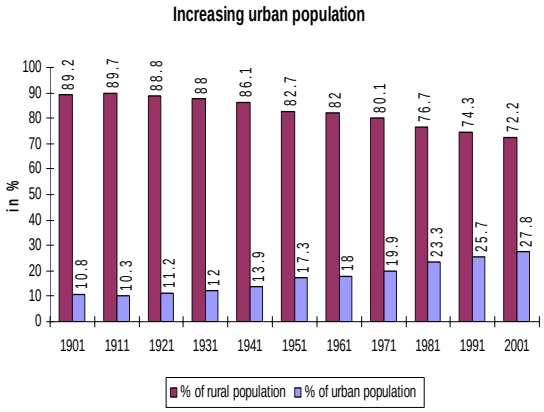
They can waste 60 - 120 litres a day flushing the toilet!

URBAN HOMES with cistern-flush toilets WASTE MORE!



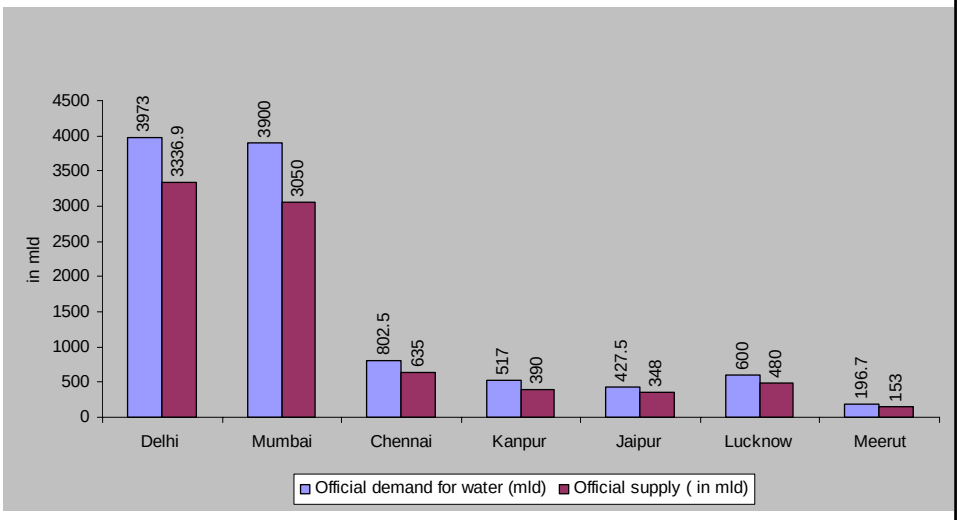
Source: house hold survey by TISS, May ,2005

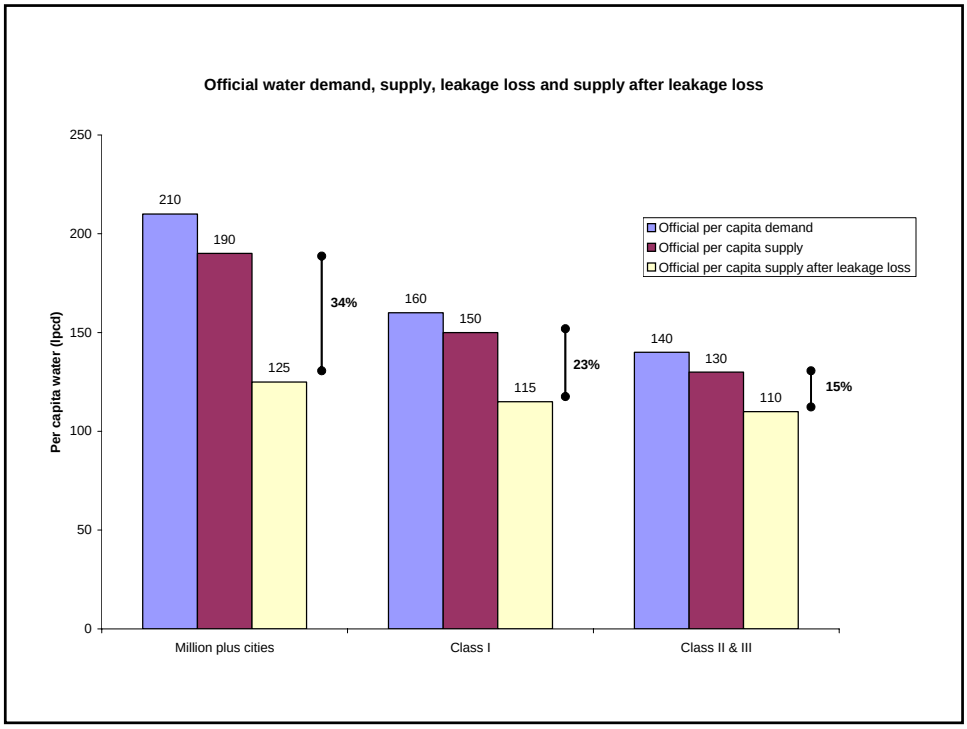
Growing urban population

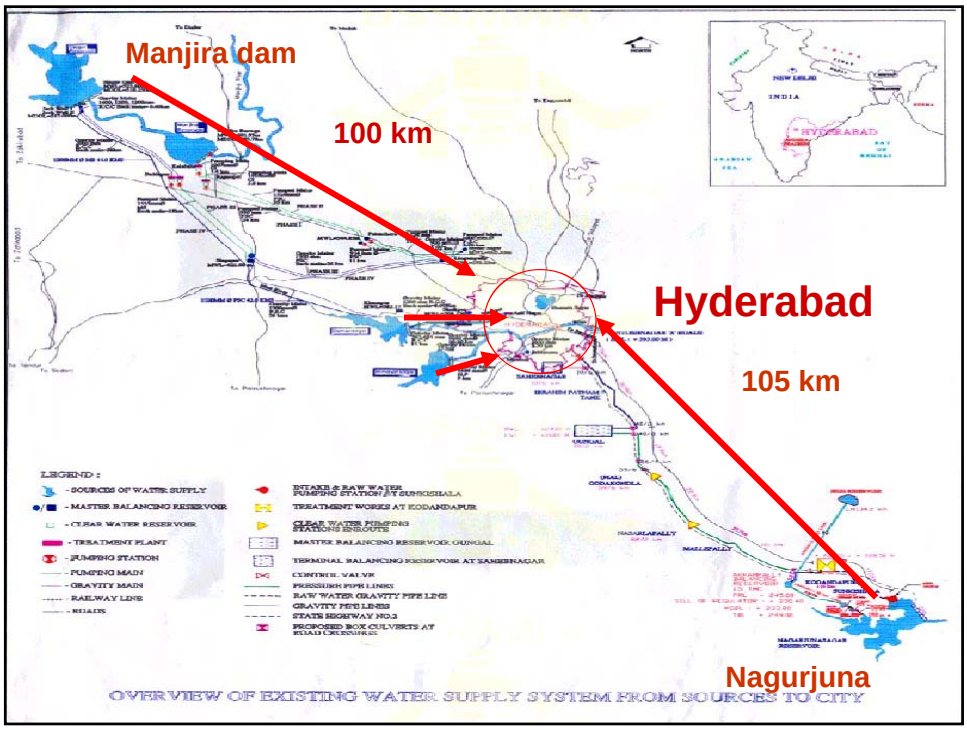


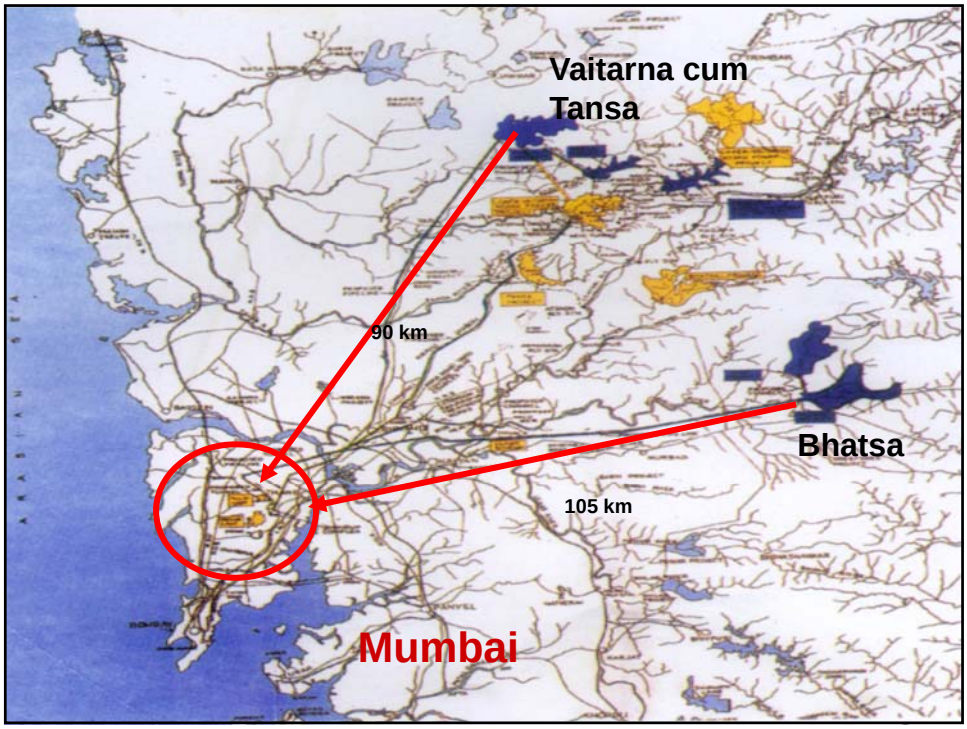
- In India, out of the total population of 1027 million in 2001, about 285 million live in urban areas
- The percentage decadal growth of population in urban areas between 1991 to 2001 is 31.1 percent.

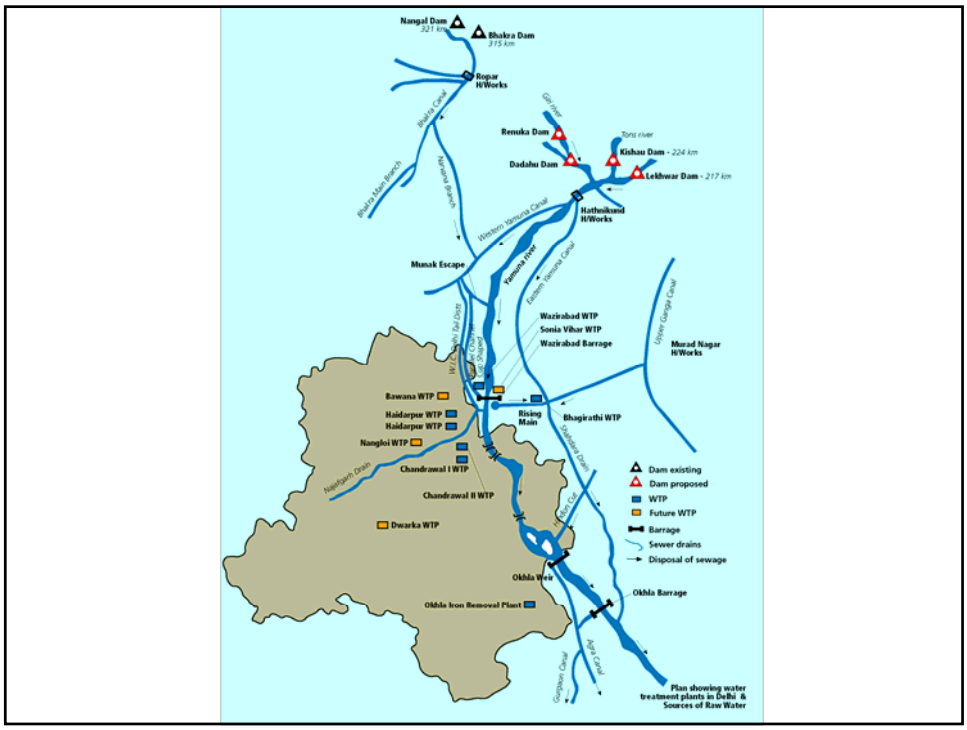
Demand & Supply

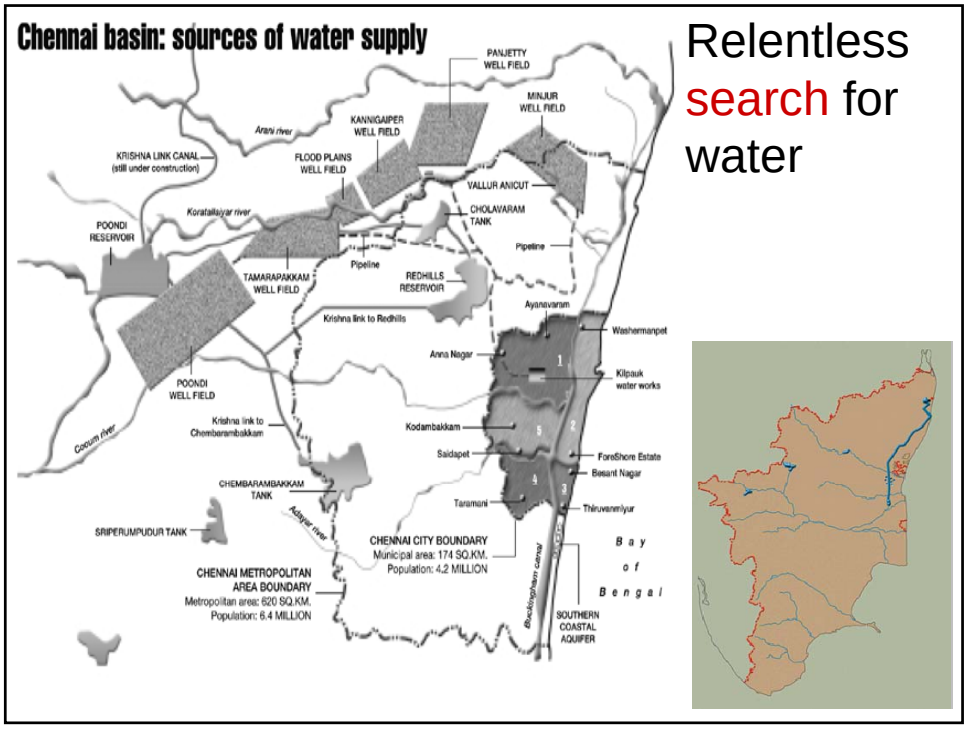


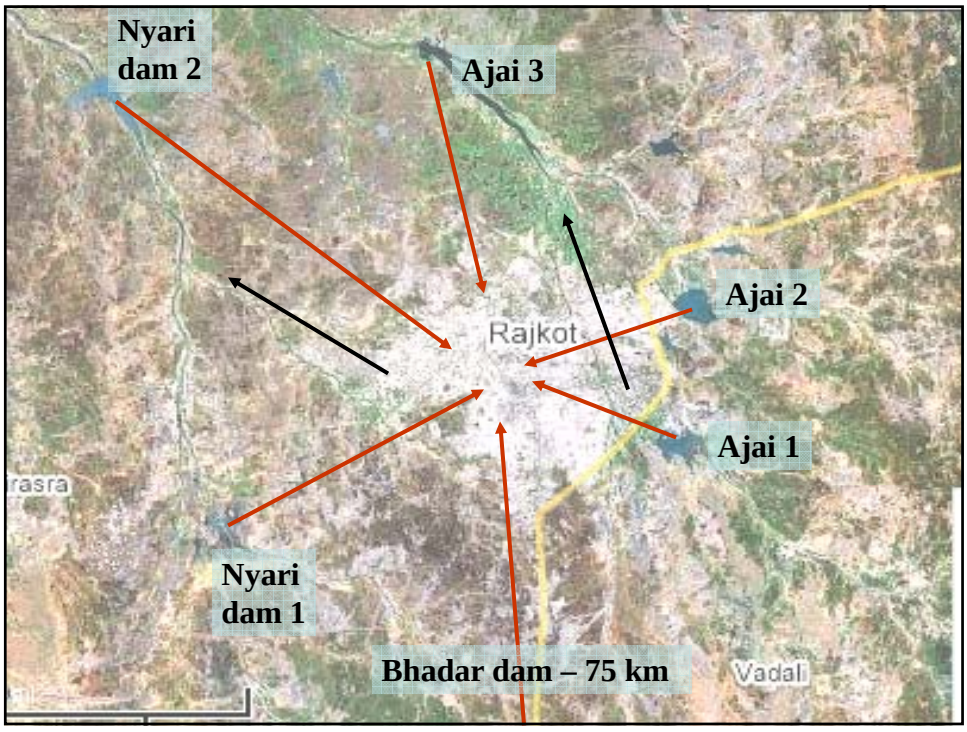

Official water demand, supply, leakage loss and supply after leakage loss
Per capita water (lpcd)
250
200
150
100
50
0
210
190
125
34%
160
150
115
23%
140
130
110
15%
Official per capita demand
Official per capita supply
Official per capita supply after leakage loss
Million plus cities
Class I
Class II & III

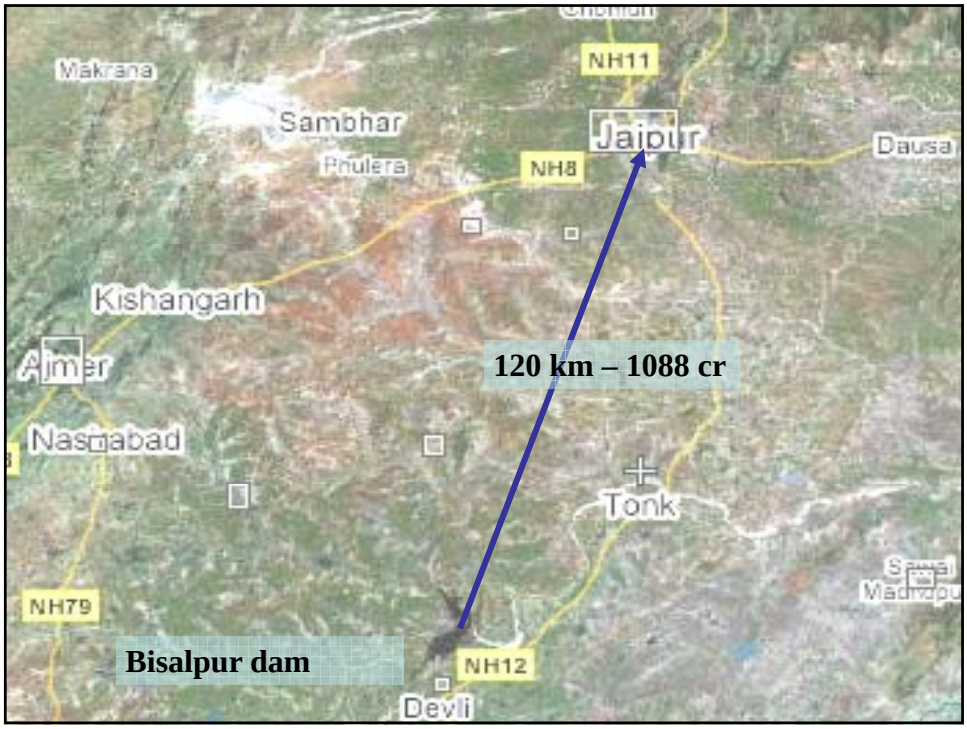

Manjira dam
100 km
Hyderabad
105 km
Nagurjuna
OVERVIEW OF EXISTING WATER SUPPLY SYSTEM FROM SOURCES TO CITY


Vaitarna cum
Tansa
90 km
Bhatsa
105 km
Mumbai

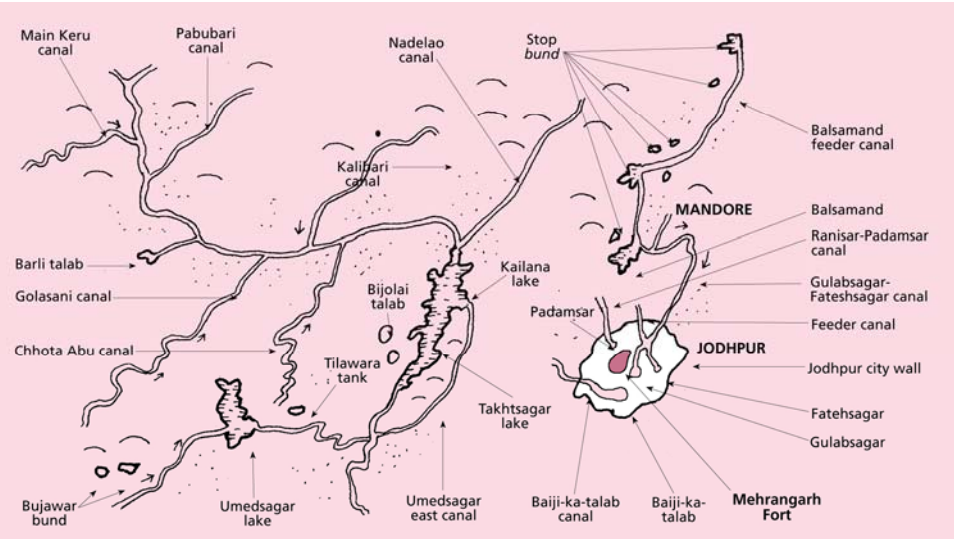

Nangal Dam
Bhakra Dam
Ropar H/Works
Renuka Dam
Dadahu Dam
Kishau Dam - 224 km
Lakhwar Dam - 217 km
Hathnikund H/Works
Munak Escape
Wazirabad WTP
Sonia Vihar WTP
Wazirabad Barrage
Murad Nagar H/Works
Bawana WTP
Haidarpur WTP
Haidarpur WTP
Nangloi WTP
Chandrawal I WTP
Chandrawal II WTP
Dwarka WTP
Rising Main
Bhagirathi WTP
Okhla Weir
Okhla Barrage
Okhla Iron Removal Plant
Dam existing
Dam proposed
WTP
Future WTP
Barrage
Sewer drains
Disposal of sewage
Plan showing water treatment plants in Delhi & Sources of Raw Water

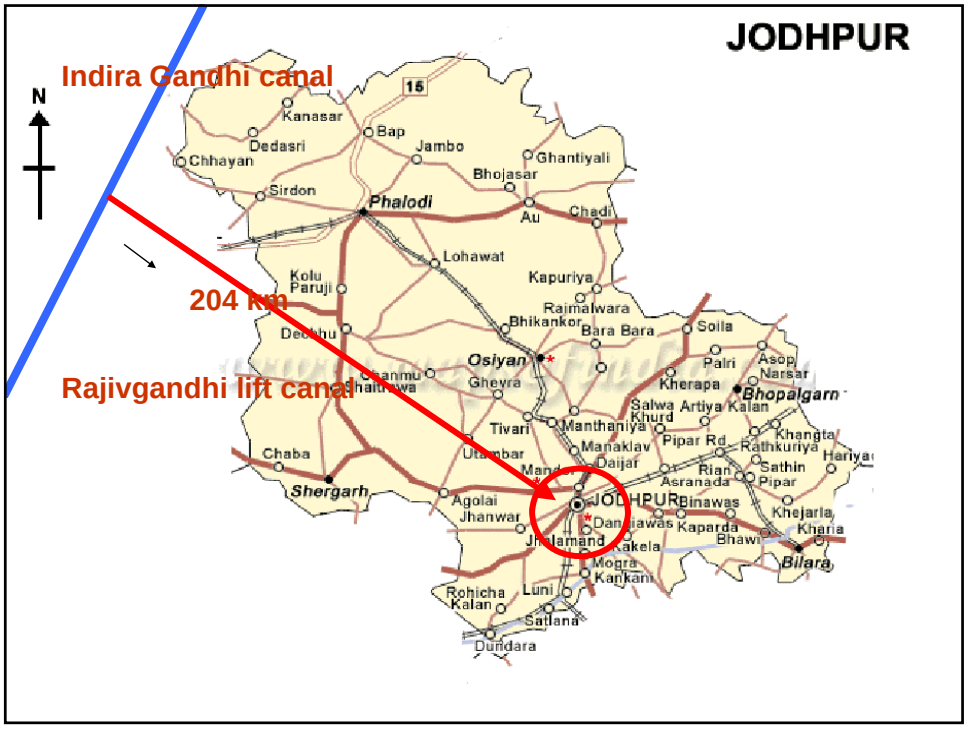

Chennai basin: sources of water supply
PANJETTY WELL FIELD
MINJUR WELL FIELD
KANNIGAIPER WELL FIELD
FLOOD PLAINS WELL FIELD
KRISHNA LINK CANAL (still under construction)
VALLUR ANICUT
CHOLAVARAM TANK
POONDI RESERVOIR
Pipeline
TAMARAPAKKAM WELL FIELD
REDHILLS RESERVOIR
Krishna link to Redhills
Ayanavaram
Washermanpet
Anna Nagar
Kilpauk water works
POONDI WELL FIELD
Krishna link to Chembarambakkam
Kodambakkam
Saidapet
ForeShore Estate
Besant Nagar
CHEMBARAMBAKKAM TANK
Taramani
Thiruvanmiyur
SRIPERUMPUDUR TANK
CHENNAI CITY BOUNDARY
Municipal area: 174 SQ.KM.
Population: 4.2 MILLION
CHENNAI METROPOLITAN AREA BOUNDARY
Metropolitan area: 620 SQ.KM.
Population: 6.4 MILLION
Bay of Bengal
SOUTHERN COASTAL AQUIFER
Relentless search for water


Nyari dam 2
Ajai 3
Ajai 2
Rajkot
Ajai 1
Nyari dam 1
Bhadar dam – 75 km
Vadal

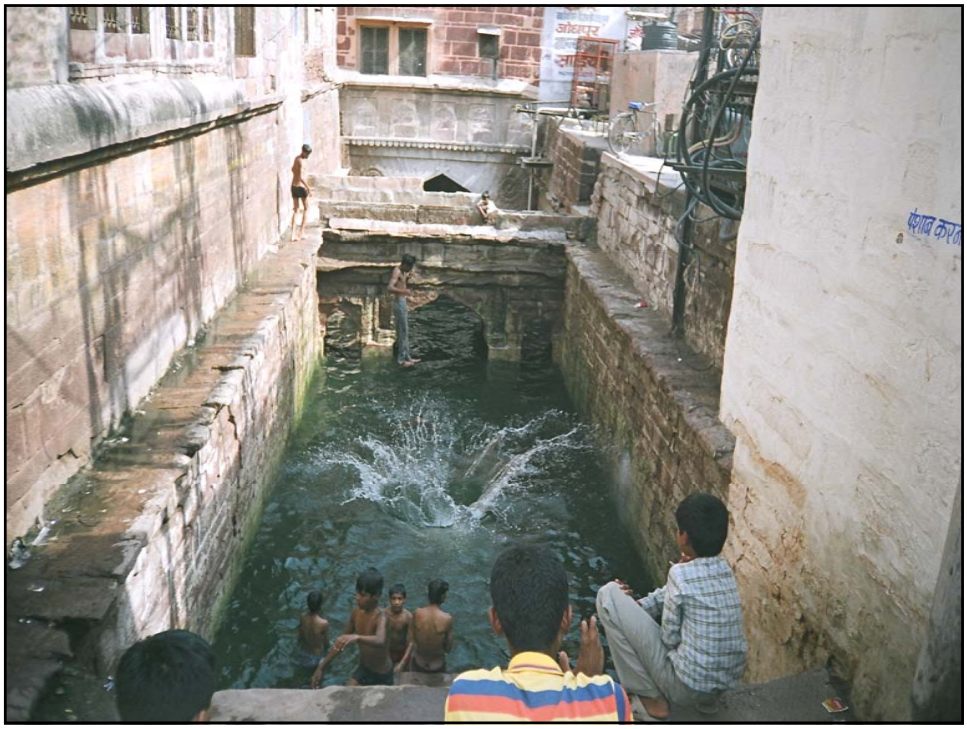


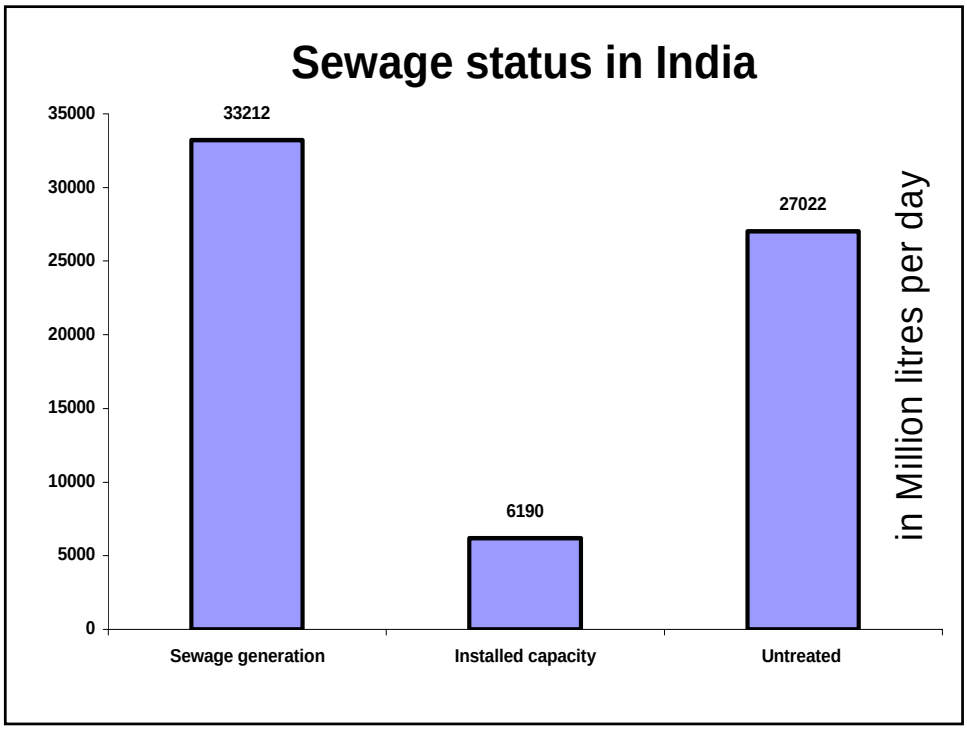
Traditional water management in Jodhpur

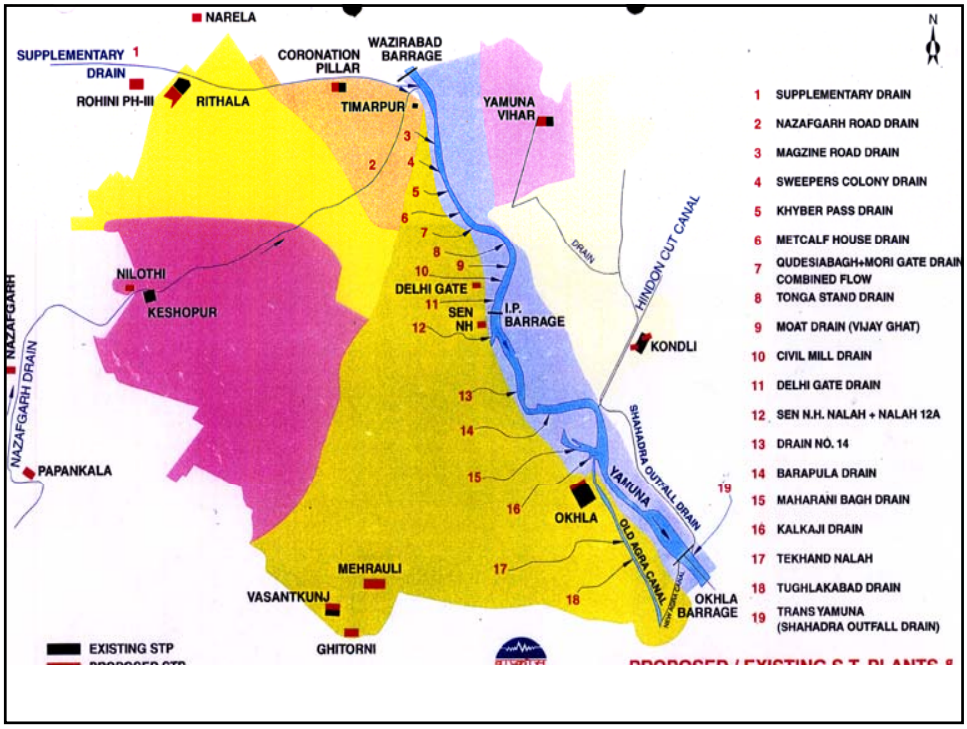


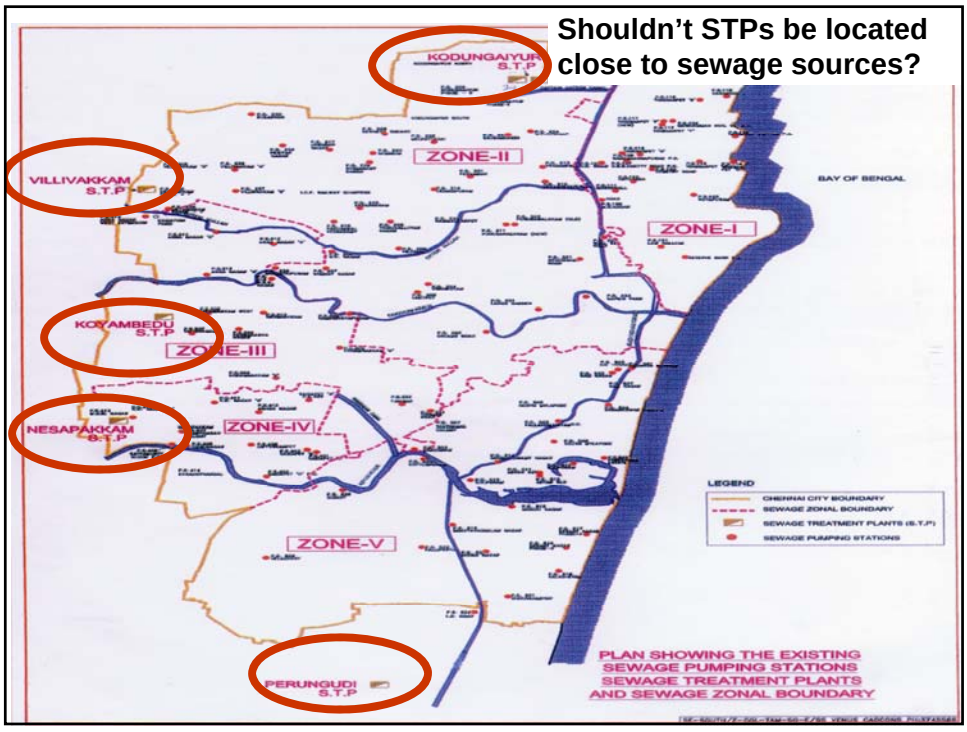


Jodhpur > unleash the potential of canals




Sewage status in India
35000
30000
25000
20000
15000
10000
5000
0
33212
6190
27022
Sewage generation
Installed capacity
Untreated
in Million litres per day





Shouldn't STPs be located close to sewage sources?

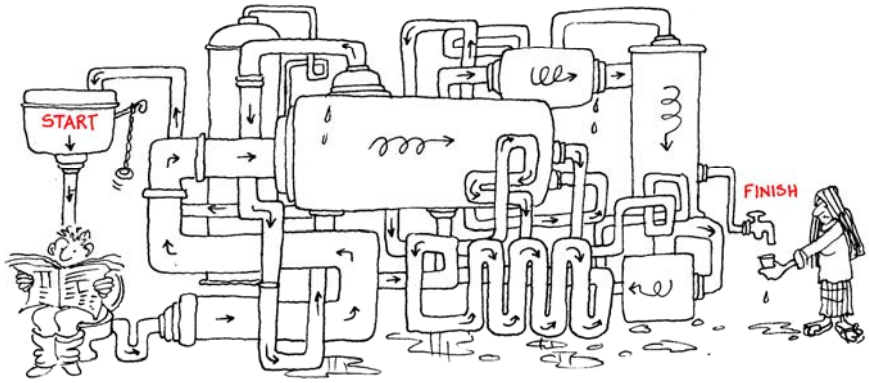
Rethinking sewage management is very crucial for urban India

S No	Level of pollution	Criteria	Riverine Length in KM	Riverine length as percentage
1	Severely Polluted	BOD more than 6 mg/l	6086	14
2	Moderately polluted	BOD 3- 6 mg/l	8691	19
3	Relatively clean	BOD less than 3 mg/l	30242	67

Rework water; rework economics

- Need to fix urban water use. Cannot be wasteful any more.
- Reduce water use to reduce waste discharge; Need to cut costs; Need to charge to reduce wastage
- Recycle and reuse waste as water
- Closing the loop!

A paradigm that **must** change, **urgently**



The way ahead: Paradigm shift required

Agenda unlimited

- Rebuilding relationship with WATER
- Augmenting water sources
  - Decentralising water supply (RWH and waterbodies)
  - Demand management (not supply side management)
  - Wastewater recycling

Governance issues:

- Needs political will and guts to charge water
- Promote sustainable water management-not only legislate but also campaign
- Build water literacy (SOFTWARE)– move away from hardware

What do we do?

Manage demand, supply or both

- **Demand management**
- ***WELS (Australia)***
  - standard showerhead uses about 15 to 25 litres of water per minute. A water efficient showerhead uses as little as 6 or 7 litres per minute
  - An old-style single flush toilet uses up to 12 litres water per one flush. Water efficient dual flush toilets average less than four litres. Savings 51 litres per person per day.
  - A single flush toilet costs around $760 over ten years to operate. A water-efficient dual flush cistern costs around $250 over ten years to operate or a 67 per cent reduction.

What do we do?

Manage demand, supply or both

- **Demand management**
- ***Water efficient homes (Singapore)***
  - A door to door campaign
  - Do-it-yourself-- excessive flow rates and cistern water savings bags installed in the old 9-litres flushing cisterns to reduce the amount of water used for flushing
  - water saving kits consisting of cistern water saving bags, leaflets on installation procedures and water conservation tips were supplied to the grassroots organizations for distribution to the residents, free-of-charge

NEwater in Singapore

PUB Singapore: 92 mld wastewater recycled;

1% mixing with freshwater; rest for non potable uses; 30 per cent rebate on water conservation tax+ waiver on waterborne tax;

Toowoomba in Queensland, Australia: referendum on mixing recycled wastewater with raw water; It failed but government determined to take it up again

Incentives >Chennai and Chandigarh

Chandigarh: The city had come out with byelaws on reuse of recycled water since 1990. About 19 mld of water is used in parks and planning to increase it to 45 mld be 2010

Agency/project	Technology used	Capital cost (Rs)	Operation and maintenance costs	purpose for which the recycled water is used
Madras Fertilizers Limited, Chennai Size: 15.12 MLD	Reverse Osmosis	Rs 14.5 crores	Rs 40-50 per kilo litre	Cooling towers; 3.0 mldresh water is being supplied to Chennai City
Chennai Petroleum Corporation Limited (earlier known as Madras Refineries Limited) Size: 11.25 MLD	Reverse Osmosis	Rs 20 crores	Rs 43 per kilo litre	cooling towers
GMR Power corporation, Chennai Size: 7. 2 MLD	Secondary and tertiary treatment followed by Reverse Osmosis	Rs 17.5 crores	Rs 25 per Kilo litre	Treated water used for cooling towers

Rajkot's reuse policy

- In August 2009, RMC amended building bye laws making it mandatory, the recycling and reuse of waste water for the buildings more than 750 sq m
- The use of potable domestic water for non potable uses like car washing, gardening, construction purposes, landscaping, irrigation uses is for bidden by virtue of powers vested with government
- The essential parts of a recycling system will be separate pipes for collecting grey water. The term grey water refers to the waste water generated from bathroom, laundry and kitchen.
- Treated grey water is pumped to a separate tank on the roof from where grey water will be supplied to toilets, garden taps, car washing taps etc.

Water reuse applications > Options

- Urban Reuse
- Construction Uses
- Industrial Reuse
- Environmental Reuse
- Irrigation & agriculture
- Groundwater Recharge
  - Indirect Potable Reuse
  - Augmentation of surface supplies

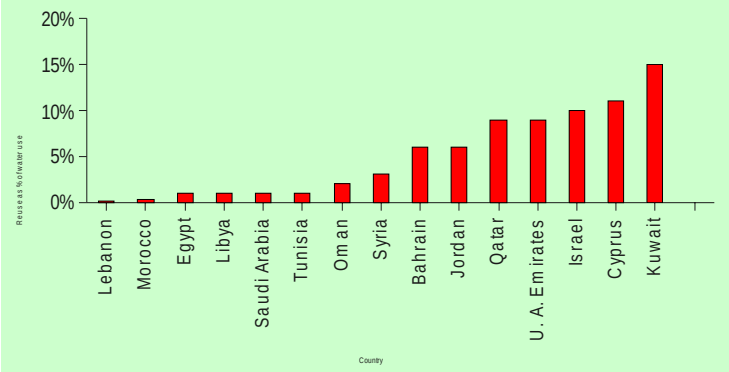
Israel > 70% treated waste water. Urban agriculture

Japan > 8000 million litres/year, or 8% irrigation of green areas. Road cleaning, car washing, firefighting

Australia, Canada, US > Toilet flushing

How to decide on the reuse application based on treated water quality?

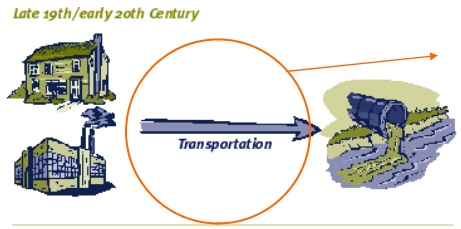
Reuse> World wide



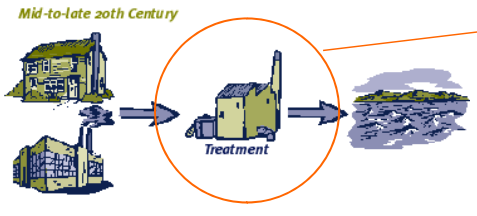
Israel: 25%; **Australia**: 11%;**Tunisia**: 10%; **Jordan:** reclaimed water use **must** increase more than 4 times by 2010 to **meet demand**

Spain: By 2012, reclaimed water use to rise by **150%**; **Egypt:** By 2025, **10 times** increase in reclaimed water use

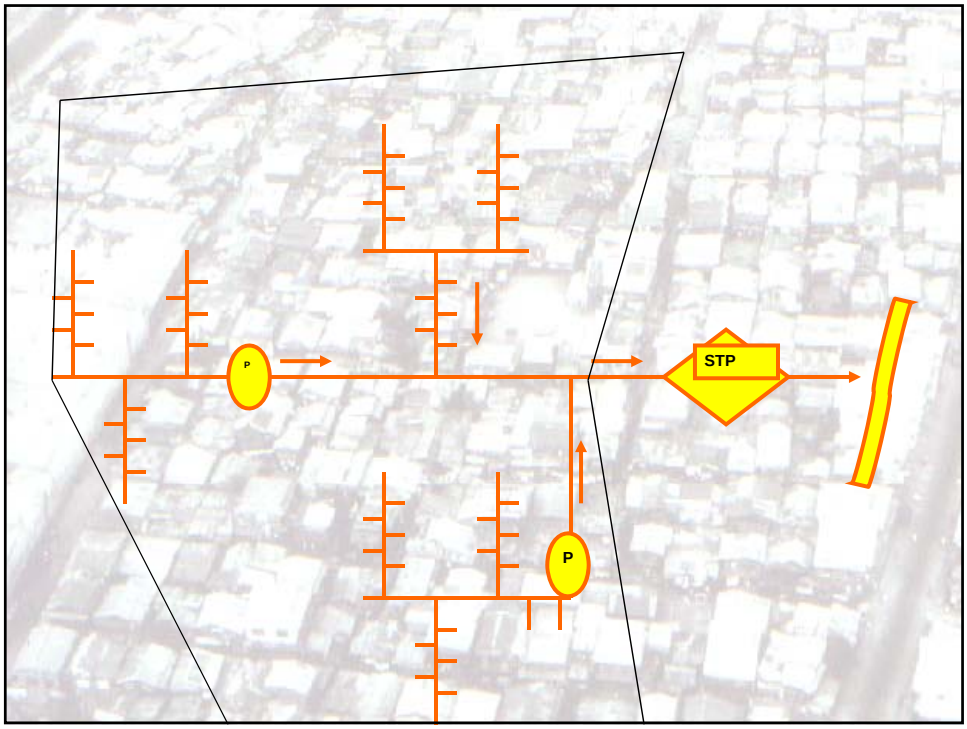
Current sewage paradigm?

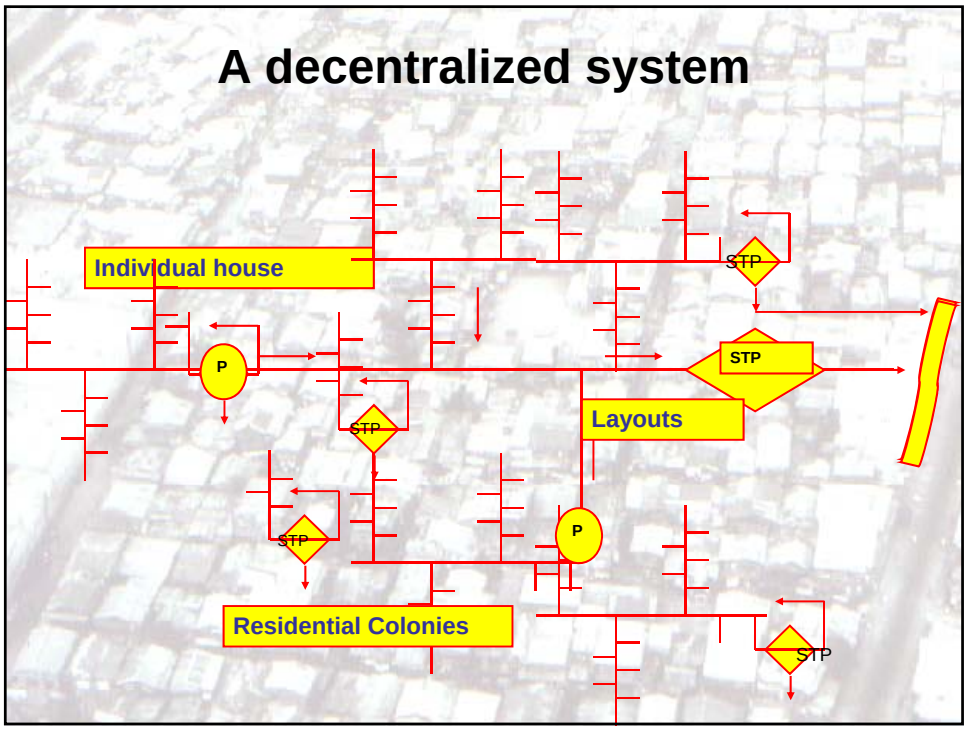


Untreated



Centralized


P
STP
P


A decentralized system
Individual house
P
STP
STP
STP
Layouts
P
Residential Colonies
STP

New sewage paradigms > decentralised > Advantages

- **Treatment at source**
- **Hence reuse can be planned**
  - **Irrigation/Gardening**
  - **Non potable applications like flushing**
  - **Recharge underground water**
- **More involvement of communities**

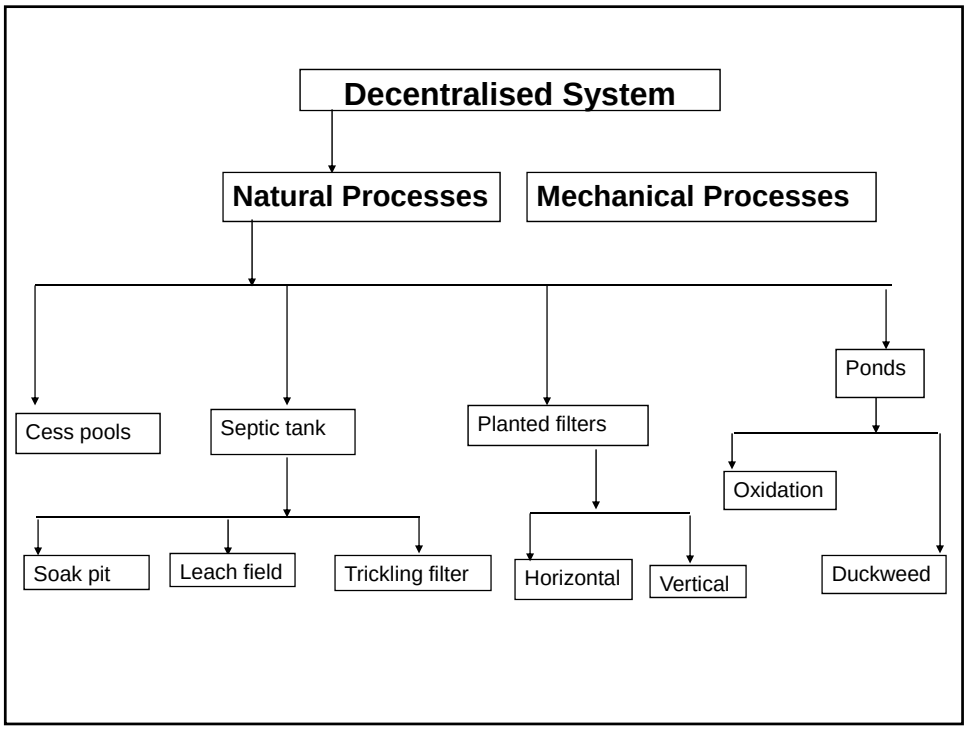
Smaller Catchment

↓

Lesser waste

↓

Water rich in nutrient available for reuse

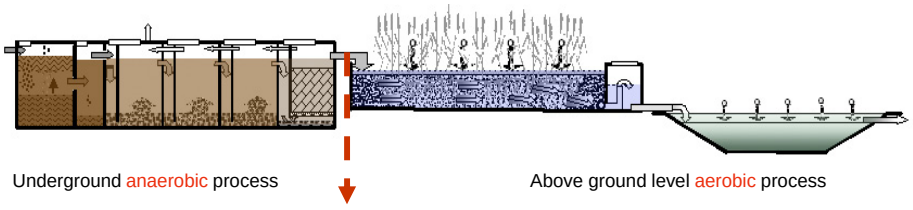


Looking for new sewage paradigms

- Understanding the existing traditional decentralised wastewater treatment systems
- Applying them in right combination in a urban scenario
- And there by treating wastewater at source itself and reusing it.

Anaerobic baffled reactor >Secondary treatment > Planted filter

Overview of the different devices



Underground anaerobic process

Above ground level aerobic process

CPCB standards are met at this point, except for the smell control

A paradigm that must change, urgently