Energy and Resource Efficiency in Urban Water Management
Challenges & potential for enabling paradigm shift under NURM

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CSE CCBP NURM Regional Workshop at Kolkatta
CSE’s Recent Publication

Volume 1 - dwells on how urban India is soaking up water, polluting rivers and drowning in its own waste (296 pages).

Volume 2 - contains a very detailed survey of 71 cities, and presents an assimilation of the survey's results (496 pages).

http://cseindia.org/content/excreta-matters-0
Buy online at http://csestore.cse.org.in
Structure of the Presentation

• Summary assessment of water (and sewage) management in India – CSE’s recent publication – *Excreta Matters* (2012) and earlier backgrounder

• Challenges & Potential for Paradigm Change – Mainstreaming Best Management Practices.
The water-sewage connection

The conventional way:

- Bring water **into** the city – storage, diversion, pipe, pump, treat – **from further and further away**.

- Flush and carry the waste **out** of the city – pipe, pump, divert, treat – **further and further away**.

Not even single city has 24-7 water supply
Location of WTPs and Sources of Water - Delhi

Above 250 kms
Chennai basin: sources of water supply

Relentless search for water
Nyari dam 2

Ayai 3

Nyari dam 1

Ajai 2

Ajai 1

Bhadar dam – 75 km

Rajkot
120 km – 1088 cr

Bisalpur dam
Indira Gandhi canal
204 km
Rajiv Gandhi lift canal
How is urban water supply need calculated in India?

<table>
<thead>
<tr>
<th>Classification of towns/cities</th>
<th>Recommended maximum water supply levels (lpcd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Towns provided with piped water supply but without sewerage system</td>
<td>70</td>
</tr>
<tr>
<td>Cities provided with piped water supply where sewerage system is exists</td>
<td>135</td>
</tr>
<tr>
<td>Metropolitan and Mega cities provided with piped water supply where sewerage systems existing</td>
<td>150</td>
</tr>
</tbody>
</table>

Per capita supply is high and completely arbitrary.
Official Water Demand, Supply, leakage loss and supply after loss

- Official per capita demand
- Official per capita supply
- Official per capita supply after leakage loss

Per capita water (lpcd)

<table>
<thead>
<tr>
<th>Category</th>
<th>Official per capita demand</th>
<th>Official per capita supply</th>
<th>Official per capita supply after leakage loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Million plus cities</td>
<td>210</td>
<td>190</td>
<td>125</td>
</tr>
<tr>
<td>Class I</td>
<td>160</td>
<td>150</td>
<td>115</td>
</tr>
<tr>
<td>Class II &amp; III</td>
<td>140</td>
<td>130</td>
<td>110</td>
</tr>
</tbody>
</table>

- Million plus cities: 34% leakage loss
- Class I: 23% leakage loss
- Class II & III: 15% leakage loss

Legend:
- Official per capita demand
- Official per capita supply
- Official per capita supply after leakage loss

CSE
Slums: Unreached, Un-supplied

<table>
<thead>
<tr>
<th>METRO</th>
<th>Supply in non-slum, MLD</th>
<th>Supply in slum, MLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,749</td>
<td>843</td>
<td></td>
</tr>
<tr>
<td>CLASS I</td>
<td>2,639</td>
<td>136</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18,388</td>
<td>979 19,367</td>
</tr>
</tbody>
</table>

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

71-CITY SURVEY: WATER THAT ACTUALLY TRICKLES DOWN TO SLUMS

<table>
<thead>
<tr>
<th>METRO</th>
<th>CLASS I</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Population living in slum (%) Supply in slum (%)

Source: Anon 2011, 71-City Water-Excreta Survey, 2005-06, Centre for Science and Environment, New Delhi
Cities Craving to Supply More

71 Indian Cities Survey by CSE reveals:

<table>
<thead>
<tr>
<th></th>
<th>Supply 2005 (MLD)</th>
<th>Demand 2011 (MLD)</th>
<th>Augmentation needed (MLD)</th>
<th>% Augmentation in 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metro</td>
<td>16,591</td>
<td>21,805</td>
<td>5,214</td>
<td>31</td>
</tr>
<tr>
<td>Class I</td>
<td>2,775</td>
<td>3,605</td>
<td>829</td>
<td>30</td>
</tr>
<tr>
<td>Class II&amp;III</td>
<td>123</td>
<td>230</td>
<td>107</td>
<td>87</td>
</tr>
</tbody>
</table>

In 2005, 32% more water was required to meet 2011 water needs.

MLD: Million litres daily
Source: Anon 2011, 71-City Water-Excreta Survey, 2005-06, Centre for Science and Environment, New Delhi
‘Loss’ not just inefficiency

• Distribution loss is **not just** about inefficiency
• Distribution loss **intrinsic to supply system**
  - distance leads to **high transmission losses**
  - distance leads to **high costs of energy**
  - distance leads to **high O&M costs of repair**

But ‘**augmentation**’ is name of water supply

Build, pipe, pump and **do not worry about supply**
<table>
<thead>
<tr>
<th>City</th>
<th>Source</th>
<th>Distance</th>
<th>Per kl cost to supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aizwal</td>
<td>Tlwang river</td>
<td>1000 metres down the valley, 18 km away</td>
<td>Rs 53.93</td>
</tr>
<tr>
<td>Bangalore</td>
<td>Cauvery</td>
<td>95 km from the city</td>
<td>12.00</td>
</tr>
<tr>
<td>Chennai</td>
<td>Lakes, Groundwater and Veeranam lake.</td>
<td>60 to 245 km</td>
<td>14.00</td>
</tr>
<tr>
<td>Delhi</td>
<td>Yamuna river, Bhakra storage and groundwater</td>
<td>Across the city</td>
<td>9.90</td>
</tr>
<tr>
<td>Indore</td>
<td>Narmada river</td>
<td>70 km</td>
<td>11.00</td>
</tr>
<tr>
<td>Jodhpur</td>
<td>Rajiv Gandhi Lift Canal</td>
<td>240 km</td>
<td>8.70</td>
</tr>
<tr>
<td>Mussorrie</td>
<td>Springwater Bhilaru, Jinsi, Khandighat, Murray rose and Dhobighat</td>
<td>6 to 7 km down</td>
<td>18.13</td>
</tr>
<tr>
<td>Mumbai</td>
<td>Bhatsa, Vihar, Tulsi, Tansa, Upper Vaitarna</td>
<td>100 to 120 km</td>
<td>8.40</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>Nagarjuna sagar and Majira dam</td>
<td>116 km</td>
<td>5.30</td>
</tr>
<tr>
<td>Hubli-Dharwad</td>
<td>Neersagar and Malaprabha reservoir</td>
<td>20 and 55 km</td>
<td>6.70</td>
</tr>
<tr>
<td>City</td>
<td>Production cost Rs/kl</td>
<td>Water charges Rs/kl</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------</td>
<td>--------------------</td>
<td></td>
</tr>
<tr>
<td>Delhi</td>
<td>8.95</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Mumbai</td>
<td>5.74</td>
<td>2.25</td>
<td></td>
</tr>
<tr>
<td>Jodhpur</td>
<td>20.00</td>
<td>1.21</td>
<td></td>
</tr>
<tr>
<td>Indore</td>
<td>9.50</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Bangalore</td>
<td>13.00</td>
<td>5.60</td>
<td></td>
</tr>
</tbody>
</table>
The current paradigm – water supply

More water supplied = More waste water generated = more costs for treatment = Unsustainable
Water, not supplied

- Planners obsessed with water, not supply
  - Water sourced from further and further away, leads to increasing cost of supply
  - Leads to high distribution losses and less water to supply at end of pipeline
  - Less water means more costly water

Cities not able to recover costs of supply, have no money to invest in sewage
Water = Wastewater

Cities plan for water, forget waste

• 80% water leaves homes as sewage

• More water = more waste

• Cities have **no accounts** for sewage

• Cities have **no clue** how they will convey waste of all, treat it, clean rivers

• Cities **only dream** of becoming New York or London
# Urban Sanitation - Rating Card

<table>
<thead>
<tr>
<th>No.</th>
<th>Category</th>
<th>Description</th>
<th>Points</th>
<th>Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RED</td>
<td>Cities Needing immediate attention</td>
<td>&lt;33</td>
<td>182</td>
</tr>
<tr>
<td>2</td>
<td>BLACK</td>
<td>Needing considerable improvement</td>
<td>34-66</td>
<td>230</td>
</tr>
<tr>
<td>3</td>
<td>BLUE</td>
<td>Recovering</td>
<td>67-90</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>GREEN</td>
<td>Healthy and Clean Cities</td>
<td>91-100</td>
<td>Nil</td>
</tr>
</tbody>
</table>

**Red-** Shimla, Srinagar, Allahabad, Black- Tiruchirapalli, Jamshedpur, Rajkot, Mangalore, Hyderabad  
**Blue-** Chandigarh, Mysore, Surat, NDMC & Delhi Cantt

Source: Ministry of Urban Development 2010
Sewage: more sums

**TWO METROS: DISPROPORTIONATE TREATMENT**

- 30% of total sewage can be treated
- But Delhi and Mumbai alone have **40 per cent** of sewage treatment capacity in the country

MLD: Million litres daily
Source: Anon 2009, Status of Water Supply, Wastewater Generation and Treatment in Class-1 cities and Class-II towns of India, Central Pollution Control Board, Ministry of Environment and Forests, Delhi
### Cost Estimates of Select Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Cost /mld (at 2008 prices) in Rs.lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Stabilization Ponds</td>
<td>25</td>
</tr>
<tr>
<td>UASB + Post treatment</td>
<td>55</td>
</tr>
<tr>
<td>Activated Sludge Process, C-Tech, FAB</td>
<td>87</td>
</tr>
</tbody>
</table>

- Cost of Interception & Diversion works (main trunk sewers, SPS excl. house connections, branch and lateral sewers) and cost of land acquisition is around Rs. 3-4 crore per mld

- Estimated Class I & II Sewage Generation in year 2020 = 45000 mld

- Cost would increase to the extent of Rs. 45,000 crore to Rs. 1,32,000 crore.
Planning for **hardware**

**Cities plan for treatment not ‘sewage’**

- Treatment plants are not simple answers

- Can build plants to treat, but there is no waste being conveyed for treatment

- Most cities do not have underground sewerage. But engineers sell pipe-dreams of **catching up with infrastructure**

- Politicians buy pipe-dreams

- We lose rivers. Generations of **lost rivers**
### 71-CITY SURVEY: AREA COVERED BY CLOSED DRAINS SHOWS REAL STATE OF SEWAGE COLLECTION

<table>
<thead>
<tr>
<th>% of area covered</th>
<th>Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>Cuttack, Guwahati, Jabalpur, Jammu, Ranchi, Thane, Aizawl, Bathinda, Bhilwara, Siliguri, Srikakulam</td>
</tr>
<tr>
<td>10-30</td>
<td>Agra, Alwar, Aurangabad, Indore, Mathura, Meerut, Puducherry, Thiruvananthapuram, Dehradun, Dewas, Hubli-Dharwad, Jhansi, Kozhikode, Lucknow, Solapur, Tumkur, Udaipur, Ujjain, Dhanbad</td>
</tr>
<tr>
<td>30-50</td>
<td>Allahabad, Bengaluru, Bhopal, Delhi, Lucknow, Patna, Srinagar, Amritsar, Bhubaneswar, Jodhpur, Mumbai</td>
</tr>
<tr>
<td>50-70</td>
<td>Faridabad(^2), Hyderabad, Jaipur(^1), Kanpur, Kolkata, Nagpur, Gwalior, Mussoorie, Nainital, Rajkot, Vadodara, Yamunanagar</td>
</tr>
<tr>
<td>&gt; 70</td>
<td>Chennai, Pune, Surat, Gurgaon(^2)</td>
</tr>
</tbody>
</table>

\(^1\)Claims 80% coverage in CSE survey, 65% in City Development Plan for JNNURM; \(^2\)Faridabad and Gurgaon: only old-city within municipal limit included


- **Cities do not have drains**
- **New growth cities are growing without drains**
- **Backlog and front-log impossible to fix**
- **As cities fix one drain, another goes under**
For example - Bengaluru: sewage not reaching

- 3610 km of sewage pipes
- 14 sewage treatment plants = 781 mld
- Generates 800-1000 mld of sewage
- But treats only 300 mld
- Rest does not reach
- Now plans to build 4000 km more
- Builds, grows and more lines need repair
- Catch-up that does not catch-up
Partial treatment = pollution

“Cities do not control pollution” and Cost of building system is high

• City can build sewerage system for few not all
• Spends on building pipes, repair and energy costs of pumping to treatment plant of this waste of some few
• Spends to treat waste of some few
• Treated waste of few gets mixed with untreated waste of majority
• The result is pollution
For example: Delhi

Has 20 drains
Has 17 STP

Capacity exists
But River Yamuna dead

Why?
Delhi keeps building to ‘catch up’

Can’t
Sewage reaches river

River has no water only sewage

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

Funds spent
Sewage system coverage high
Large number of pumping stations

Why still polluted?
Pumps and pumps
Takes to outskirts of city
Dumps it back into canals and rivers
These flow through city

Engineers say ‘all is well’
Waste is intercepted
Only stormwater flows

But not true
Sewage flows, Treated sewage flows
Water Production & Energy Use

Energy Required to Produce Potable Water

Source/Process:
- Lake or River
- Groundwater
- Wastewater Treatment
- Wastewater Reuse
- Desalination

Source: Alliance to Save Energy
Water financials, a dilemma

- Water price is a public issue (no volatility, even fixed)
- Chemicals & additives will increase
- Asset management need regular investments

Source: Schneider Electric
Urban water paradigm – cause & effect

**Supply**
- Water is imported – pipes, tankers, trains
  - Costs for government
  - Cannot meet the demand
    - Indiscriminate groundwater mining within and outside the city

**Treatment**
- Raw water quality is very poor
  - Costs of treatment for government
  - Cannot meet the demand
    - High health impacts among poor
      - Growth of bottled water industry

**Sewerage**
- Supplied water turned into polluted water
  - Costs of collection and treatment for government
  - Cannot meet the demand
    - Polluted rivers and lakes. Further reduction of water supply
What is happening in Kolkatta?

- Water Supply Leakage losses 35%
- Population covered by sewage network 50-60%
- Total sewage generated 1100 mld (treated 20% by STPs and 1/3 in wetlands)
- Sewerage network - 1500 km
What is happening in Kolkatta?

Mounting costs and little returns

Source: Based on data received from Kolkata Municipal Corporation, 2005-06
Third or half of city’s sewage treated through East Kolkatta wetlands (purified through oxidation & natural aeration that are now losing battle to builders and planners.

Treated sewage (15 % of total citys through STPs) disposed in Hoogly river
Cannot play catch up game

Cannot flush – and forget

Have to find new approaches:

affordable and sustainable
Rework water-energy nexus in UWM; rework economics

• Need to fix urban water use. Cannot be wasteful any more.
• Reduce energy to cut costs; Need to charge to reduce wastage
• Local recycle and reuse waste water
• **Closing the loop!**
Reform agenda

1. Prioritize public investment differently
2. Plan to cut costs of water supply
3. Invest in local & decentralised water systems
4. Reduce water demand
5. Spend on sewage not on water
6. Cut costs on sewage systems
7. Plan to recycle and reuse every drop
Today’s Sustainable Water Management - Agenda

Challenge of innovative policy and practice

**Challenge of scale** -- implement change at the scale of the transition needed

**Challenge of capacity** – need multipliers in society to implement changes, think and act differently
Reform Agenda for Sustainable Water Management

Today idea is accepted but practice is not

Practice difficult

Practices, methods evolved in the rich world are unaffordable or unworkable

Practice does not push envelope of change

At ULB level need big-ticket change
Innovative technologies need innovative policies

WAB & CSE pushing to get different approach in water-waste management - Decentralised, cost-effective technologies

Need capacity in society – training programmes

Need strategies to experiment / practice and scale-up
Paradigm Shift in Enabling Environment

Mainstreaming requires paradigm shift at all four levels – in terms of development in practice:

**Policy** → **Plan** → **Programme**
&
**Project**

In DPRs for JnNURM Phase II:

We need objectives, indicators and standards that can be measured and monitored and that meet challenges of ‘energy efficiency aimed at carbon neutral city’.
Future Urban Hydrology

- Capturing rainwater from macro and micro catchments
- Rooftop water can be used for domestic purposes
- Groundwater recharge

and also –
- Recycle wastewater
- Look at dry sanitation options
- Use less water. Do not be wasteful - Do not make cities first water-wasteful and then think efficiency.
- Only bring the deficit water from outside.
Future Urban Hydrology

- Not a task for engineers alone
- Integrated planning of urban land and water
- Objective of equity, economic efficiency and environmental integrity
- Making water everybody’s business…
Way ahead

- Create informed public opinion

- Demand side management

- Capacity building & training the real users and implementers

- Legislation followed by strict implementation
THANK YOU