

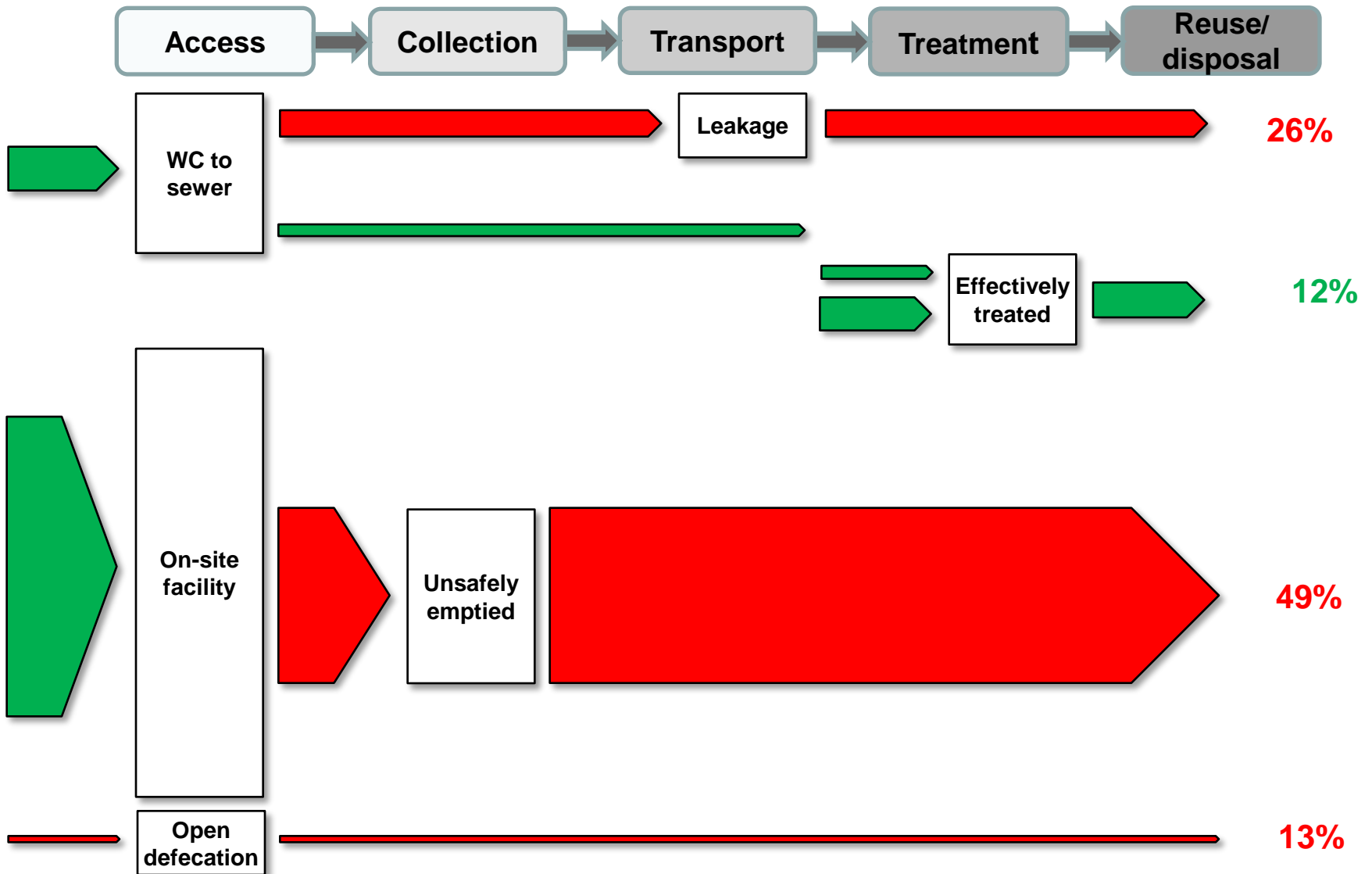


Wastewater recycle and reuse: an economical and sustainable option

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Tracking Fecal Waste Flows



Wastewater generation

WASTEWATER GENERATION AND TREATMENT IN CLASS I AND II TOWNS				
Sl. No.	City Classification	Sewage generation (MLD)	Sewage treated (MLD)	Untreated Sewage (MLD)
Class I towns				
1	- More than 1 million			
2	- 0.50 to 10 million			
3	- 0.20 to 0.5 million			
4	- 0.10 to 0.20 million			
Class II towns				
5	- 0.05 to 0.10 million			
Total		38,254	11,787	26,467
Proportion of Total			31%	69%
Source: Central Pollution Control Board, GoI, 2009; and WSP 2008				

Water Utilities: Cities in search for water

Chennai: Veeranam - 235 km

and now desalination plants (200 MLD in operation).

Bangalore: Cauvery - 95 km

pumping 1000 m elevation.

Hyderabad: Krishna - 130 km

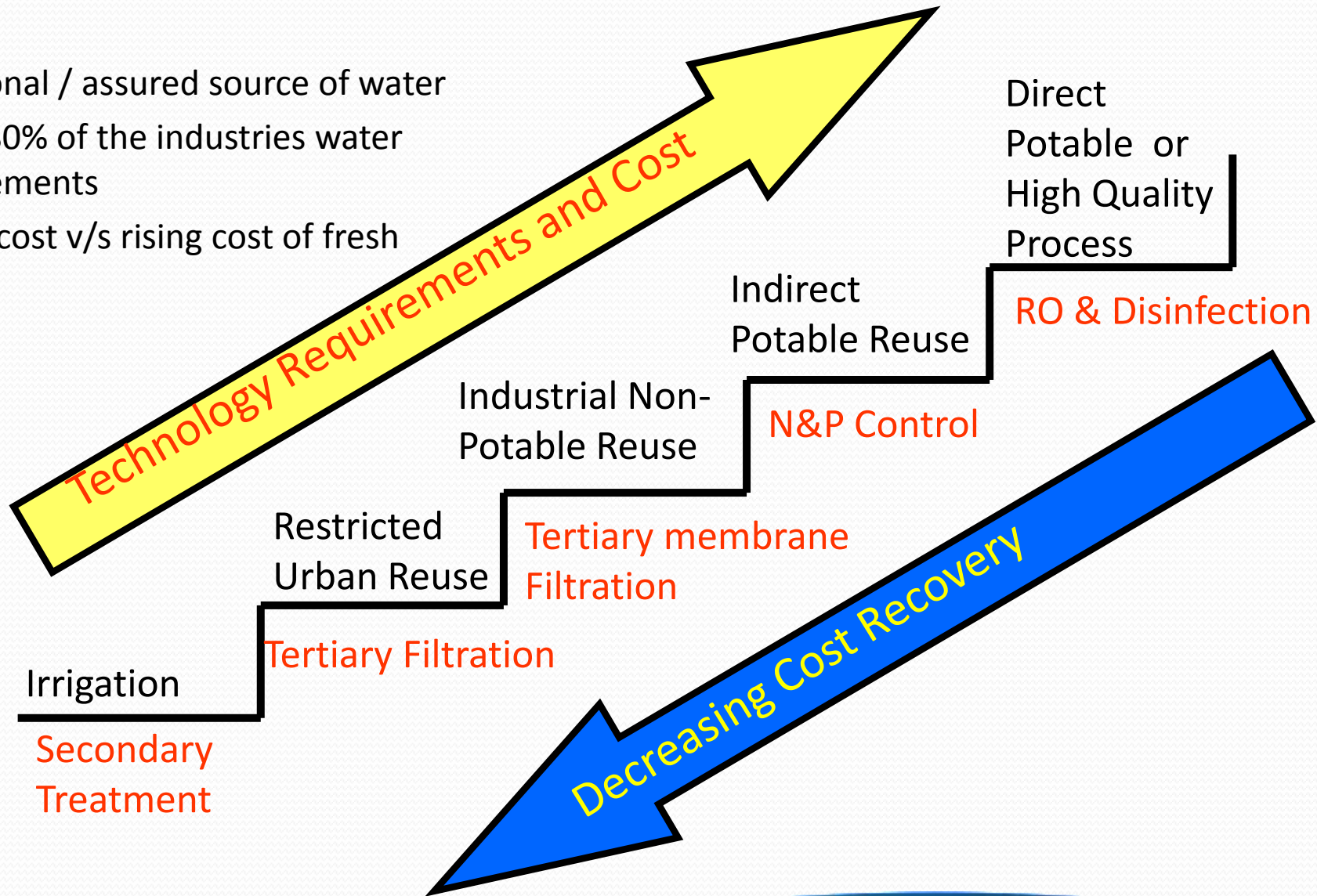
multi stage pumping

Swap – treated wastewater use by industries and agriculture frees up water which could be used to meet city's water demand



Recycle and Reuse for Industries: *A Balancing Act*

- Additional / assured source of water
- Meet 80% of the industries water requirements
- Stable cost v/s rising cost of fresh water



Recycle and Reuse for Agriculture:

A valuable resource



- Treated urban wastewater (~38,000 MLD), if channeled to meet irrigation requirements, would provide ~14 BCM of irrigation water
- Potentially irrigate an area ranging between 1-3 million hectares.

Tenth Five Year Plan	Major and Medium	Surface water fed Minor irrigation
Potential created (Mha)	4.59	0.71
WWI potential (Percent)	44%	~300%

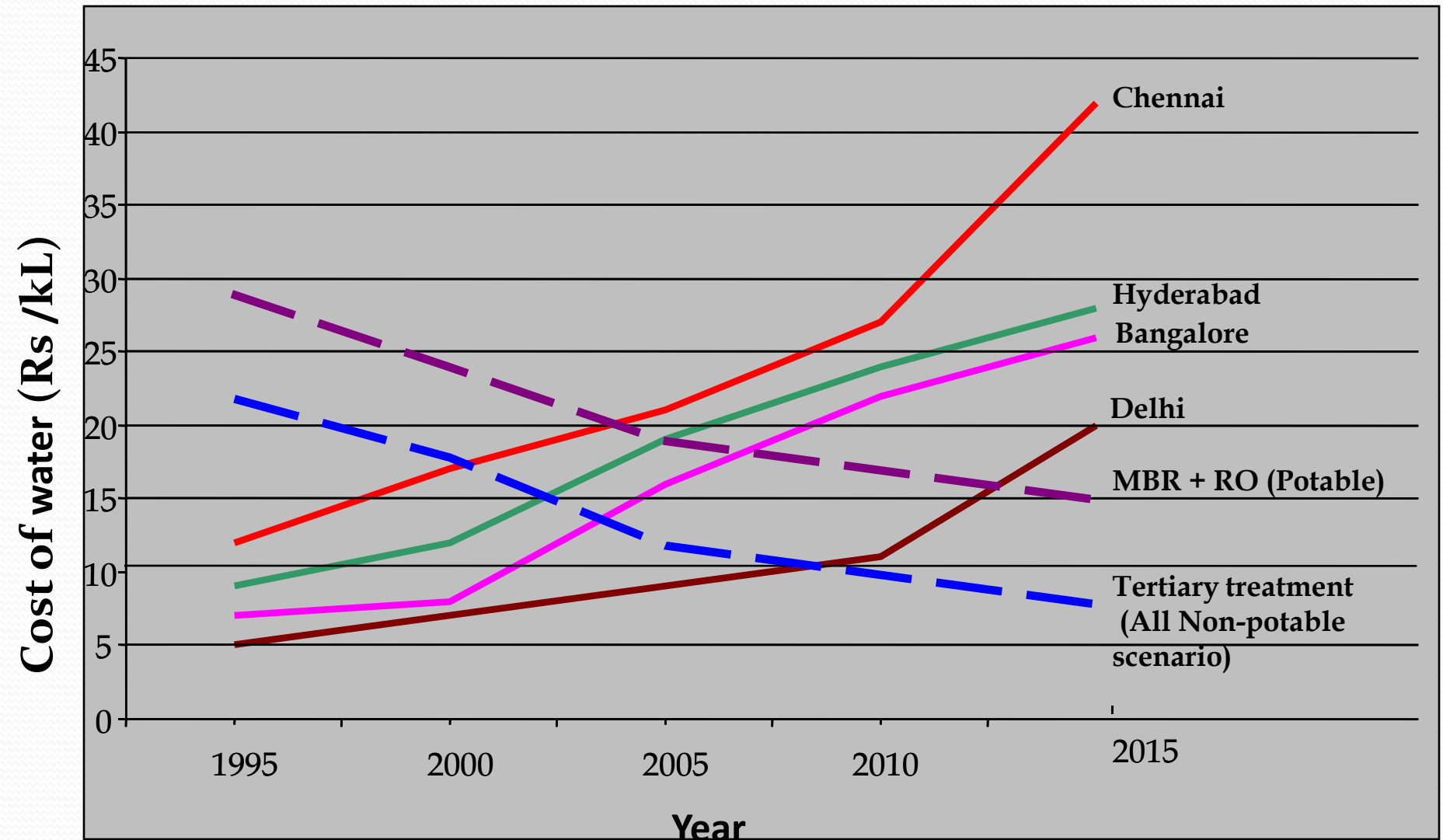
Nutrient Potential

- Nutrient potential in WW ranges from 0.63 – 0.73 tonnes/MLD
- Upto 40% reduction in nutrient load possible
- Reduced fertilizer requirement may reduce the Government fertilizer subsidy burden by ~ 100 crores annually

Energy savings

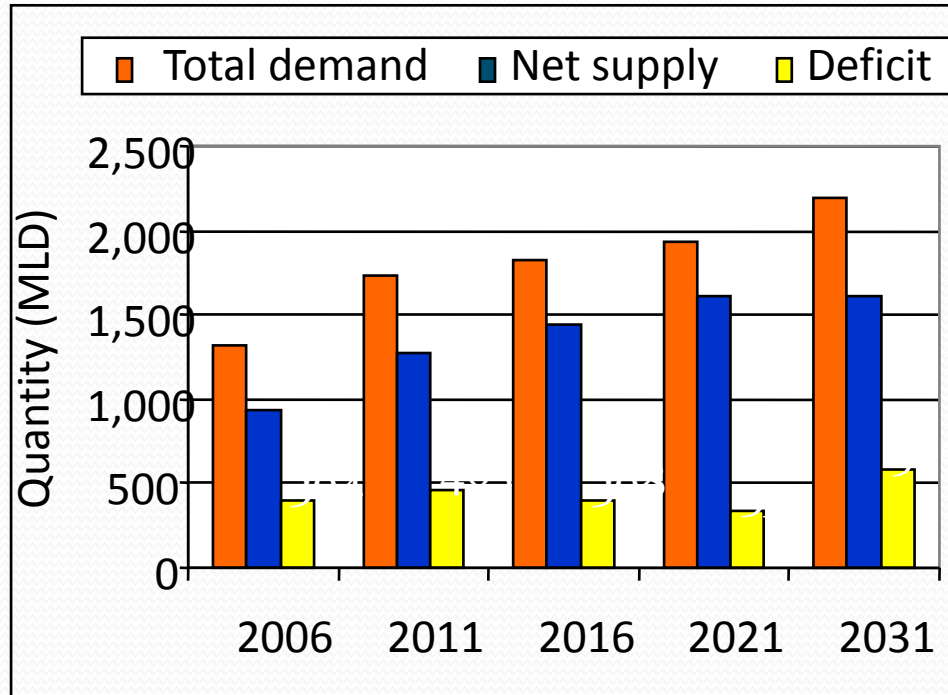
- Reduction in groundwater pumping, associated energy requirements
- Saving potential of ~ 600 Crores annually

Trends in Water Cost for Industries

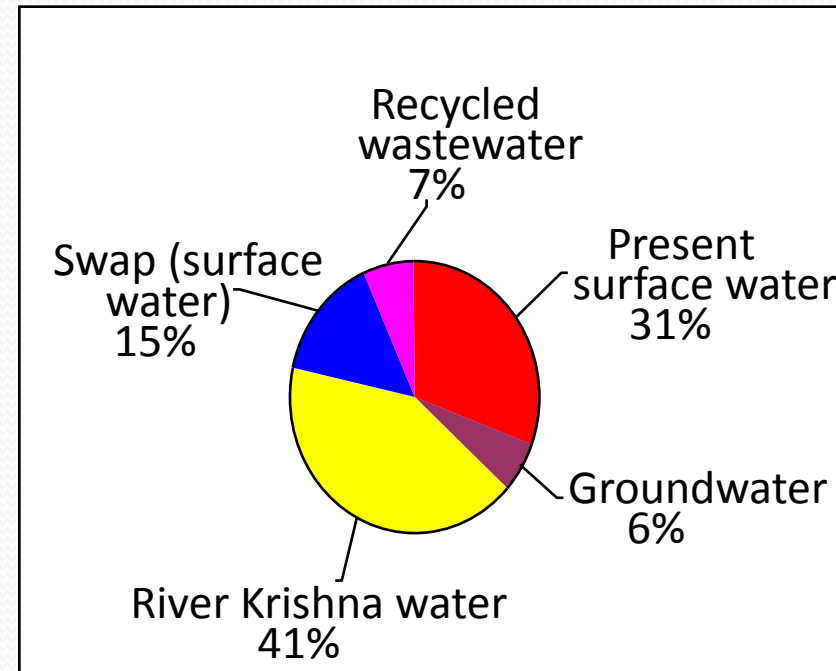


Recycled WW to meet deficit

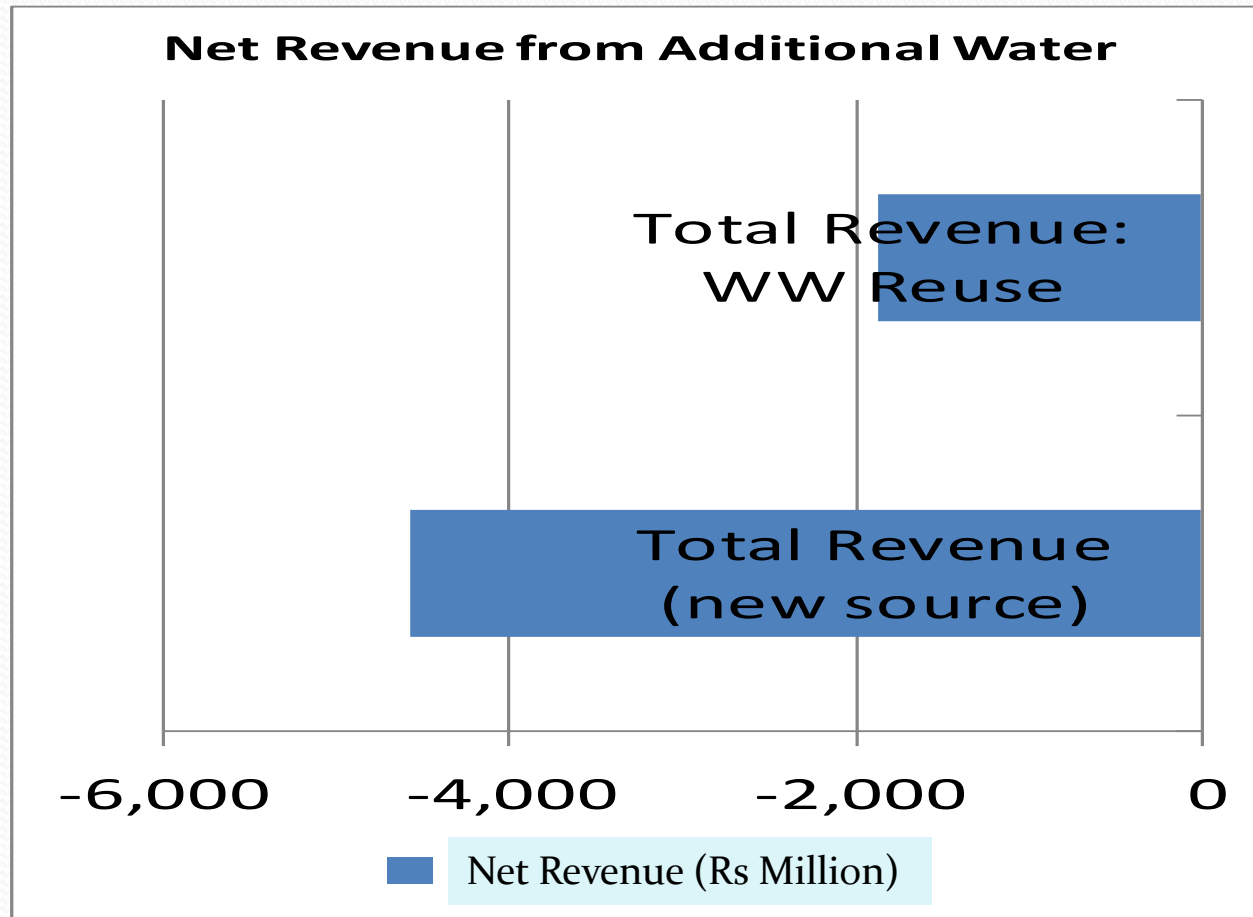
Freeing up Water for Augmented Supply



Average deficit 21% (436 MLD), Range 14% - 26%



Role of wastewater recycle and reuse : Water sustainability for Hyderabad



Sustainability of STPs: Chennai Metropolitan Water Supply and Sewerage Board



- Sale of 36 MLD of treated sewage @ Rs 8.75/KL
- Annual Revenue - Rs. 100 Million
- Revenue from sale of treated wastewater - 120% of O&M needs

Wastewater Recycle & Reuse in Industries



Customer : **Chennai Petroleum Corporation Limited**

Capacity : 12.25 MLD

Application : Chennai city sewage recycled to industrial grade water

Project by : **DOSHION LIMITED**



Treated wastewater price of Rs. 45/KL vs Rs. 60/KL for fresh water

Recycle and Reuse Projects

India

City	Capacity (MLD)	Status
Kohlapur	76	Operational
Delhi Jal Board	35	Operational
Chandigarh	45	Operational
Surat	40	Under implementation
Nagpur	110	Under implementation
Tuticorin	24	Under implementation
Vishakapatnam	63	Under implementation
Ahmedabad	60	Planned

International

Worldwide installed capacity – 40,000 MLD (Global water intelligence, 2010)

Brightwater, USA	250	Operational
Marrakech, Morocco	110	Operational
Singapore	92	Operational
Israel (80% of wastewater generated)	1000	Operational
Windhoek, Namibia	19	Operational

Limitations to Industrial Reuse

- While economically viable, industrial reuse is limited by the availability of industrial clusters in the vicinity of the treatment plant
- CPCB has identified **88 industrial cluster in 20 States** in India. Industrial reuse in these areas may be viable.
- Other areas need to explore alternate use of treated wastewater – Agricultural reuse for irrigation.

Wastewater Reuse Agriculture

- Potential to irrigate 1-3 Million Ha
- 40% reduction in fertilizer use
- Nutrient potential of 0.63 – 0.73 tonnes/MLD
- Reduction in GW required for irrigation, resulting in energy savings ~30% in WW irrigated areas

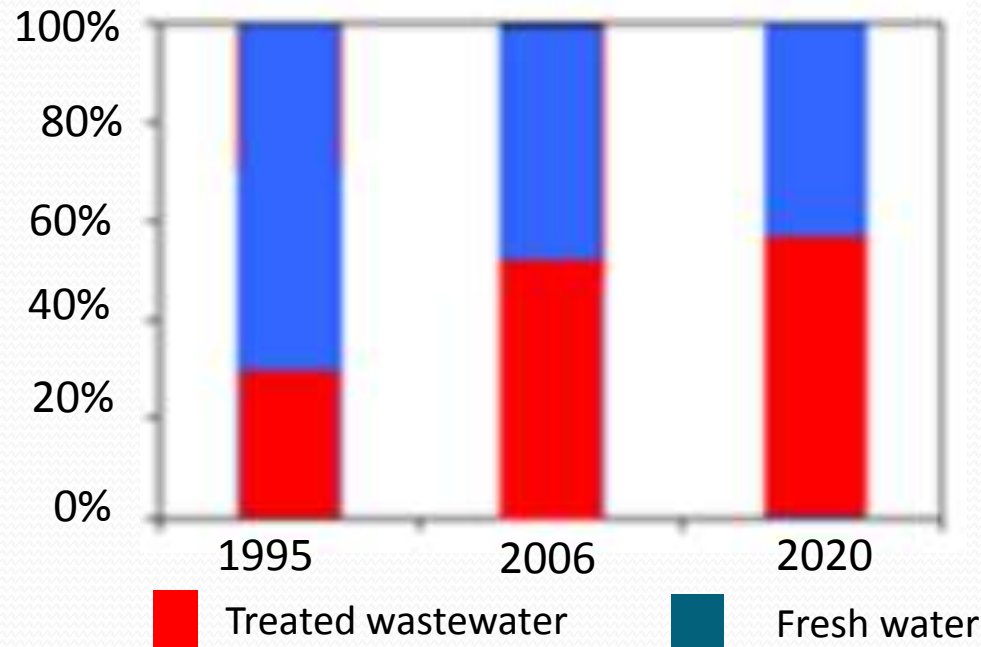
Nutrients in wastewater

Nutrient	mg/l
Nitrogen	32 - 36
Phosphorus	6.3 – 9.5
Potassium	10 - 13

ISRAEL'S EXPERIENCE

By 2020 60% of agricultural need met by treated wastewater, freeing water for other uses

% wastewater of the total water used for agriculture



Source: Silva and Scot 2002
Minhas 2002
Naty Barak, World Bank, 2009

Benefits of wastewater reuse for irrigation in select cities in India

City	Crop cultivated	Increase in yield (%)	Decrease in fertilizer use	Increase in pesticide use	Avg. Annual Incremental benefit (Rs./ha)
Indore	Wheat (Rabi) / Vegetables (Summer)	30-40%	50%	Almost double	36,752
Nagpur	Wheat (Rabi) / Vegetables (Summer)	30-40%	33%	Almost double	26,951
Jaipur	Wheat (Rabi) / Vegetables (Summer)	30-40%	50%	Almost double	37,790
Bangalore	Rice (Rabi), Sapota, Flowers (Summer)	30-40%	100%	Almost double	33,849
Ahmedabad	Rice and wheat (Rabi)	-	-	-	-14,640
Delhi	Okra	67%	60%	Increased by 50%	8,500
Kanpur	Paddy and wheat	Decrease in yield	-	-	6,166 (paddy) 954 (wheat)

Benefits of wastewater recycle and reuse in agriculture

- Use of treated wastewater for agriculture can help farmers increase their earnings
 - Case studies reveal an average by Rs. 17,000 / Ha per annum on account of water availability and reduced fertilizer use
 - Potential to increase of about 30% in the farmer's income when the farmer uses of freshwater alone
- Channeling the entire quantum of treated wastewater towards agriculture has the potential to support 2 million farmers

Challenges for Agricultural Reuse

- Irrigation water charges in India recommended by 13th FC are Rs. 1,175 in Major irrigation command areas and Rs. 588 in minor irrigation command areas for one hectare of irrigated land, or about **10-25 paise per kilo liter**.
- The O&M cost of treating wastewater is significantly higher compared to this.
- Treated wastewater when used for agricultural irrigation presents potential economic and environmental benefits to consumers, city governments and states - an **assured and reliable water supply**, the **nutrients** present in wastewater, and **avoided costs of groundwater pumping and fertilizer subsidies**
- Utilities and city governments will need to explore sustainable business models aimed at different user categories, working in partnership with various State Government Departments and Agencies

Govt. of India - Initiatives



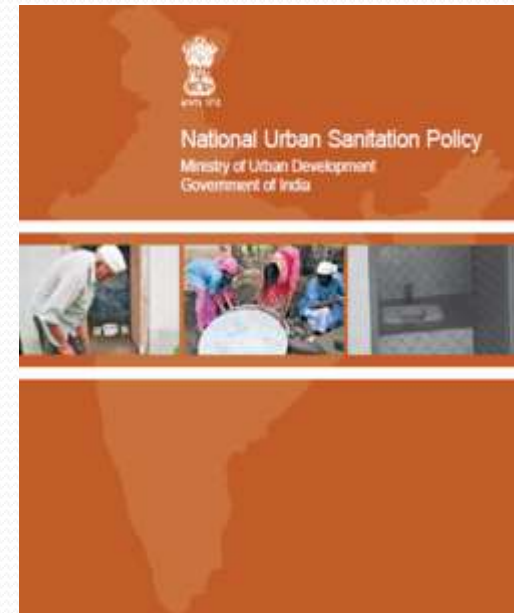
Vision: “All Indian cities and towns become totally sanitized, healthy, ensure public health and environmental outcomes for all their citizens.”

Goals:

- Achieve open defecation free cities;
- Total Sanitation: Safe disposal of 100% human and liquid waste;
- Adequate attention to O&M

SLB – 20% recycle of wastewater

Guidelines of wastewater recycle and reuse – Manual on sewerage and sewage treatment



Conclusions

- Availability of a continuous and reliable source of water;
- An economical option to meet a city's water demand;
- Improves viability of STPs when used to meet industrial water requirements;
- Sustainable option for industries;
- As a potential nutrient source for agriculture, with potential to reduce fertilizer requirements (up to 50-100% reduction as compared to freshwater) and an associated beneficial impact on crop yields (upto 30-60% increase reported by various researchers);
- Results in overall economic benefits for the farmer due to higher yields and lower costs (on average, an incremental benefit of about Rs. 17,000/hectare/year has been reported across the studies included in this review).

Discussion