Revised Discharge Standards and the Challenge of Treating Increasing Sewage Volumes

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Structure of the presentation

- Introduction
- Background
- Countrywide status of sewage treatment
- Capacity created under NRCP
- Status of the metros
- Diverse issues affecting sewage discharges
- Discharge standards for STPs – national and international
- Diverse schools of thought.
- An alternate paradigm.

Introduction

- Current status re sewage treatment capacity and discharge norms.
- The presentation is neither a critique nor a prescription.
- It is experience sharing, bringing out issue and highlighting challenges.

Background

- Okhla Sewage Treatment Plant, 1937!
- Water (Prevention and Control of Pollution) Act, 1974
  - Min. National Standards (MINAS) as recommendations from CPCB to SPCBs.
- Ganga Project Directorate, 1984
  - Ganga Action Plan, 1985
  - Yamuna Action Plan, 1993
- The Environment (Protection) Act, 1986
- The Environment (Protection) Rules, 1986
  - General Standards, 1988
  - General Standards in 1993 (+ / - few parameters).
  - Revised standards for selected parameters, 2017.

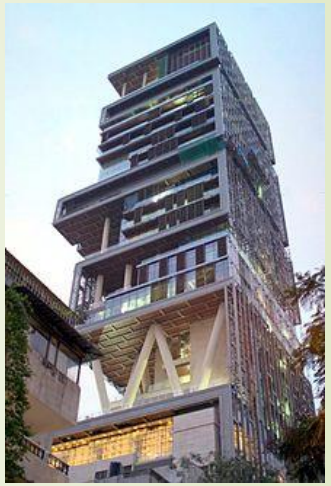
Country wide inventory of STPs

Particulars		Total
Existing STPs across the country		695
- Operational STPs	615	
- Non-operational STPs	80	
STPs under construction		154
STPs under planning		71
Total		**920**
Compliance with discharge quality		~ 40%

Source: CPCB, 2015

Countrywide status of sewage generation & treatment

	2004-5	2014-15
Sewage generation	38,250	62,000
Installed STP capacity	12,000	23,500
% installed capacity	~ 30%	~ 38%



- Capacity utilisation of existing STP : ~ 30%
- Actual sewage treated (2015) : ~ 7,000 mld (11% of total generation)
- STPs' discharge compliance: ~ 40%.
- Untreated sewage discharge: ~ 55,000 mld (89% of total generation)

Source: MOEF/ CPCB, 2015

Countrywide status of sewage generation & treatment

- MH, TN, UP, NCT Delhi & Guj (5/36) account for:
  - ~ 50% of total generation in the country, and
  - ~ 67% of the total installed STP capacity.
- 7 states/UTs without an STP:
  - Chhattisgarh, Daman & Diu, Assam, Tripura, Arunachal Pradesh and Nagaland.
- Only HP & Sikkim and Chandigarh (UT) have adequate STP capacity to deal with present sewage volume.

Capacity created under River Action Plans

- Ganga Action Plan Ph-I
  - States : UP (UK), Bihar (JH) and WB
  - Number of towns: 25
  - Original estimated flow: 1340 mld
  - **Number of STPs: 34**
  - **Aggregate STP capacity: 870 mld**
  - Cost (1994) : Rs. 462 Crore
- Yamuna Action Plan
  - States: Haryana, UP (and Delhi)
  - **Number of STPs: 42**
  - **Aggregate STP capacity: 732 mld**
  - Cost (1993-2003) : Rs. 676 Crore
- National River Action Plan (excluding GAP & YAP)
  - 14 states (AP, Tel, JH, Guj, Goa, KR, MH, MP, Odisha, Punjab, TN, Kerala, Sikkim and Nagaland)
  - Number of towns: 75
  - Number of river stretches: 31
  - **Aggregate STP capacity created : 2,446 mld**

STP capacity in Metro Cities

- Status in the 65 metro and capital cities (more than 10 Lac Population).
  - Sewage generation : ~ 15,644 mld
  - STP capacity : ~ 8,040 mld
  - Coverage : ~ 51%.
- Delhi & Mumbai : 55% of the total metro capacity.
- Remaining 63 cities account for the balance 45% capacity.
- In most of these cities > 50% of the sewage is discharged untreated.

Sewage treatment capacity in Delhi

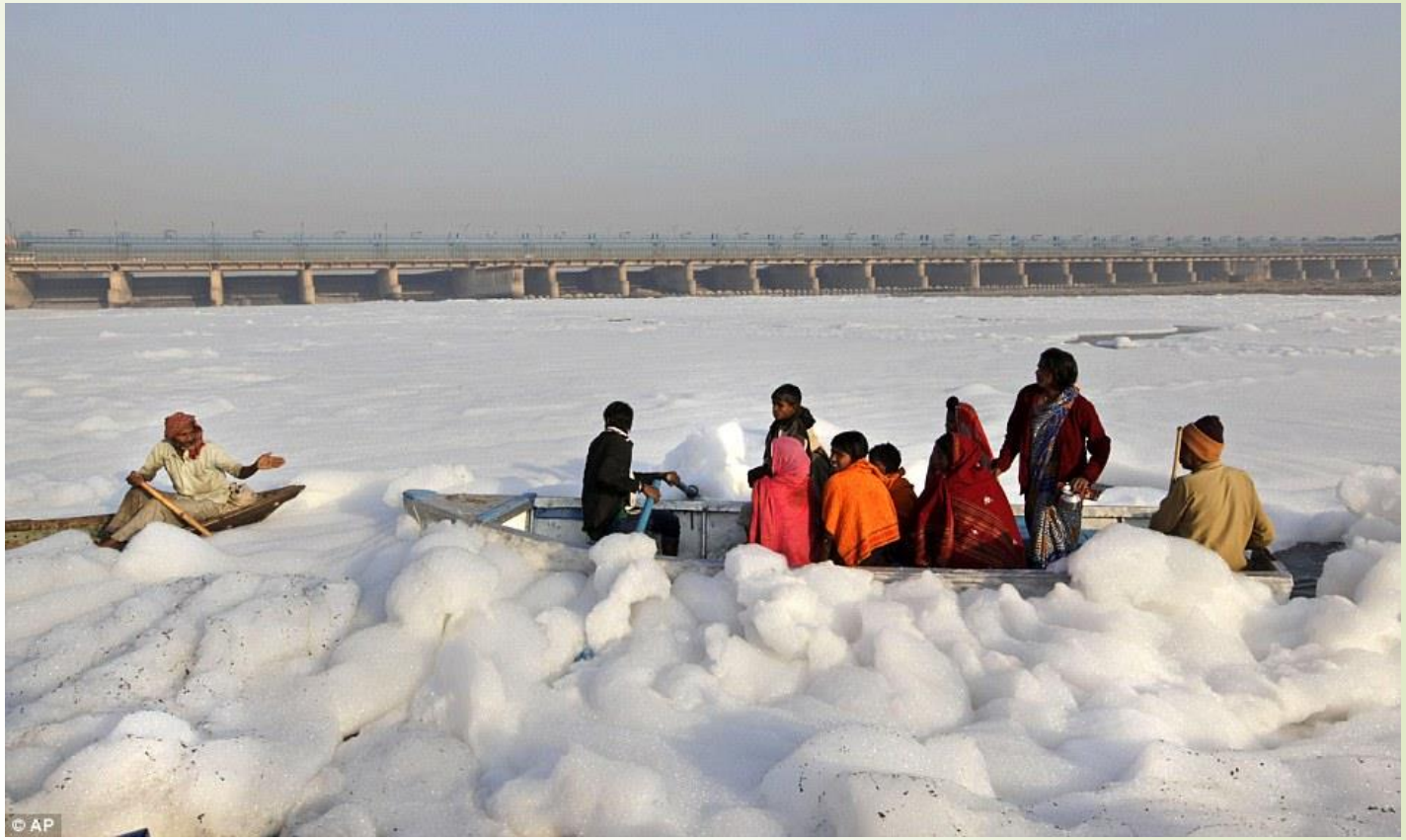
- Number of STPs : 36
- Sewage generation : 4155 mld
- Aggregate installed capacity: 3110 mld
- Operational capacity: 2755 mld
- Sewage collected and treated : 2065 mld (50% of generation)
- **Untreated sewage discharged into river Yamuna: 2090 mld (50%)**
- **STP capacity utilization: 66%**

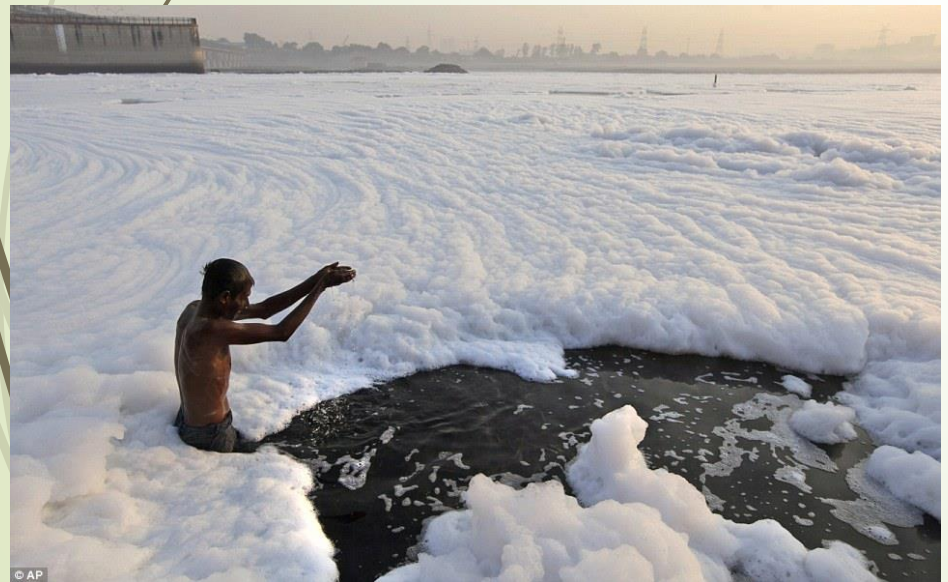
- 318 mld STP to be commissioned in 2019.
- 564 mld STP is planned at Okhla.
- Over 150 decentralized STPs (1-4 mld) are planned all across NCT for rural settlements.

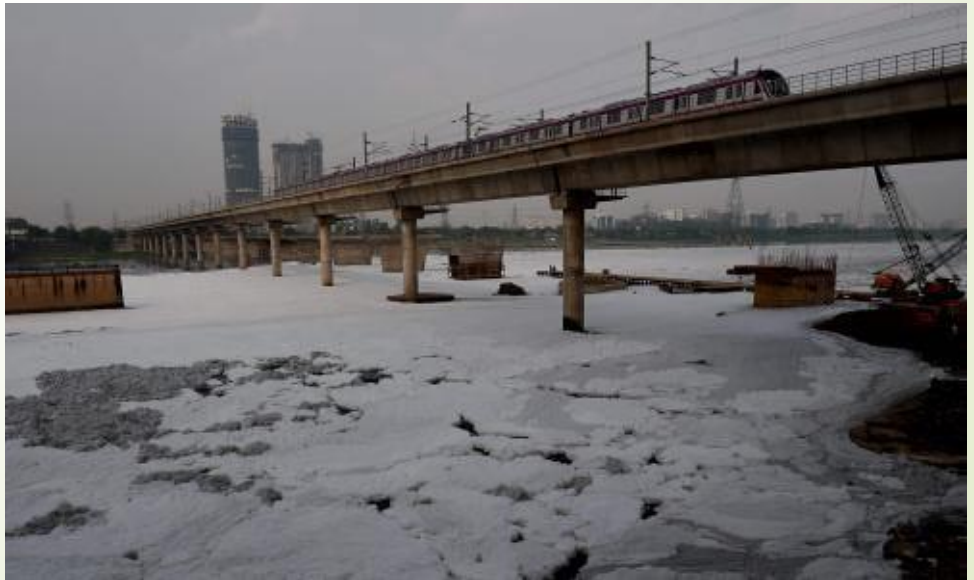
Discharge norms in Delhi

	Norms	Capex /mld
1st generation	30 : 50	
2nd generation	20 : 30	0.9 Cr
3rd generation	10 : 10; N_{tot} < 10mg/l P < 2 mg/l	1.8 Cr.

Yamuna in Delhi

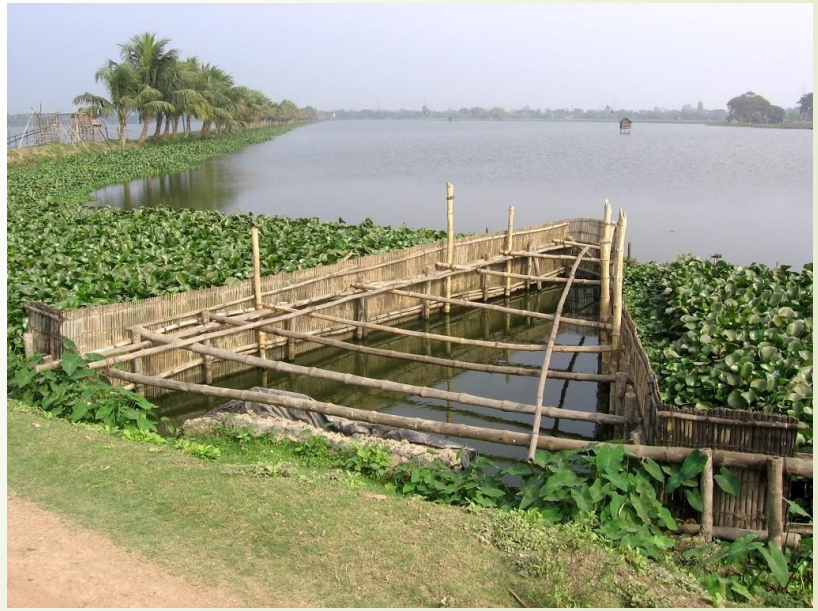




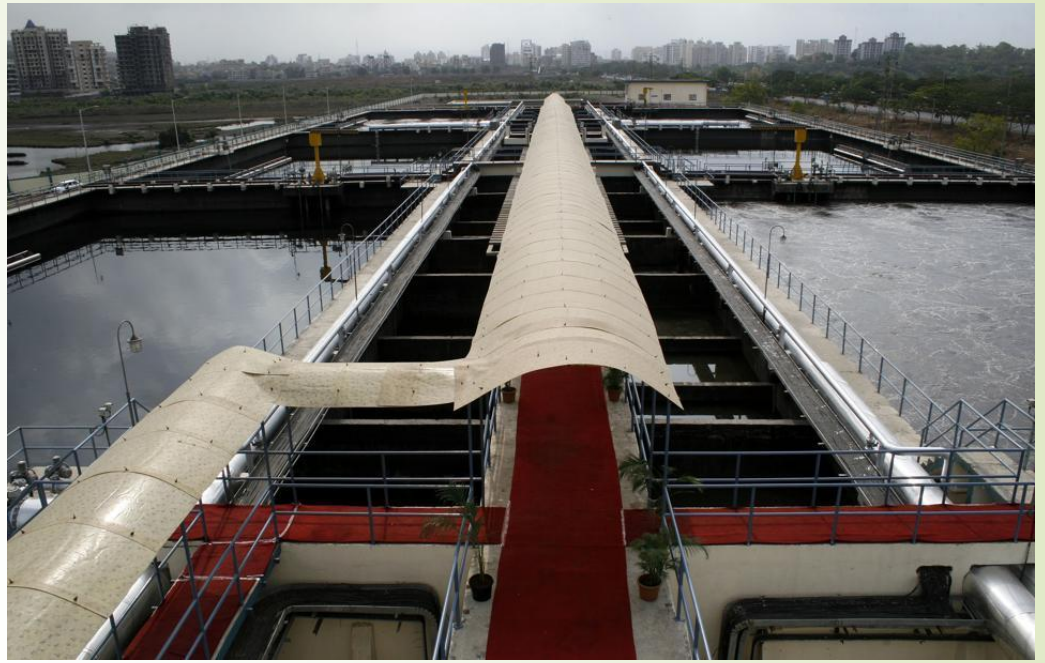


STP capacity in Kolkata

- Number of STPs : 5
- Sewage generation : ~ 2200 mld
- Aggregate installed capacity: ~ 180 mld
- Sewage collected and treated : ~ 170 mld (~100 % of generation)
- Untreated sewage discharged into East Kolkata Wetland System: 2030 mld (+90%)

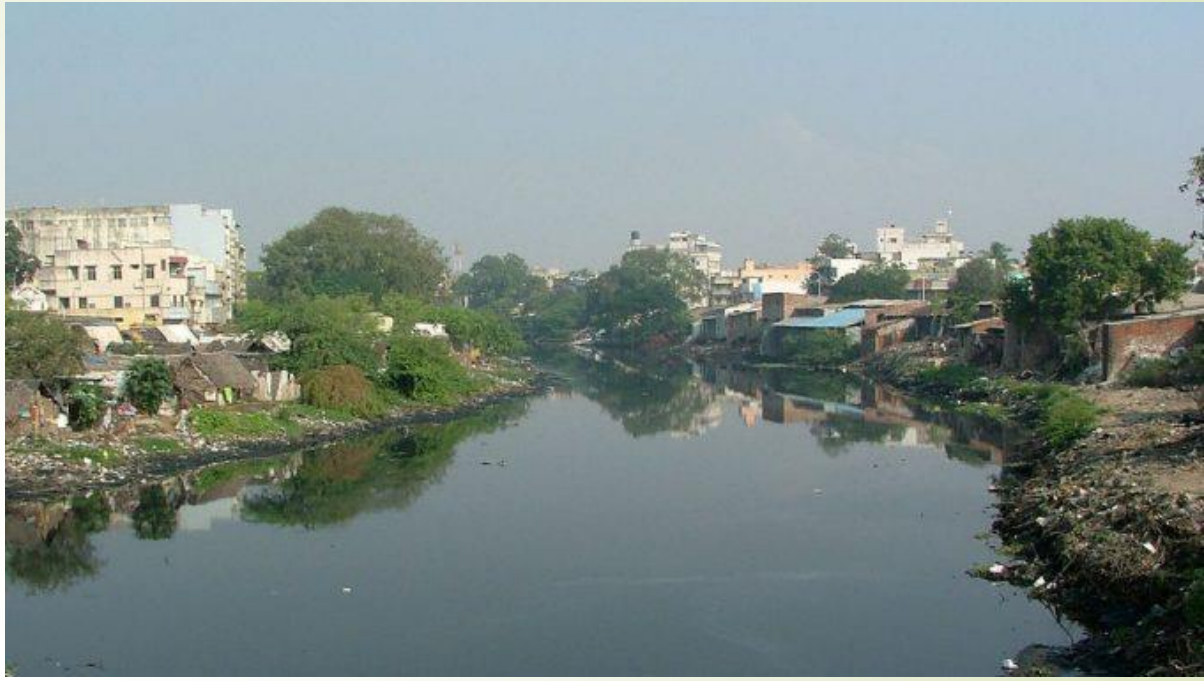


STP capacity in Mumbai



- Sewage generation: ~ 2700 mld
- Number of existing STPs: 7
  - Installed capacity: 2130 mld
  - Mainly primary treatment
- Present collection and Tr. : 1384 mld (~50%)
- Untreated discharge: ~ 1300 mld (~50%)
- Proposed new STPs: 7
  - Aggregate capacity: ~ 1700 mld
  - Secondary and tertiary treatment for Re-N-Re!

STP capacity in Chennai

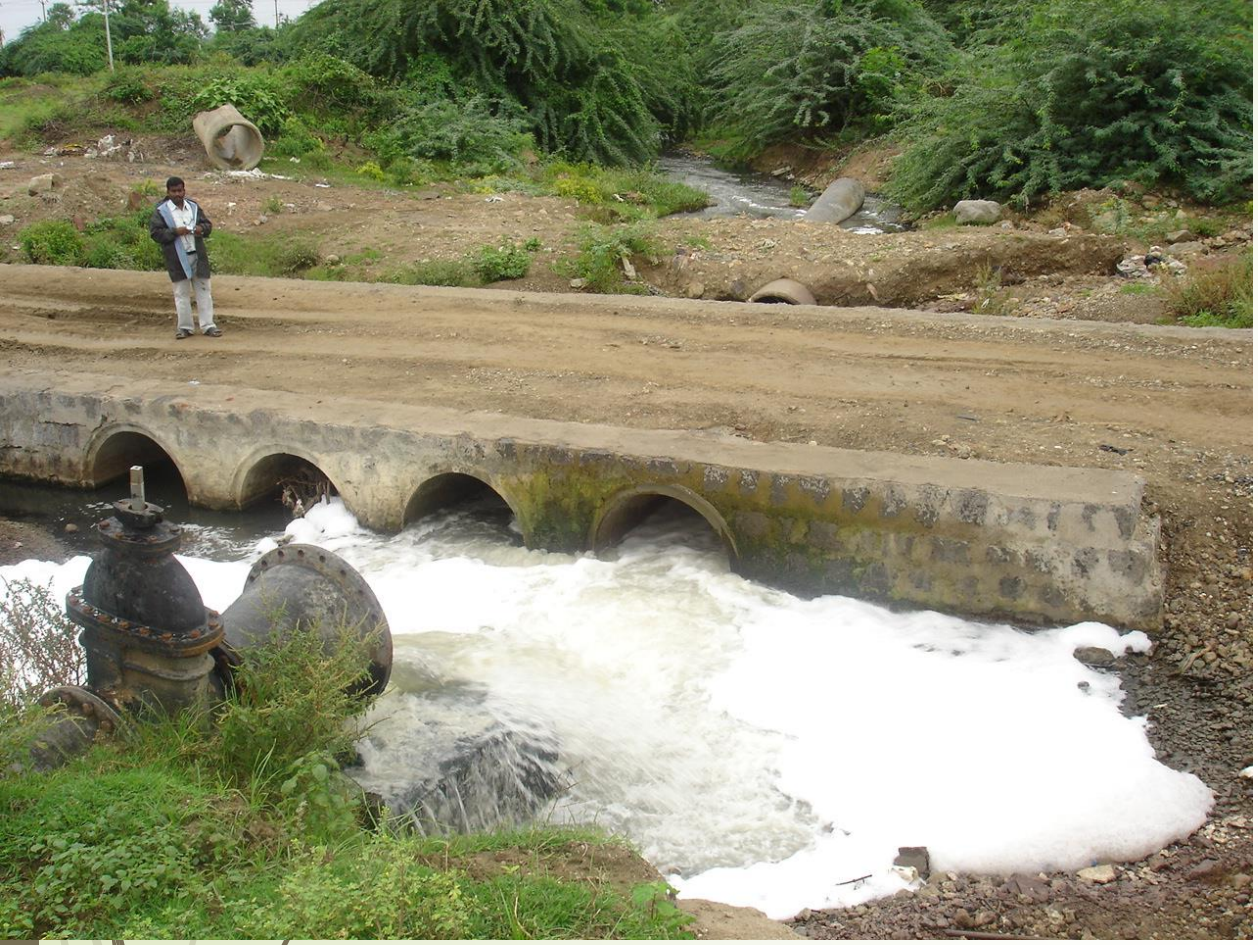


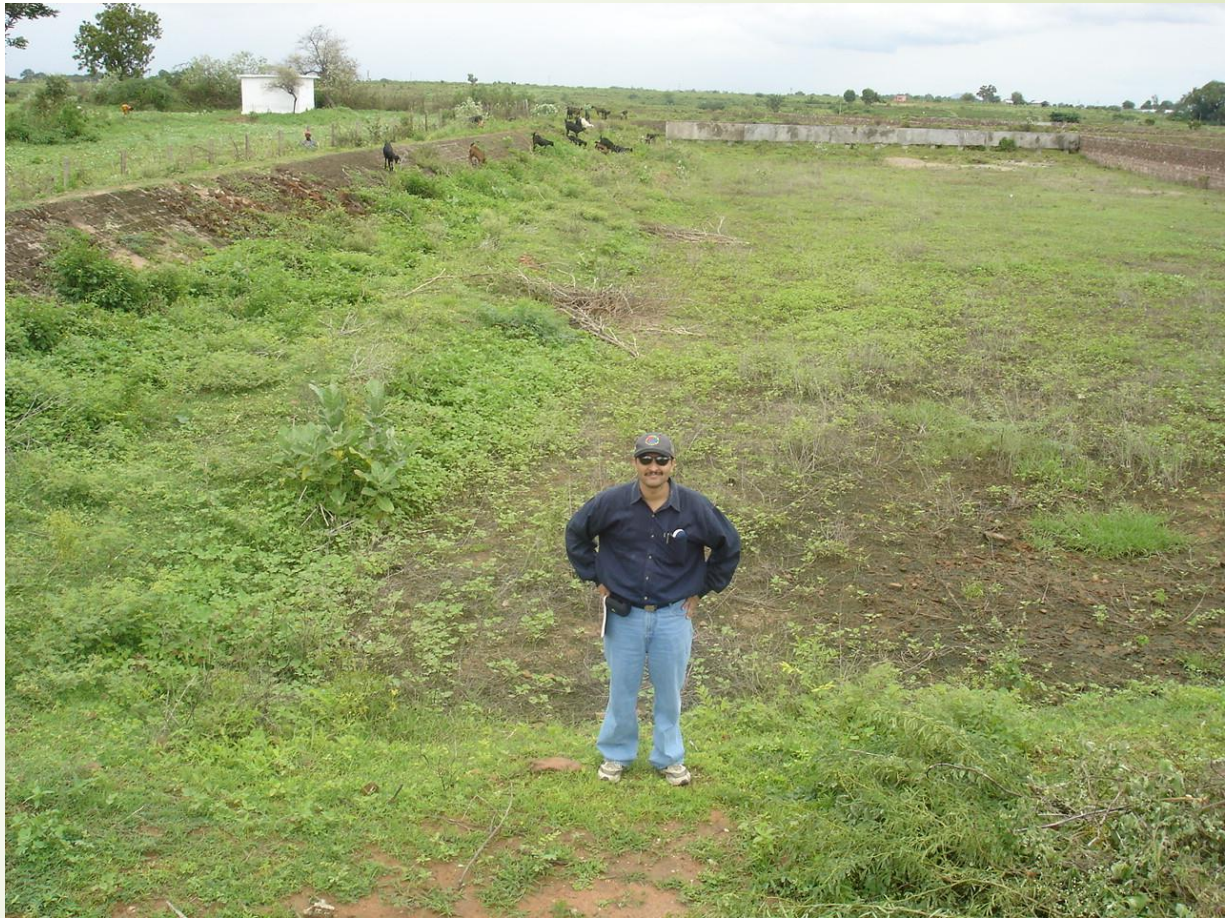
- Sewage generation: ~ 1800 mld
- Number of existing STPs: 12
  - Installed capacity: 764 mld
- Present collection and Tr. : 550 mld (~ 30%)
  - 36 mld treated sewage Re-N-Re in industries.
- Untreated discharge: ~ 1250 mld (~70%)

Diverse issues affecting sewage treatment

- Non-existent or partial sewerage systems.
  - Limitations of trunk sewers.
  - Arbitrary diversions to open drains.
- Weak enforcement for house connection.
- Inadequate conveyance system.
  - Inadequate pumping capacity.
  - Inoperative pumping machinery.
  - Inadequate back up capacity.
  - Unwillingness to operate generators.
- Lack of funds with ULBs for :
  - O&M of Sewage pumping stations.
  - O&M of STPs.
  - Replacement of worn-out equipment
- Limited technical expertise for operation.
- Rapid deterioration of plant and equipment.
- Lack of MIS and supervision.

- **Lack of robust and systemic approach for continuous monitoring and evaluation at the program level.**
- **Inconsistent paradigms of (1) resource and energy recovery coupled with (2) cost, energy and footprint minimization.**
- **Lack of inputs towards capacity building.**





Revised STP discharge standards

Parameter	General standards (1993-2015) for discharge of effluent		Draft standards for new STPs (2015)	Final standards (2017)	EU	China
	Water bodies	Land				
pH	6.5 – 9.0	6.5 – 9.0	6.5 – 9.0	6.5 – 9.0	NA	6-9
BOD (mg/l)	30 3d@ 27℃	100 3d@ 27℃	**10 3d@ 27℃**	**20$ / 30 3d@ 27℃**	25 5d@ 20℃	30 5d@ 20℃
COD (mg/l)	250	NS	**50**	**250**	125	100
TSS (mg/l)	100	200	**20**	**50$ / 100**	35[a] / 60[b]	30
NH4-N (mg/l, N)	50	NS	**5**	**NS (50)#**		
TKj-N (mg/l, N)	82 (100 as NH_3)	NS	**NS**	**NS (82)#**		
Nitrate-N (mg/l, N)	10	NS	**NS**	**NS (10)#**		
Total-N (mg/l, N)	NS (~ 92)	NS	**10**	**NS (~ 92)#**	10[c] / 15[d]	
Phosp. (mg/l, P)	5^	NS	**NS**	**NS (5)#**	1[c] / 2[d] €	3
Faecal Coliform (MPN/100 ml)						
- Desirable	1000*		**< 100**	**< 1000**		10,000¥
- Max perm.	10,000*					

$: Metro and state capitals
^: Dissolved Phosphorus
#: Min. National Standards
*: Recommended under NRCP.
¥: Total coliform

a: > 10,000 PE
b: 2,000-10,000 PE
c: > 100,000 PE
d: 10,000-100,000 PE
€: Total (dissolved + suspended)

WWTP effluent thresholds, EU Directive 91/271/EEC

Parameter	Unit	Maximum concentration	Remarks
Biochemical oxygen demand (BOD_5)	mg/l O_2	25	Without nitrification
Chemical oxygen demand (COD)	mg/l O_2	125	
Total suspended solids (TSS)	mg/l	35	60 (Discharge < 10,000 PE)
Total phosphorus ($P_{tot.}$)	mg/l P	2	1 (Discharge > 100,000 PE)
Total nitrogen ($N_{tot.}$)			

COD : BOD ratio = 5

German Wastewater Directive (AbwV)

Sample according to size of WWTP	Population Eq.	COD	BOD_5	NH4-N	Total Nitrogen (as N)	Total Phosphorous (as P)
Class 1: < 60 kg/d BOD_5(raw)	1,000	150	40	-	-	-
Class 2: 60 to 300 kg/d BOD_5 (raw)	1,000-5,000	110	25	-	-	-
Class 3: 300 to 600 kg/d BOD_5 (raw)	5,000-10,000	90	20	10	-	-
Class 4: 600 to 6,000 kg/d BOD_5 (raw)	10,000-100,000	90	20	10	18	2

COD : BOD ratio = 3.75 - 5

Note:

1. Qualified sample or 2 h mixed sample.
2. No specification for N and P for smaller plants.

Indian revised standards – few observations

- Uniform standards for discharge into water bodies or on land for irrigation.
- Uniform standards for plants/ ULBs of all sizes.
  - 30:100 remains for all non-metro cities.
- MINAS apply for all other parameters not specified in the Oct 2017 Notification.
- Do not specify nature and duration of samples; permissible violations in a month/year.
- Apparent resistance in lowering of standard for COD
  - COD: BOD ratio is between 8 – 12.5
- The challenges of nitrogenous oxygen demand and phosphorus are yet to get consideration.
- Correlation between Total-Nitrogen and Faecal Coliform is yet to be addressed.

Diverse schools of thought

- Full treatment in one go - effluent quality at par with the best.
- Energy and resource recovery.
- Minimalist approach:
  - Minimising foot print.
  - Minimising energy requirement.
  - Minimising capital and operating costs.
- Water resources diversion for productive uses.
- Ecological discharge in rivers.
- Zero discharge from STPs.

- Lessons from the past
  - There are no easy solutions.
  - Resources are limited.
  - Slow speed in capacity creation
    - Last 30 years - average capacity @ 750 mld/annum.

An alternate paradigm

- Can we keep things simple – practicable and affordable?
- Wider geographical coverage over the watershed/ river basin versus few plants producing high effluent quality.
- To start with, aim for moderate effluent quality.
- Plant upgradation in stages to achieve higher effluent quality.
  - Phase-I: Enhanced Primary Treatment.
  - Phase-II: Secondary Treatment.
  - Phase-III: Tertiary Treatment.

Comparative organic load reduction assessment

Particulars	Unit	Conventional approach	Enhanced Primary Treatment approach	Remarks
Sewage quantity	mld	62,000	62,000	
Quantity being treated	mld	7,000	43,400	11% v/s 70%
Raw BOD	mg/l	200	200	
Final BOD	mg/l	30	50	75% reduction
BOD reduction	mg/l	170	150	
BOD load reduced	**Tonnes/day**	**1,190**	**6,510**	
BOD load discharged	**Tonnes/day**	**11,210**	**5,890**	

Thank you very much