# Treatment and Potential Uses of Wastewater

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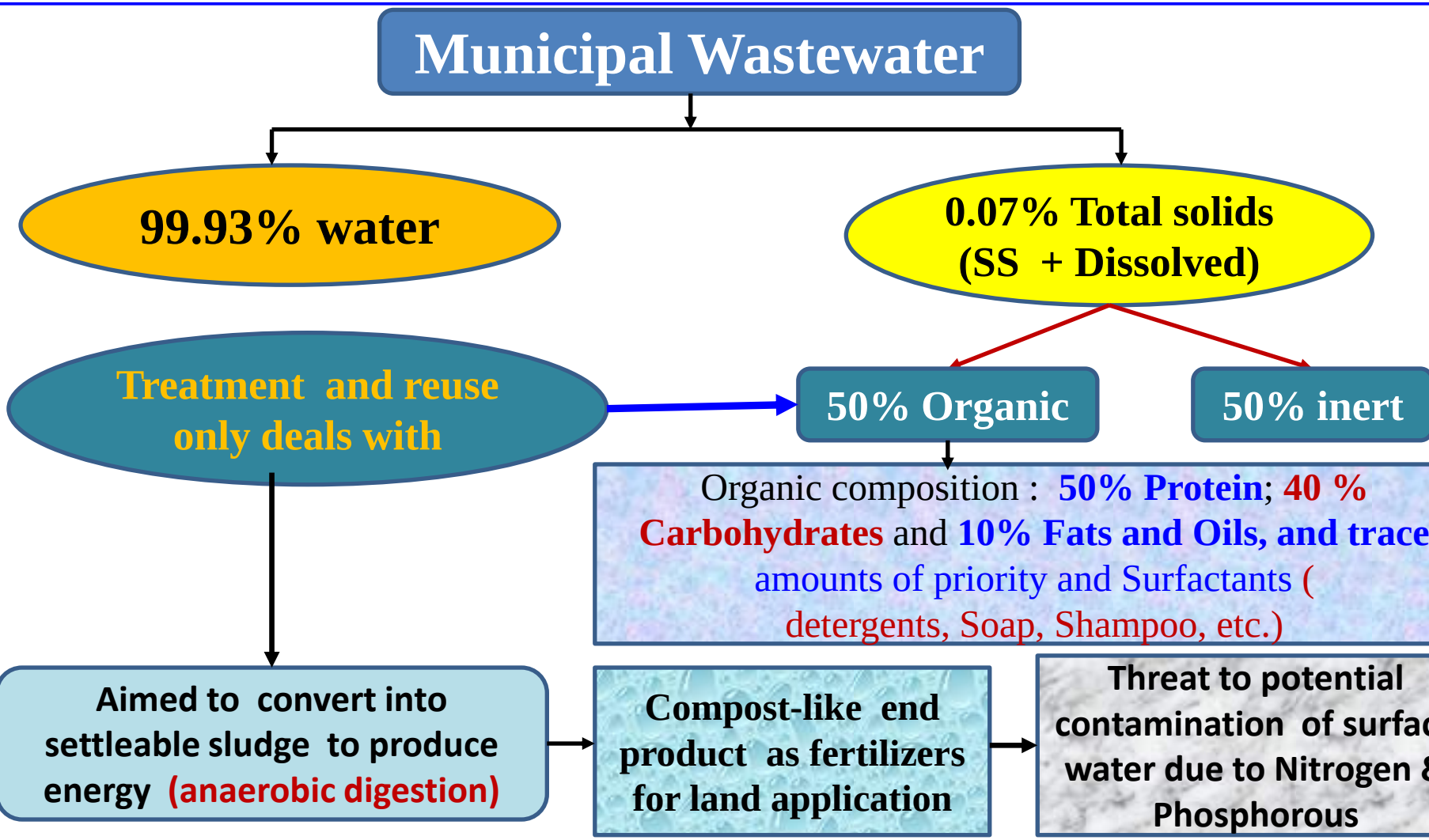
# Composition of Wastewater




- Municipal wastewater typically contains : **220 mg/L of both SS & BOD**
- Microbiological composition of Wastewater includes : **$10^5$ - $10^8$ CFU Coliform, $10^3$ – $10^4$ CFU Fecal Streptococci , etc.**
- Water > **1000 mg/L TDS is unsafe for irrigation.**

# Composition of Wastewater contd..

## Industrial Wastewater (Point Source Pollution)

| Sector | Pollutant |
|---|---|
| ➢ Iron and Steel | BOD, **COD,** Oil**, Metals, Acids, Phe** **ide** |
| ➢ Textiles and Leather | BOD, Solids, **Sulfates** and **Ch** |
| ➢ Pulp and Paper | BOD**, COD**, Solids, **Ch** **anic compounds** |
| ➢ Petrochemicals and Refineries | BOD, **COD, Mi** **nols, and Chromium** |
| ➢ Chemicals | **COD** **emicals, Heavy metals,** **SS and** |
| ➢ Non-ferrous met | **e** and SS |
| ➢ Microelectr | **COD** and Organic Chemicals |
| ➢ Minin | SS, **Metals, Acids and Salts** |

❑ **Removal of Inorganic Chemicals are concern and require mechanized treatment technique**

# Composition of Wastewater contd..

## Agricultural Wastewater (Nonpoint and point Source Pollution)

| Source | Pollutant |
|---|---|
| ➢ Sediment Runoff | SS and Turbidity |
| ➢ Nutrient Runoff | Nitrogen, Phosphor |
| ➢ Pesticides | Active ingredi ngredients |
| ➢ Animal Wastes | Strong C , Nitrate and Ph d concentration, Antibiotics, rasites, Pathogenic Bacteria, etc |
| ➢ Piggery Wastes | s animal wastes, and elevated Copper. |
| ➢ Milking P | Organic pollutants, Disinfection chemicals, etc. |
| ➢ Sla s | Same as Milking Parlor |
| ➢ ashing W | Soil and Vegetable Pieces, and Pesticides |

**Major concerns - Organic Pollutants and 'Natural Treatment Techniques' can be used.**

# Potential Treatment Techniques

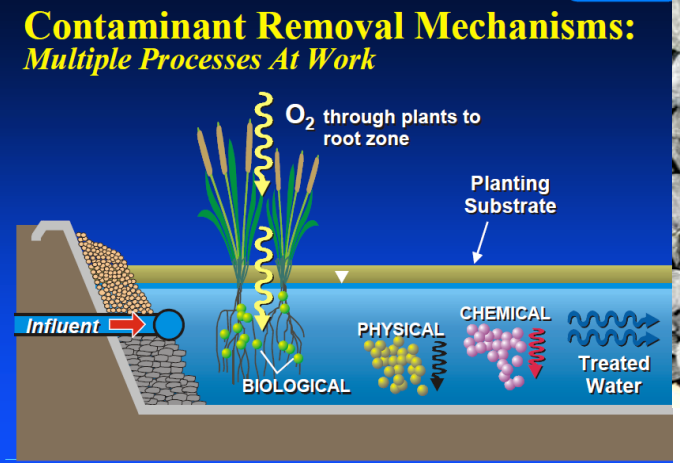
## ➢ Municipal Wastewaters

- **Natural Treatment Techniques (NTTs):** ***Stabilization or oxidation ponds, Natural and Constructed Wetlands, Phyto and Bio-remediation.***
  ***(Land Footprint is more).***

- **Mechanized Treatment Techniques :** ***Aerated Lagoon, Trickling Filters, Conventional Treatment Techniques, etc.***
  ***(Costly and recurring energy foot print and O & M cost).***

- **Combination of NTT & Mechanized system :** ***CW followed by oxidation or stabilization pond , Or, Aerated Lagoon followed by oxidation pond. ( Marginal land and Energy foot prints).***

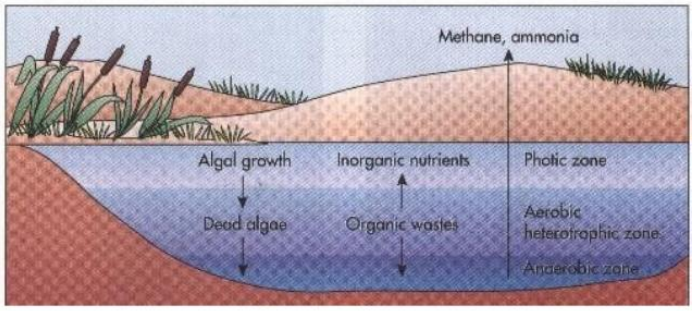
- **Advanced Technique :** ***Blasted Sand Flocculation (BSF) together with mechanized system. ( Efficient & Reduced land foot prints)***




Constructed Wetland

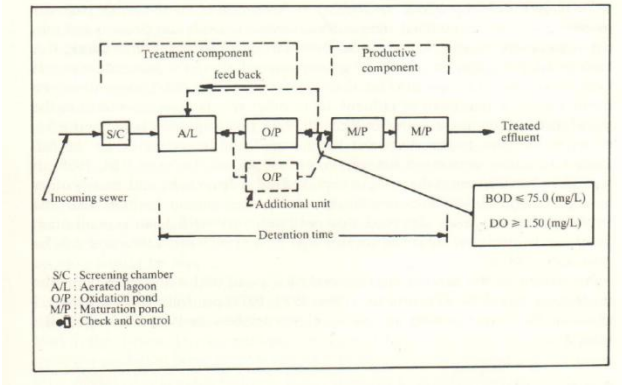
Reed material as filtering media

Facultative Oxidation (Waste Stabilization) Pond



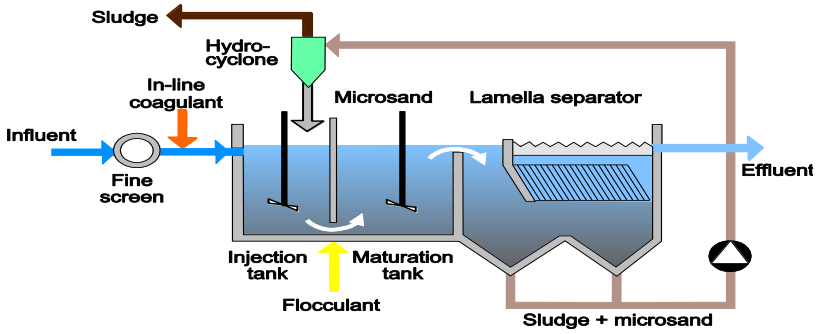

Waste Stabilization pond

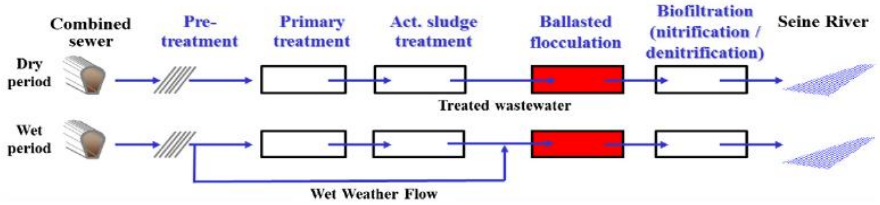
Mechanized system : Aerated Lagoon




Combination of AL & OP

(Ghosh & Bose, 1994)



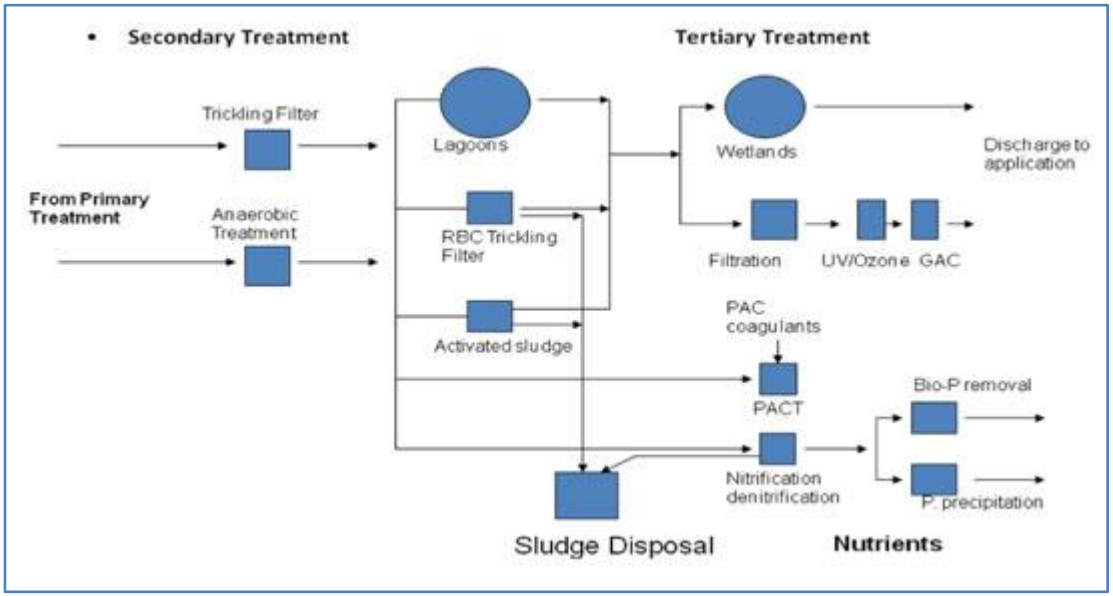

Ballasted Sand Flocculation

# Potential Treatment Techniques contd..

## Industrial Wastewater Techniques :

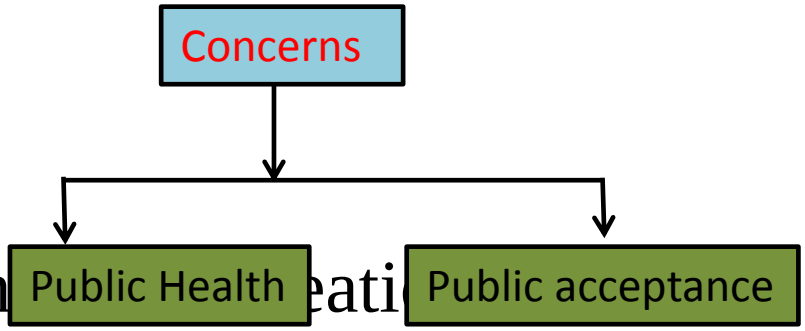
**Mechanized techniques vary from types of Industrial effluents.**

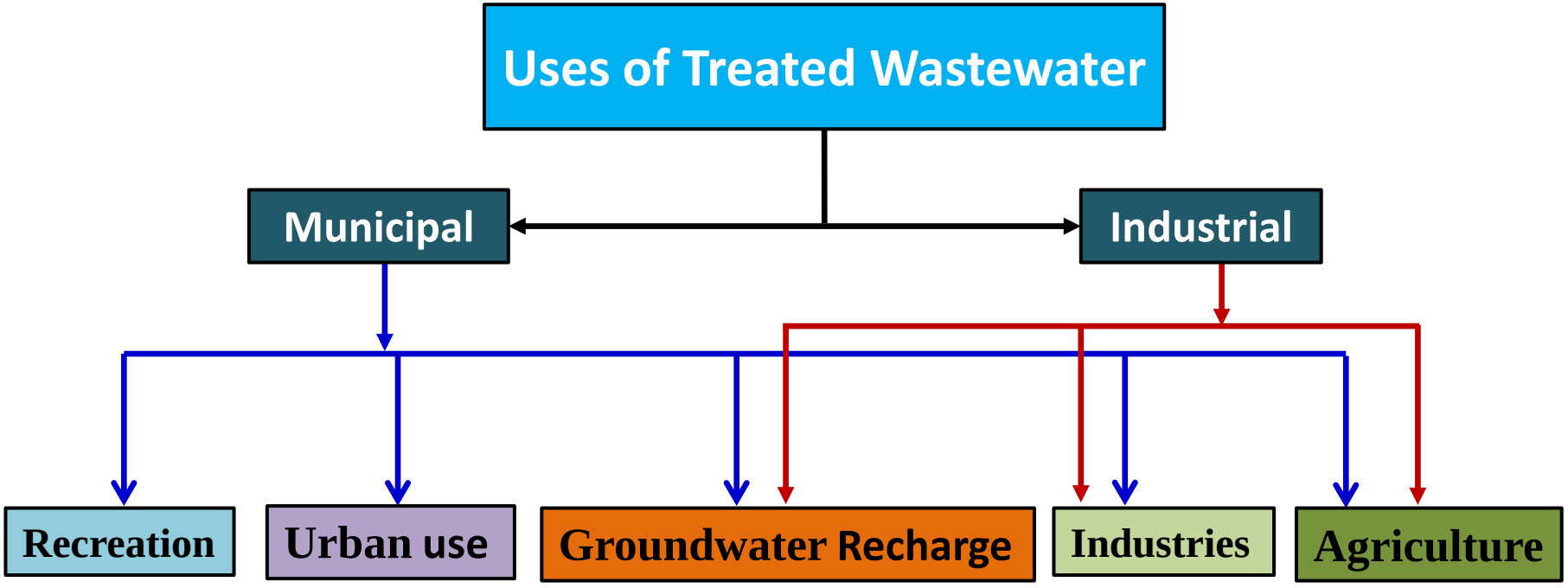
**Primary – Secondary- Tertiary Treatment of Wastewater**



# Potential Uses of Reclaimed Wastewaters

- Urban uses
- Industrial uses
- Agricultural purposes
- Habitat restoration/enhancemen eati
- Groundwater recharge

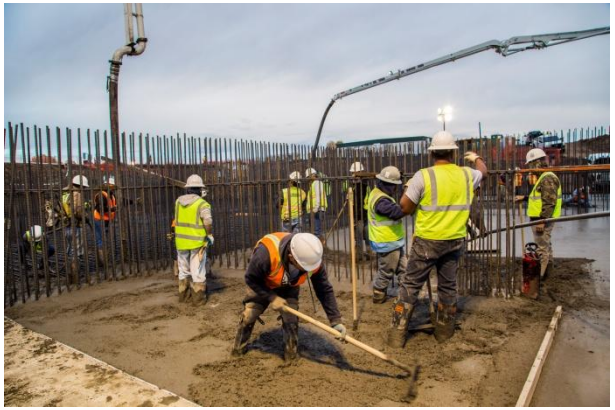


# Potential Urban Uses

- **Irrigation** - public parks, schools, road and building construction, landscaped areas, golf courses, etc.
- **Commercial** - vehicle washing facilities, laundry facilities, mixing pesticides and herbicides
- **Construction** - dust control, concrete production
- **Toilet and urinal flushing**
- **Fire protection**

Lawn watering



Building Construction

Car washing

# Potential Agricultural Uses

## Agricultural uses

### Benefits

- High concentrations of nutrients
- May eliminate need for fertilizer
- Long-term soil enrichment
- Decreases demand on potable water supply
- Additional treatment in soil

### Limitations

- Health risk from associated pathogens
- Health risk from other contaminants ( e.g. metals, chemicals, pharmaceuticals)
- Decrease in soil quality from accumulation of metals and acidification.
- Contamination of groundwater


# Potential Uses for GW Recharge

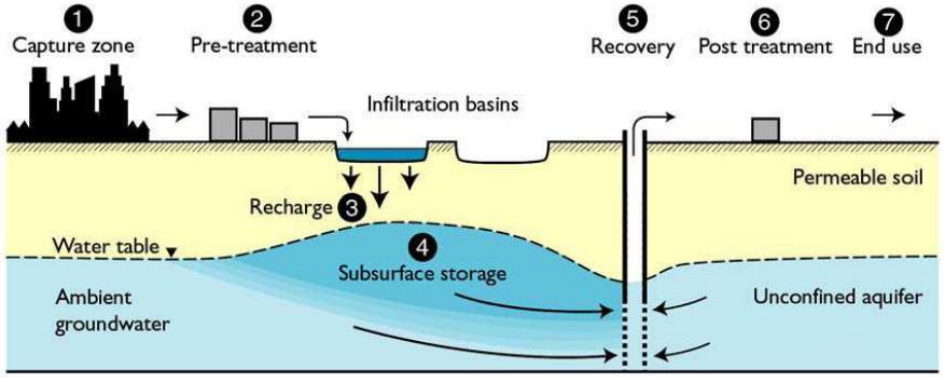
## Groundwater Recharge

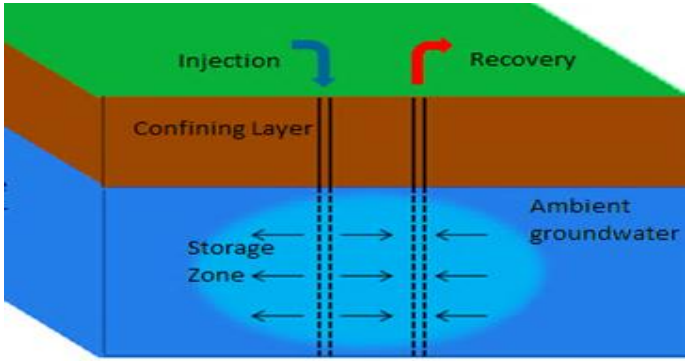
### Advantages

- Establish saltwater intrusion barriers
- Provide further treatment for future reuse
- Provide storage of reclaimed water for subsequent retrieval and reuse
- Control or prevent ground subsidence
- No evaporation, taste and odor

### Limitations

- Extensive land areas needed for spreading basins
- Costs of treatment, water quality monitoring, and injection/infiltration facilities may be expensive.
- Recharge may increase danger to aquifer contamination due to inadequate pretreatment.
- Inadequate institutional arrangement or groundwater laws



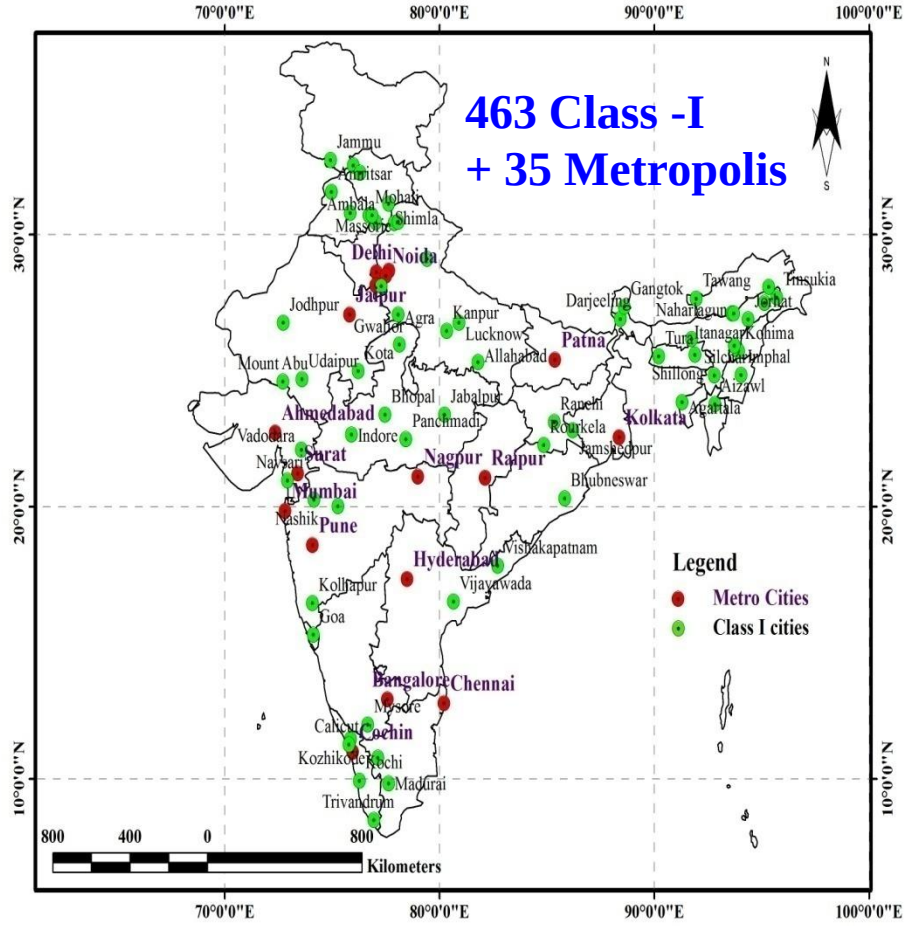



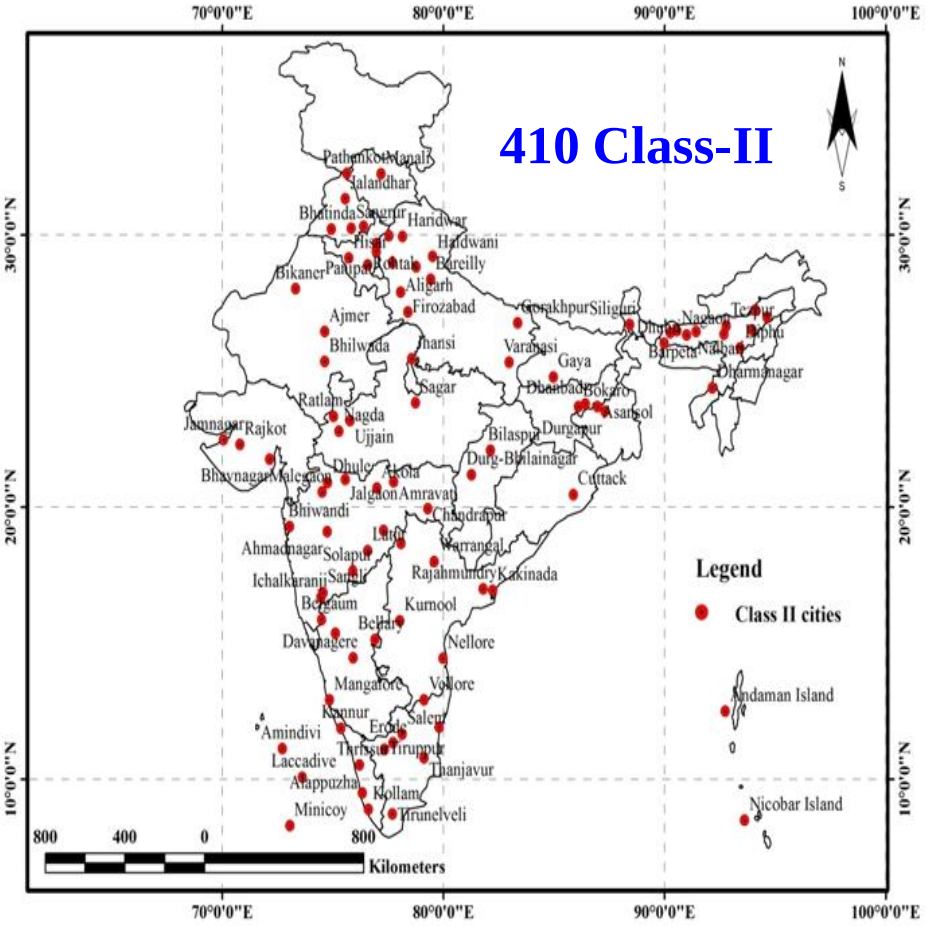
# India's Status on Wastewater

**NWP (2012) :** incentivizes for recycle and re-use of water.

**Survey (2010) :** **Class-I** (Population > 0.1 million) **: 498** i/c 35 metropolitan

**Class-II** (0.1 > Population > 0.05 million) **: 410** **India's cities**



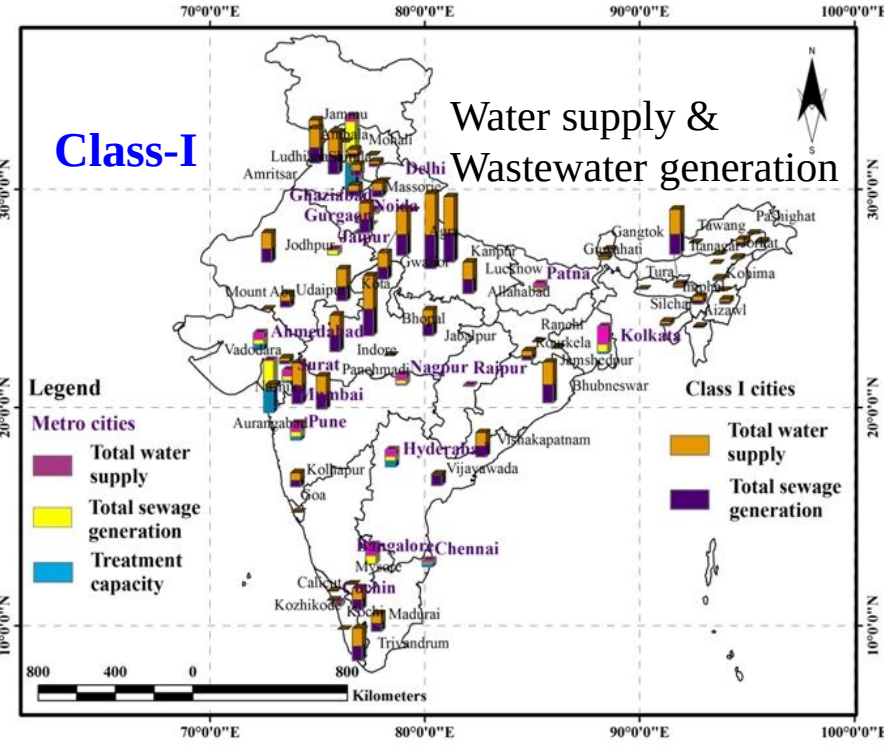
# India's Status of Municipal Wastewater

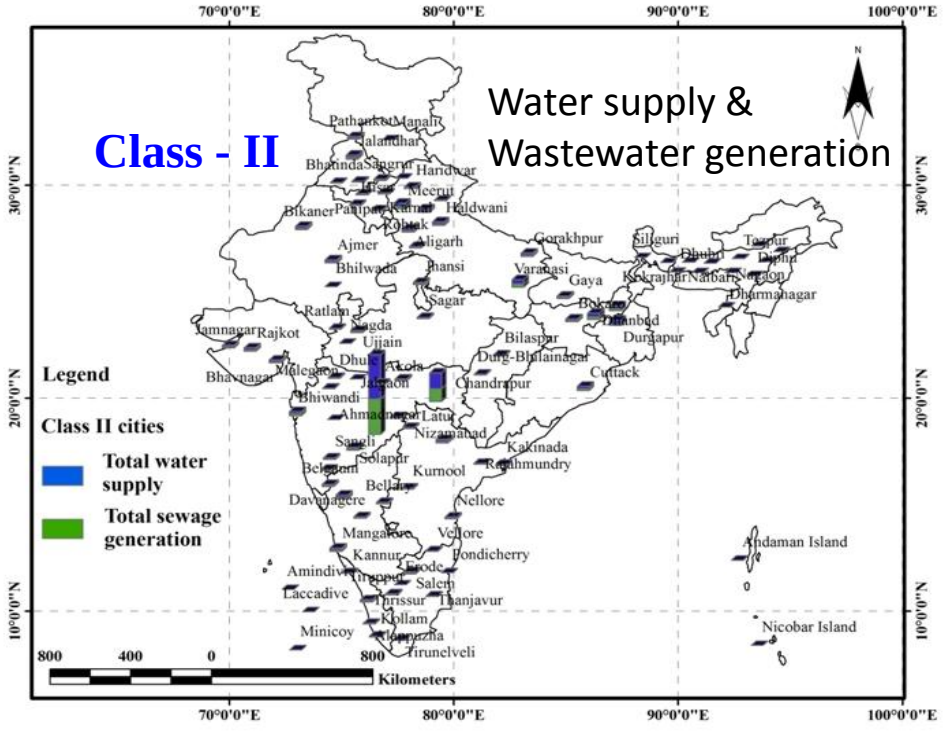
## ➢ Wastewater generation

- **Class-I cities : 35,558 MLD** ( 44% from Metropolitan cities)
- **Class-II towns : 2,697 MLD** **(Source : CPCB, 2009)**

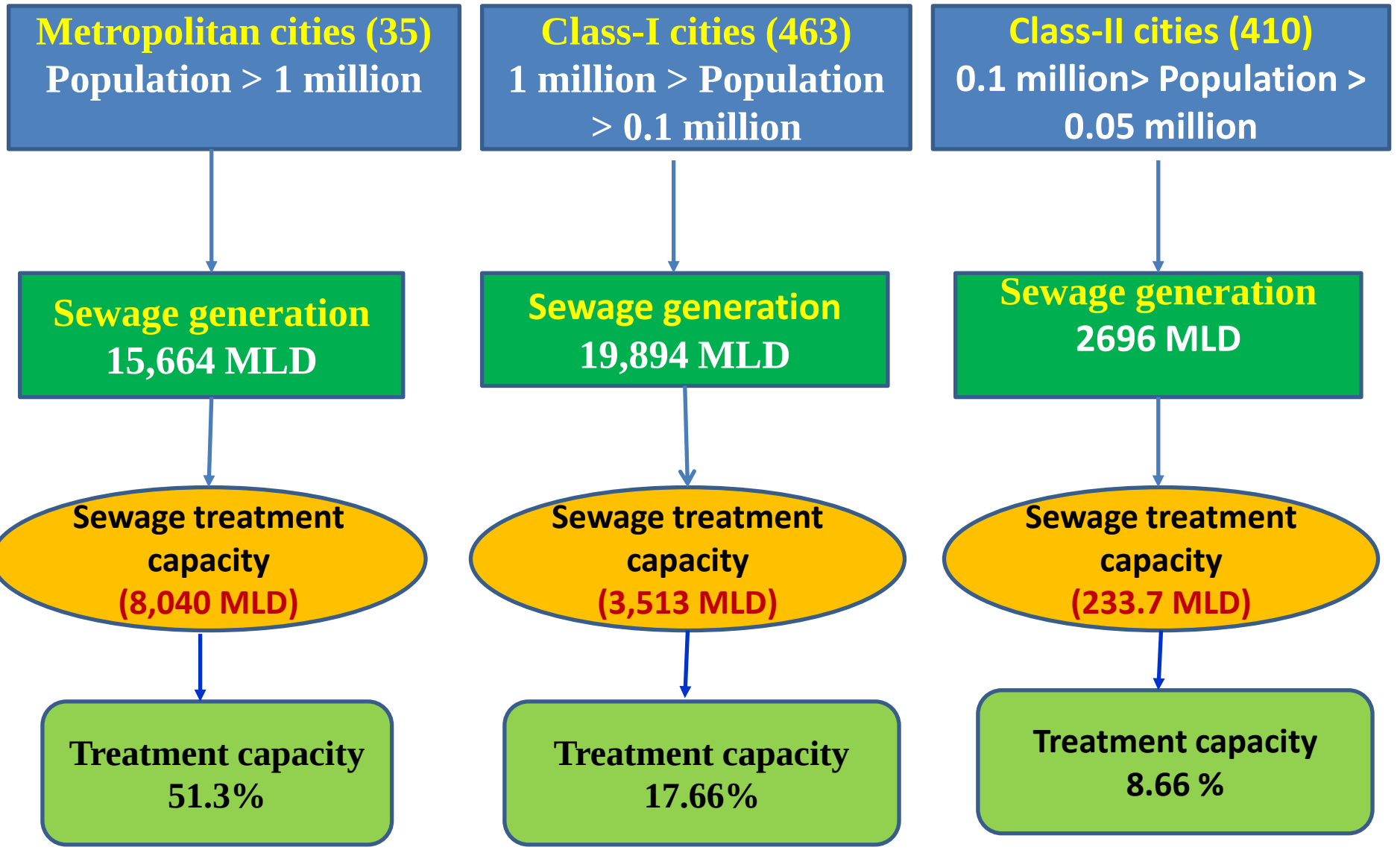
## ➢ Existing capacity of wastewater treatment

- **Class I cities : 11,553 MLD** (32 % of wastewater generated)
- **Class-II towns : 233.7 MLD** ( 8.66% of wastewater generated).



# Status of Municipal Wastewater treatment in urban areas (source : CPCB-CUPS/70/2009-2010)



# Status of Municipal Wastewater treatment in urban areas (source : CPCB-CUPS/70/2009-2010)

## Status of Municipal water supply, wastewater generation and treatment in India

| Category | No. of cities | Total water supply (MLD) | Wastewater generation (MLD) | % wastewater generation to water supply | % of wastewater treated |
|---|---|---|---|---|---|
| Class-I (i/c Metropolitan ) | 498 | 44,769 | 35,558 | 79 % | 32 % |
| Class-II | 410 | 3,324 | 2696.7 | 81 % | 8.66% |
| Total | 908 | 48,093 | 38,254.7 | 79.5% | 30.8% |

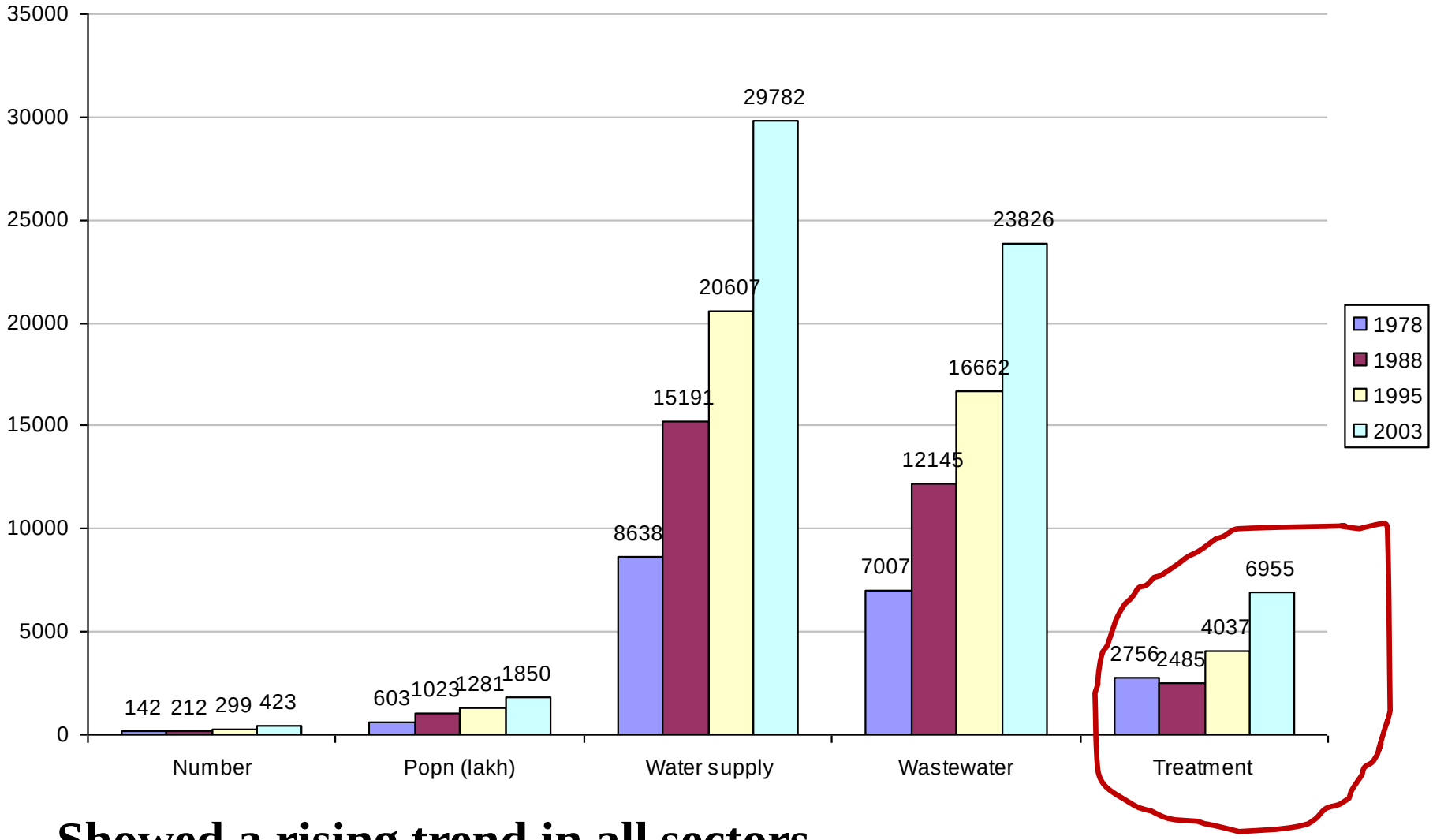
- **Untreated wastewaters flow onto/to overland, streams, and surface water bodies**

**Industrial wastewaters:** About 57,000 polluting industries generate about 13,468 MLD (nearly, 60% treated).

# Water Supply and Sewage Treatment in Class-I Cities

## Water supply and sewage disposal status in class I cities

Source : R. C. Trevedi, (CPCB, 2005)

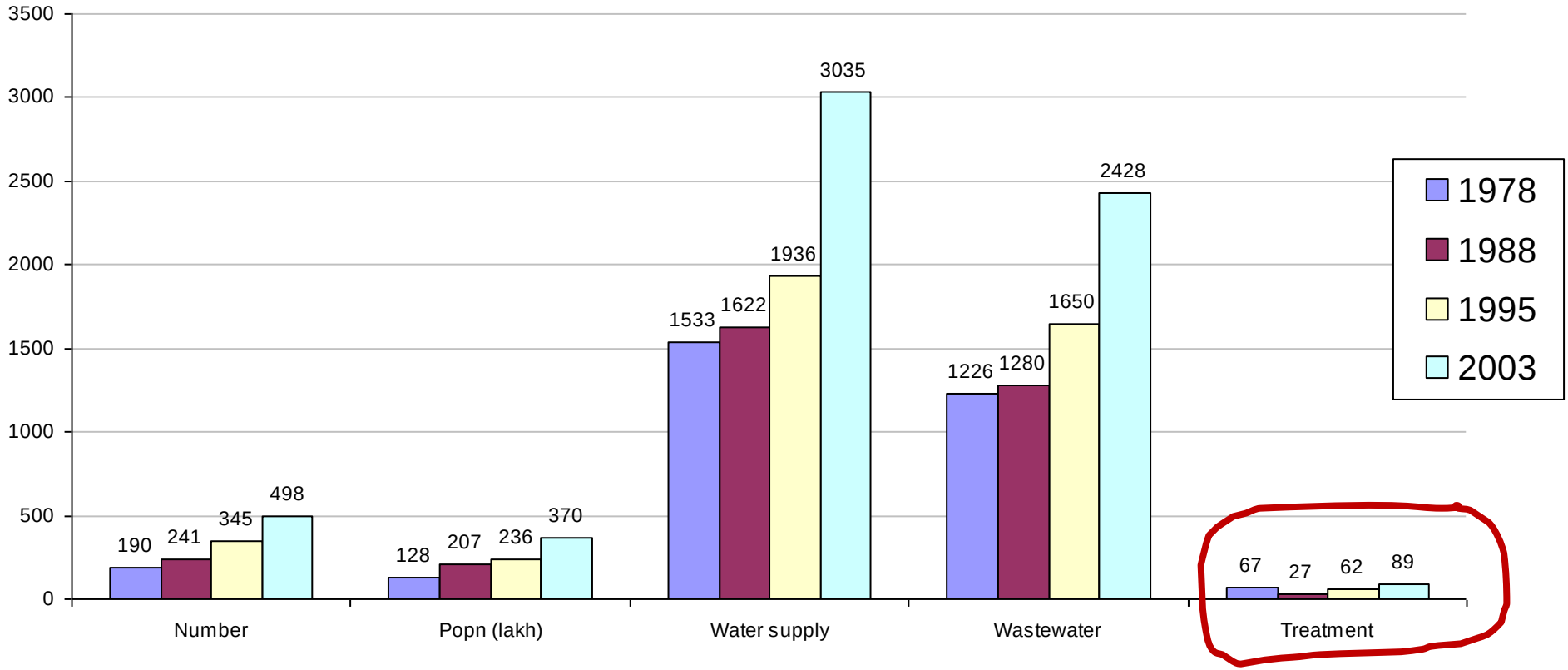



**Showed a rising trend in all sectors**

# Water Supply and Sewage Treatment in Class-II Cities

## Water supply and wastewater generation and treatment in class II towns of India

Source : R. C. Trevedi, (CPCB, 2005)




**Showed not much improvement to wastewater treatment side**

# Status of municipal sewage generation in Ganga Basin

| Category | Sewage generation (MLD) | Treatment (%) | Disposal to/on |
|---|---|---|---|
| Class – I cities | 2637.7 | 44.5% | Ganga River |
| | 7841.5 | 46.8% | Tributaries of Ganga |
| | 907.4 | 16% | Land |
| Class-II cities | 122 | 13.4% | Ganga River |
| | 134.6 | 6.6% | Tributaries of Ganga |
| | 767.3 | 7% | Land |
| Total | 12,410.5 | | |

**Status of Ganga Basin (2005-06) :**

Ganga river : **1569.6 MLD** of untreated sewage

Tributaries : **4297.4 MLD** of untreated sewage

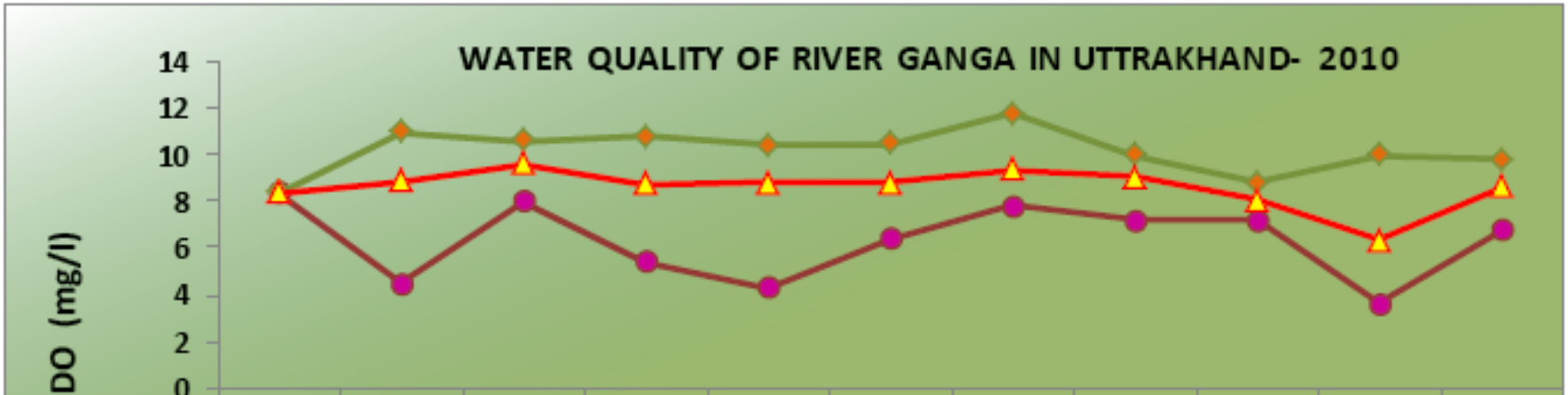
Land : **1475.8 MLD** of untreated sewage

**Total : 7342.8 MLD** of untreated sewage

# WQ status of the River Ganga

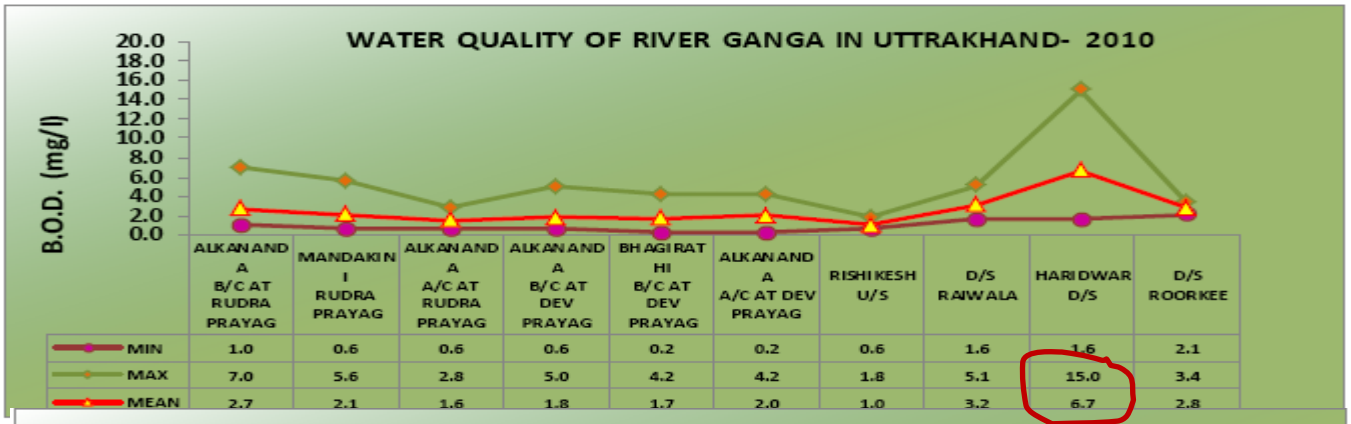
- Total length the river : **2525 km**
- In Uttarakhand & Uttar Pradesh : **1450 km**
- U. P. & Bihar boundary **: 110 km**
- Bihar **: 445 km**
- West Bengal **: 520 km**

**Length Up to Haridwar from source, : 253 km**



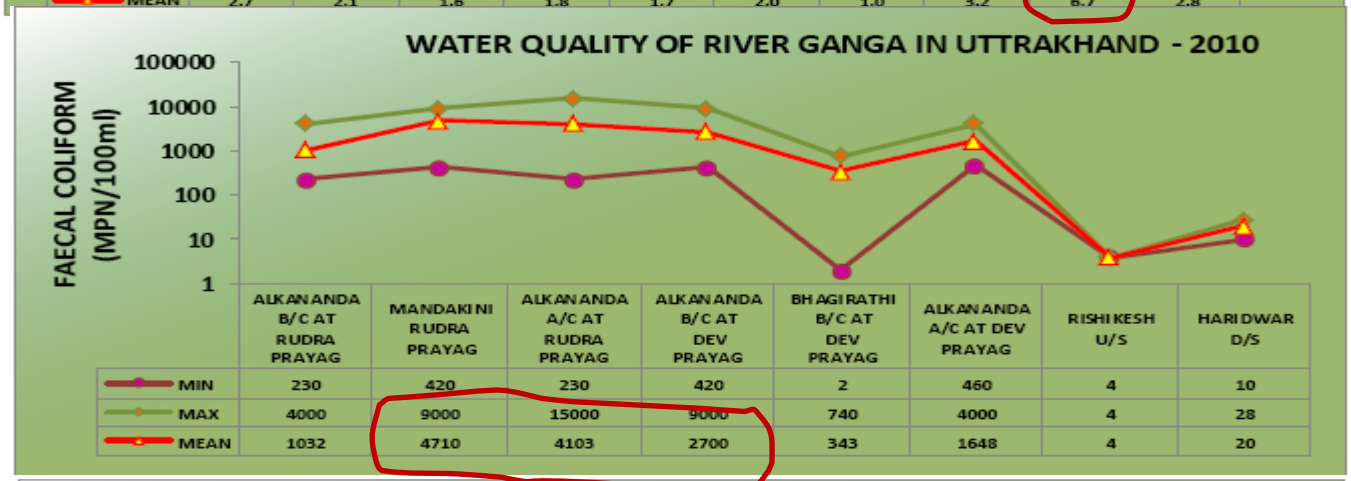

| | GANGOTRI | ALKANANDA B/C AT RUDRA PRAYAG | MANDAKINI RUDRA PRAYAG | ALKANANDA A/C AT RUDRA PRAYAG | ALKANANDA B/C AT DEV PRAYAG | BHAGIRATHI B/C AT DEV PRAYAG | ALKANANDA A/C AT DEV PRAYAG | RISHIKESH U/S | D/S RAIWALA | HARIDWAR D/S | D/S ROORKEE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 8.4 | 4.5 | 8 | 5.4 | 4.3 | 6.4 | 7.8 | 7.18 | 7.2 | 3.6 | 6.8 |
| MAX | 8.4 | 11 | 10.6 | 10.8 | 10.4 | 10.5 | 11.8 | 10 | 8.8 | 10 | 9.8 |
| MEAN | 8.4 | 8.9 | 9.6 | 8.8 | 8.8 | 8.8 | 9.4 | 9.0 | 8.1 | 6.3 | 8.6 |

# WQ status of River Ganga – in Uttarakhand)



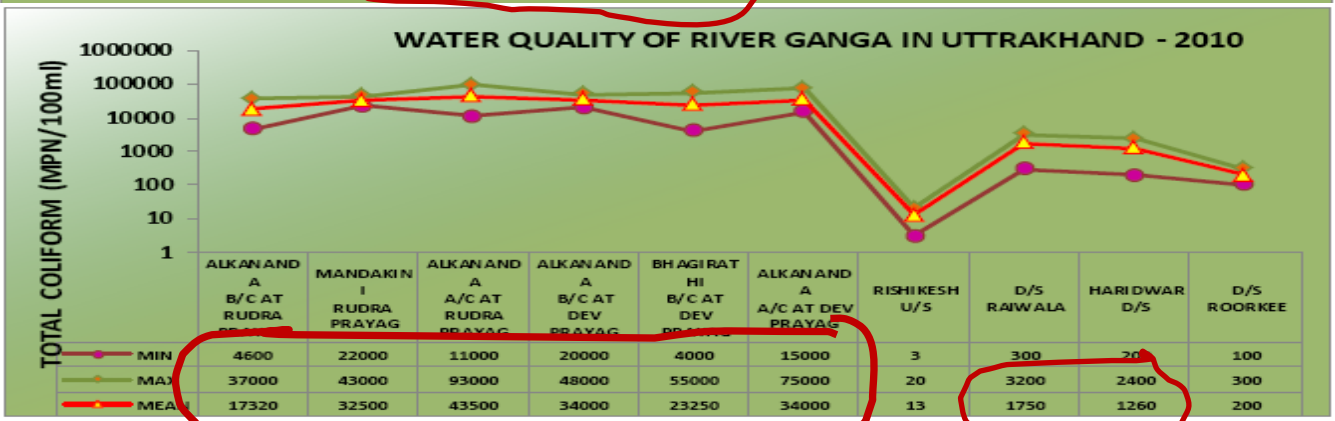

| | ALKANANDA B/C AT RUDRA PRAYAG | MANDAKINI RUDRA PRAYAG | ALKANANDA A/C AT RUDRA PRAYAG | ALKANANDA B/C AT DEV PRAYAG | BHAGIRATHI B/C AT DEV PRAYAG | ALKANANDA A/C AT DEV PRAYAG | RISHIKESH U/S | D/S RAIWALA | HARIDWAR D/S | D/S ROORKEE |
|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 1.0 | 0.6 | 0.6 | 0.6 | 0.2 | 0.2 | 0.6 | 1.6 | 1.6 | 2.1 |
| MAX | 7.0 | 5.6 | 2.8 | 5.0 | 4.2 | 4.2 | 1.8 | 5.1 | 15.0 | 3.4 |
| MEAN | 2.7 | 2.1 | 1.6 | 1.8 | 1.7 | 2.0 | 1.0 | 3.2 | 6.7 | 2.8 |

**BOD > 3 mg/L**




| | ALKANANDA B/C AT RUDRA PRAYAG | MANDAKINI RUDRA PRAYAG | ALKANANDA A/C AT RUDRA PRAYAG | ALKANANDA B/C AT DEV PRAYAG | BHAGIRATHI B/C AT DEV PRAYAG | ALKANANDA A/C AT DEV PRAYAG | RISHIKESH U/S | HARIDWAR D/S |
|---|---|---|---|---|---|---|---|---|
| MIN | 230 | 420 | 230 | 420 | 2 | 460 | 4 | 10 |
| MAX | 4000 | 9000 | 15000 | 9000 | 740 | 4000 | 4 | 28 |
| MEAN | 1032 | 4710 | 4103 | 2700 | 343 | 1648 | 4 | 20 |

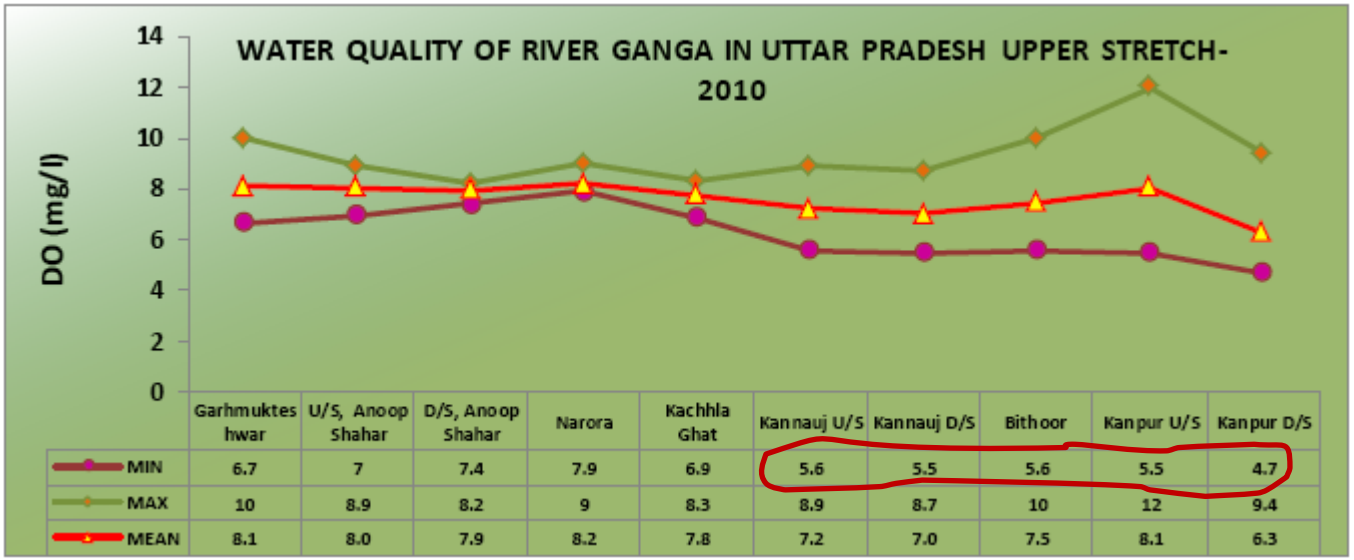
**FC > 5000 MPN/100 ml**




| | ALKANANDA B/C AT RUDRA PRAYAG | MANDAKINI RUDRA PRAYAG | ALKANANDA A/C AT RUDRA PRAYAG | ALKANANDA B/C AT DEV PRAYAG | BHAGIRATHI B/C AT DEV PRAYAG | ALKANANDA A/C AT DEV PRAYAG | RISHIKESH U/S | D/S RAIWALA | HARIDWAR D/S | D/S ROORKEE |
|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 4600 | 22000 | 11000 | 20000 | 4000 | 15000 | 3 | 300 | 20 | 100 |
| MAX | 37000 | 43000 | 93000 | 48000 | 55000 | 75000 | 20 | 3200 | 2400 | 300 |
| MEAN | 17320 | 32500 | 43500 | 34000 | 23250 | 34000 | 13 | 1750 | 1260 | 200 |

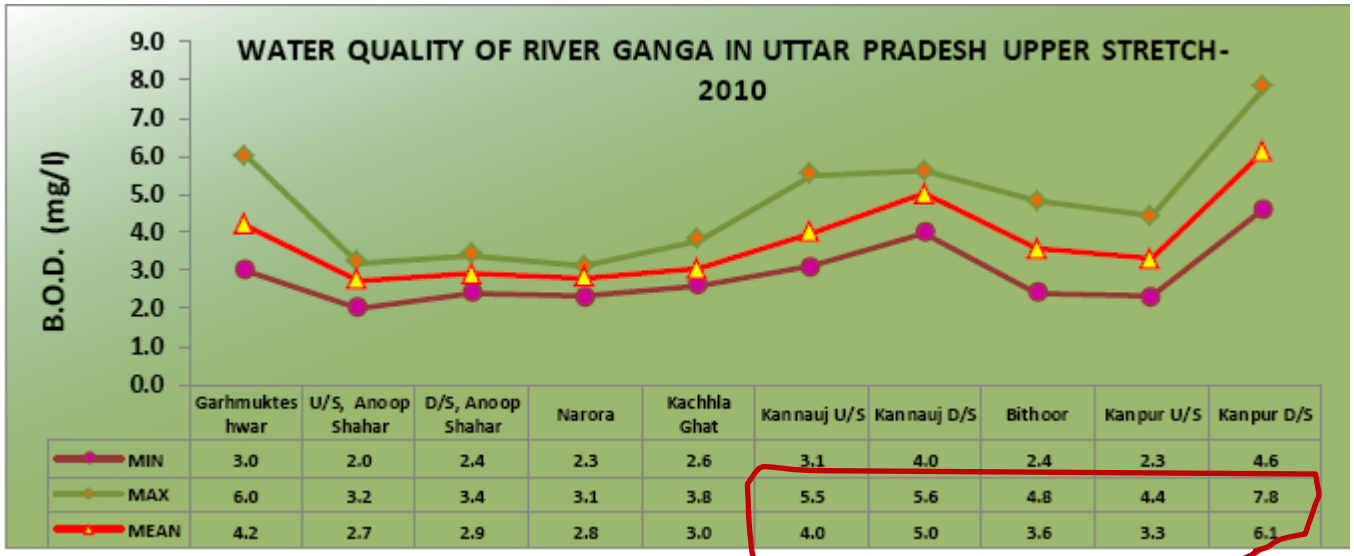
**TC > 5000 MPN/100 ml**

# WQ status of the River Ganga – U. P. (upper stretch)




| | Garhmuktesh war | U/S, Anoop Shahar | D/S, Anoop Shahar | Narora | Kachhla Ghat | Kannauj U/S | Kannauj D/S | Bithoor | Kanpur U/S | Kanpur D/S |
|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 6.7 | 7 | 7.4 | 7.9 | 6.9 | 5.6 | 5.5 | 5.6 | 5.5 | 4.7 |
| MAX | 10 | 8.9 | 8.2 | 9 | 8.3 | 8.9 | 8.7 | 10 | 12 | 9.4 |
| MEAN | 8.1 | 8.0 | 7.9 | 8.2 | 7.8 | 7.2 | 7.0 | 7.5 | 8.1 | 6.3 |

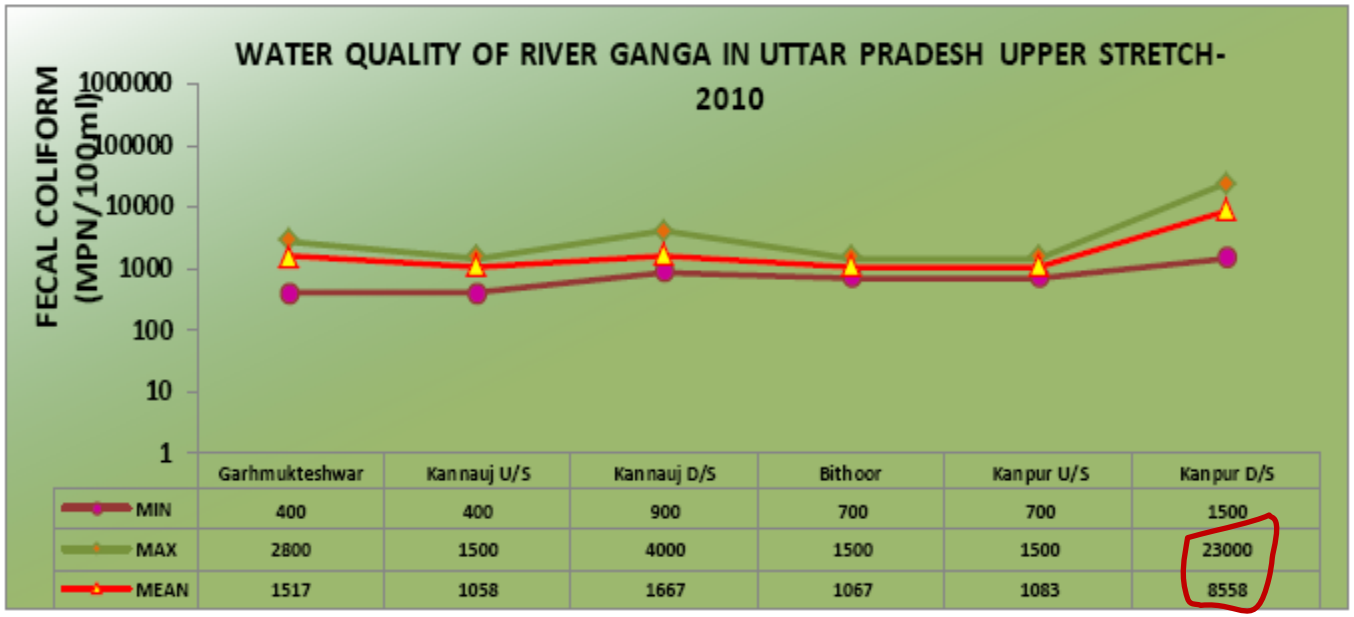
**DO < 6 mg/l**




| | Garhmuktesh war | U/S, Anoop Shahar | D/S, Anoop Shahar | Narora | Kachhla Ghat | Kannauj U/S | Kannauj D/S | Bithoor | Kanpur U/S | Kanpur D/S |
|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 3.0 | 2.0 | 2.4 | 2.3 | 2.6 | 3.1 | 4.0 | 2.4 | 2.3 | 4.6 |
| MAX | 6.0 | 3.2 | 3.4 | 3.1 | 3.8 | 5.5 | 5.6 | 4.8 | 4.4 | 7.8 |
| MEAN | 4.2 | 2.7 | 2.9 | 2.8 | 3.0 | 4.0 | 5.0 | 3.6 | 3.3 | 6.1 |

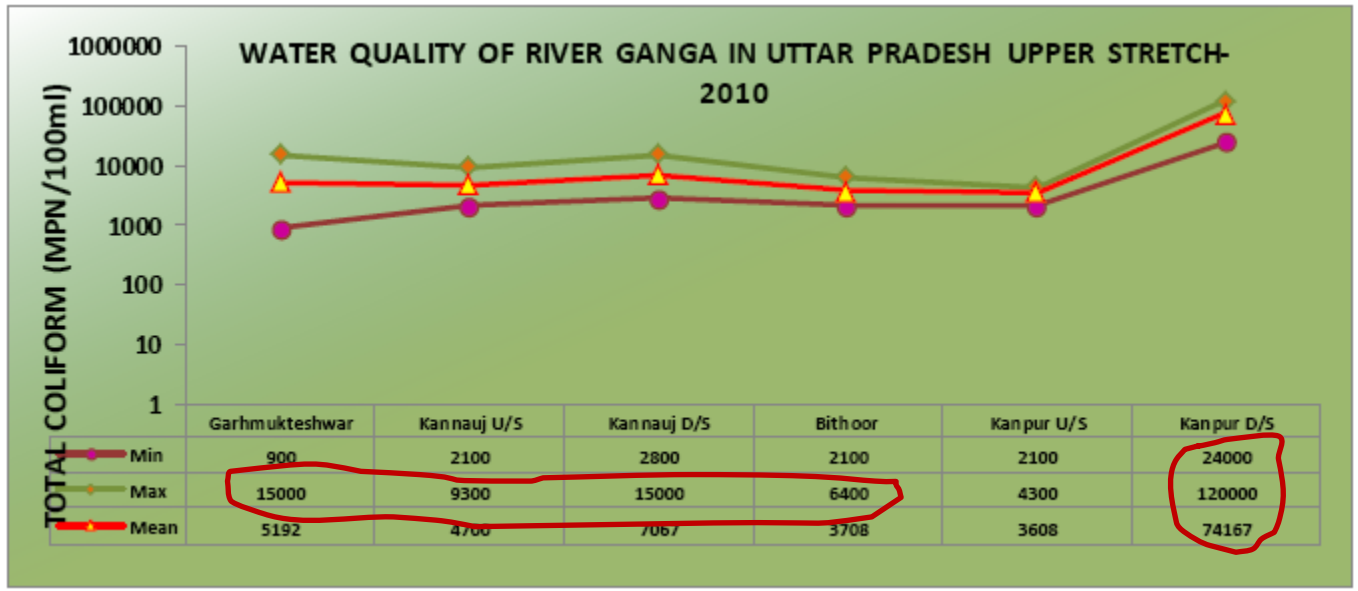
**BOD > 3 mg/l**

# WQ status of Ganga river –U.P (Upper stretch)




| | Garhmukteshwar | Kannauj U/S | Kannauj D/S | Bithoor | Kanpur U/S | Kanpur D/S |
|---|---|---|---|---|---|---|
| MIN | 400 | 400 | 900 | 700 | 700 | 1500 |
| MAX | 2800 | 1500 | 4000 | 1500 | 1500 | 23000 |
| MEAN | 1517 | 1058 | 1667 | 1067 | 1083 | 8558 |

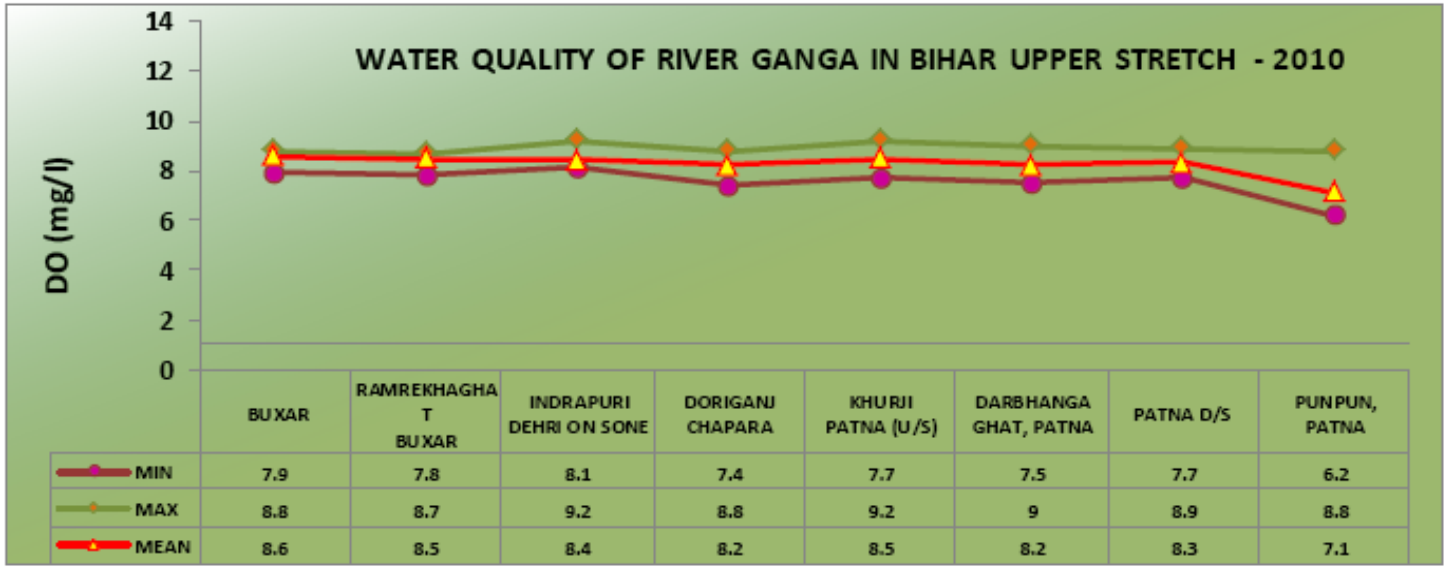
**FC > 5000 MPN/100 ml**



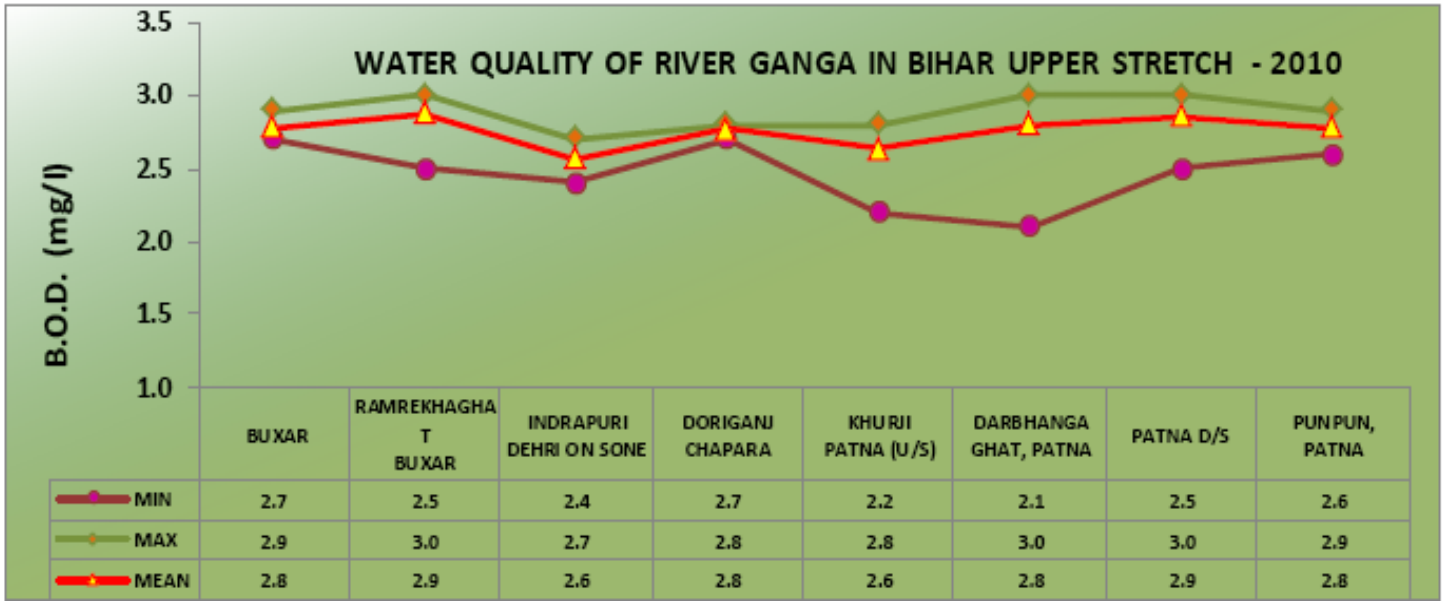

| | Garhmukteshwar | Kannauj U/S | Kannauj D/S | Bithoor | Kanpur U/S | Kanpur D/S |
|---|---|---|---|---|---|---|
| Min | 900 | 2100 | 2800 | 2100 | 2100 | 24000 |
| Max | 15000 | 9300 | 15000 | 6400 | 4300 | 120000 |
| Mean | 5192 | 4700 | 7067 | 3708 | 3608 | 74167 |

**TC > 5000 MPN/100 ml**

# WQ status of Ganga river – in Bihar



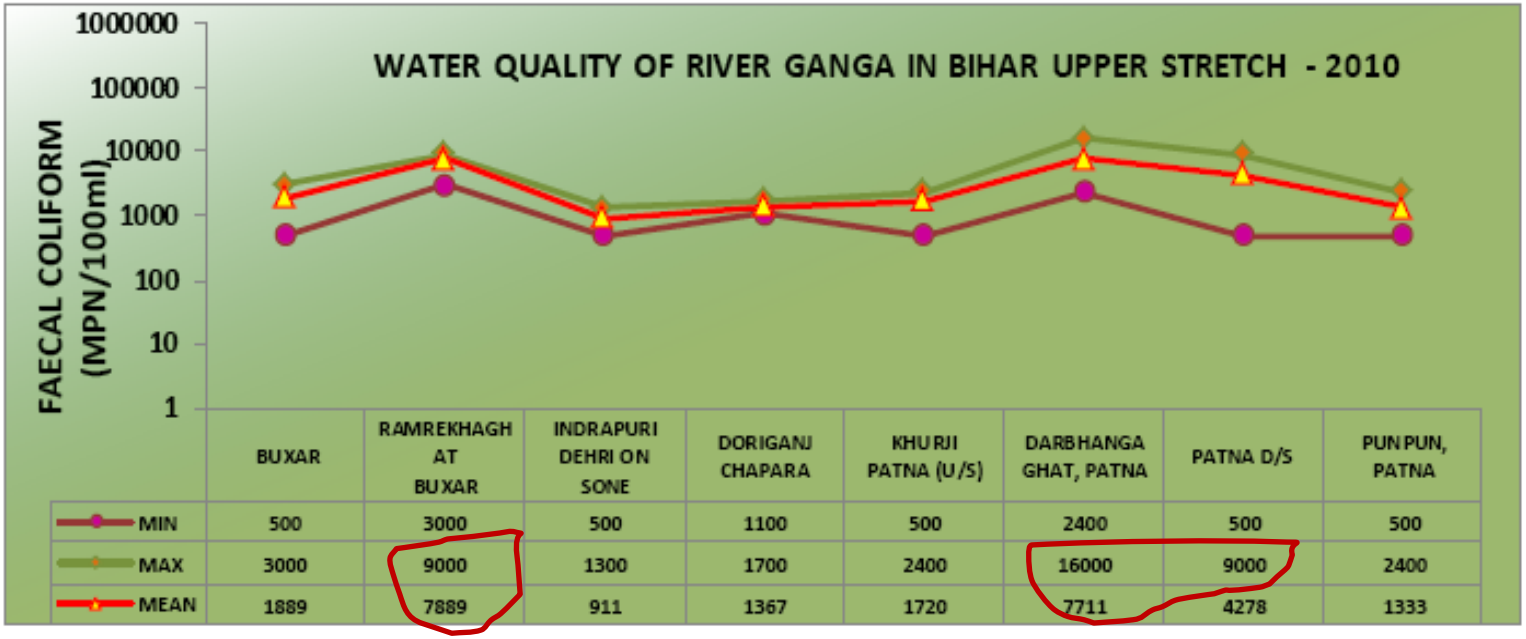

| | BUXAR | RAMREKHAGHAT BUXAR | INDRAPURI DEHRI ON SONE | DORIGANJ CHAPARA | KHURJI PATNA (U/S) | DARBHANGA GHAT, PATNA | PATNA D/S | PUNPUN, PATNA |
|---|---|---|---|---|---|---|---|---|
| MIN | 7.9 | 7.8 | 8.1 | 7.4 | 7.7 | 7.5 | 7.7 | 6.2 |
| MAX | 8.8 | 8.7 | 9.2 | 8.8 | 9.2 | 9 | 8.9 | 8.8 |
| MEAN | 8.6 | 8.5 | 8.4 | 8.2 | 8.5 | 8.2 | 8.3 | 7.1 |



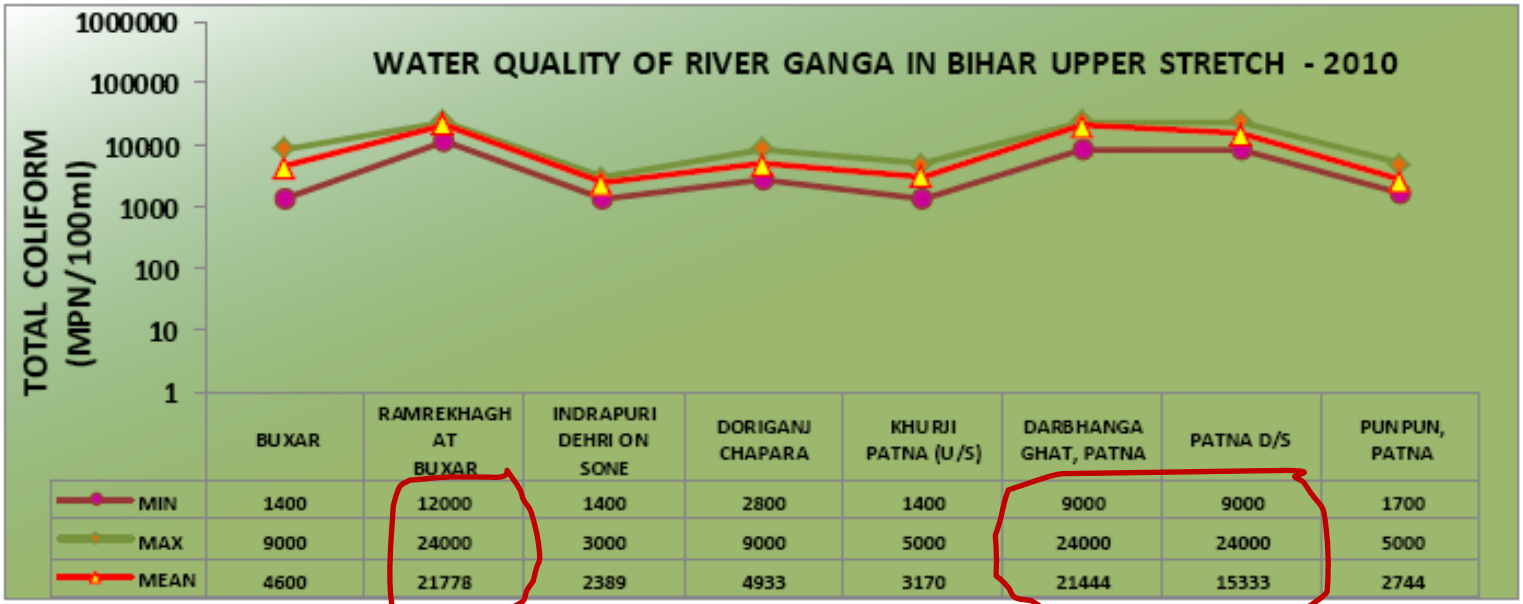

| | BUXAR | RAMREKHAGHAT BUXAR | INDRAPURI DEHRI ON SONE | DORIGANJ CHAPARA | KHURJI PATNA (U/S) | DARBHANGA GHAT, PATNA | PATNA D/S | PUNPUN, PATNA |
|---|---|---|---|---|---|---|---|---|
| MIN | 2.7 | 2.5 | 2.4 | 2.7 | 2.2 | 2.1 | 2.5 | 2.6 |
| MAX | 2.9 | 3.0 | 2.7 | 2.8 | 2.8 | 3.0 | 3.0 | 2.9 |
| MEAN | 2.8 | 2.9 | 2.6 | 2.8 | 2.6 | 2.8 | 2.9 | 2.8 |

**In Bihar Upper stretch considerable improvement in DO & BOD**

# WQ status of Ganga river in Bihar

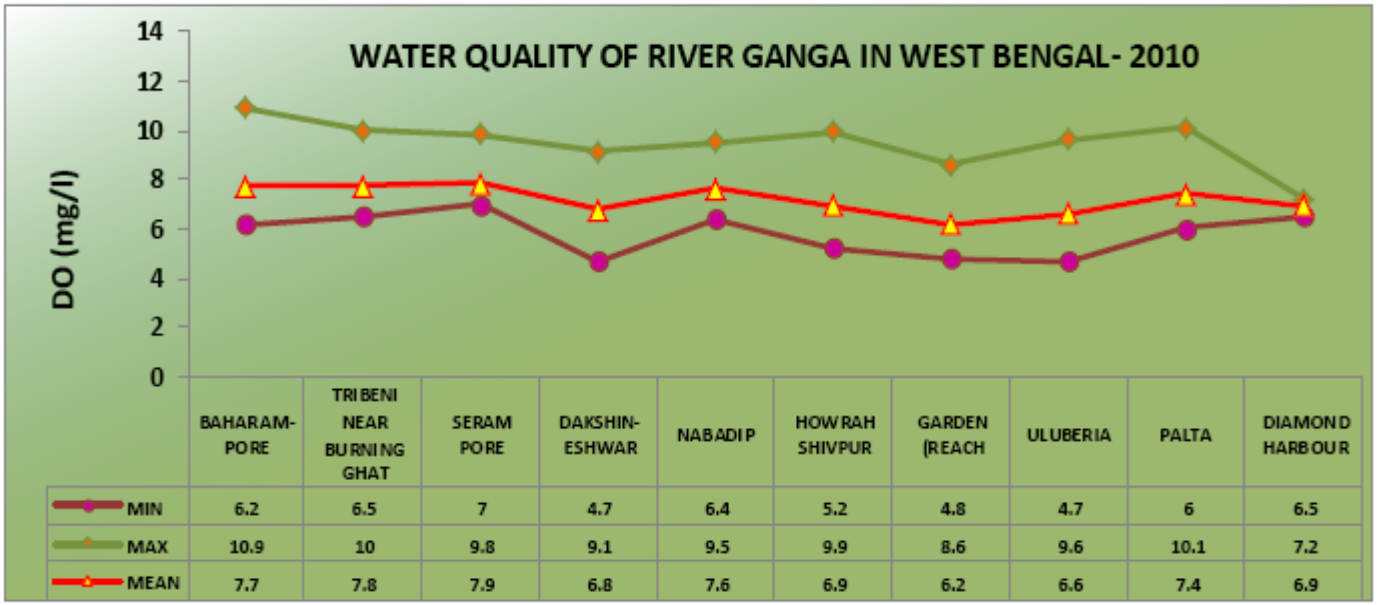



| | BUXAR | RAMREKHAGHAT BUXAR | INDRAPURI DEHRI ON SONE | DORIGANJ CHAPARA | KHURJI PATNA (U/S) | DARBHANGA GHAT, PATNA | PATNA D/S | PUNPUN, PATNA |
|---|---|---|---|---|---|---|---|---|
| MIN | 500 | 3000 | 500 | 1100 | 500 | 2400 | 500 | 500 |
| MAX | 3000 | 9000 | 1300 | 1700 | 2400 | 16000 | 9000 | 2400 |
| MEAN | 1889 | 7889 | 911 | 1367 | 1720 | 7711 | 4278 | 1333 |



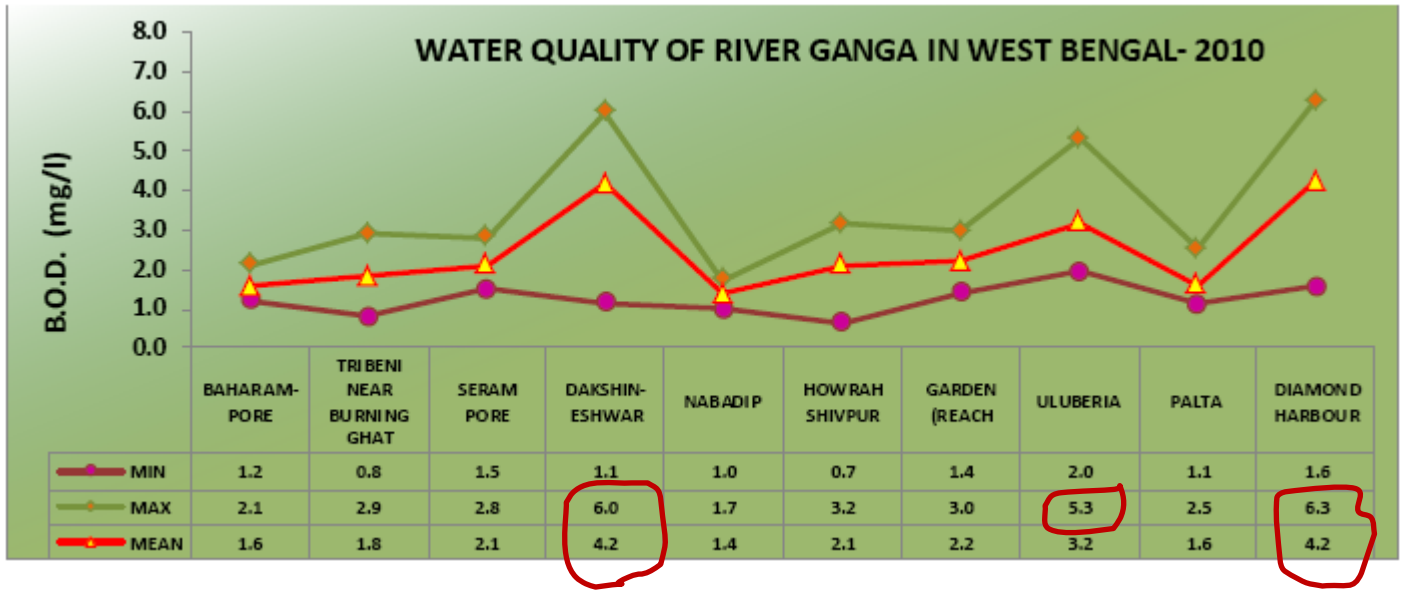

| | BUXAR | RAMREKHAGHAT BUXAR | INDRAPURI DEHRI ON SONE | DORIGANJ CHAPARA | KHURJI PATNA (U/S) | DARBHANGA GHAT, PATNA | PATNA D/S | PUNPUN, PATNA |
|---|---|---|---|---|---|---|---|---|
| MIN | 1400 | 12000 | 1400 | 2800 | 1400 | 9000 | 9000 | 1700 |
| MAX | 9000 | 24000 | 3000 | 9000 | 5000 | 24000 | 24000 | 5000 |
| MEAN | 4600 | 21778 | 2389 | 4933 | 3170 | 21444 | 15333 | 2744 |

# WQ status of Ganga river in West Bengal



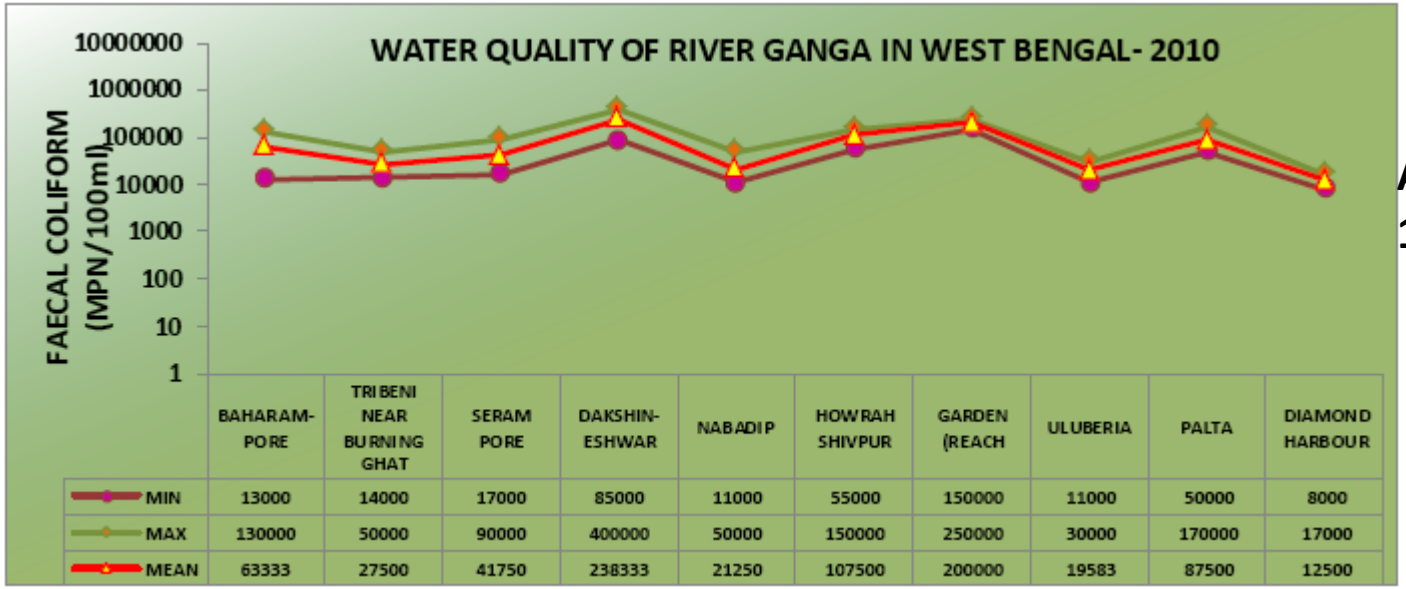

| | BAHARAM-PORE | TRIBENI NEAR BURNING GHAT | SERAM PORE | DAKSHIN-ESHWAR | NABADIP | HOWRAH SHIVPUR | GARDEN (REACH | ULUBERIA | PALTA | DIAMOND HARBOUR |
|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 6.2 | 6.5 | 7 | 4.7 | 6.4 | 5.2 | 4.8 | 4.7 | 6 | 6.5 |
| MAX | 10.9 | 10 | 9.8 | 9.1 | 9.5 | 9.9 | 8.6 | 9.6 | 10.1 | 7.2 |
| MEAN | 7.7 | 7.8 | 7.9 | 6.8 | 7.6 | 6.9 | 6.2 | 6.6 | 7.4 | 6.9 |

**Avg. DO > 6.5 mg/l**



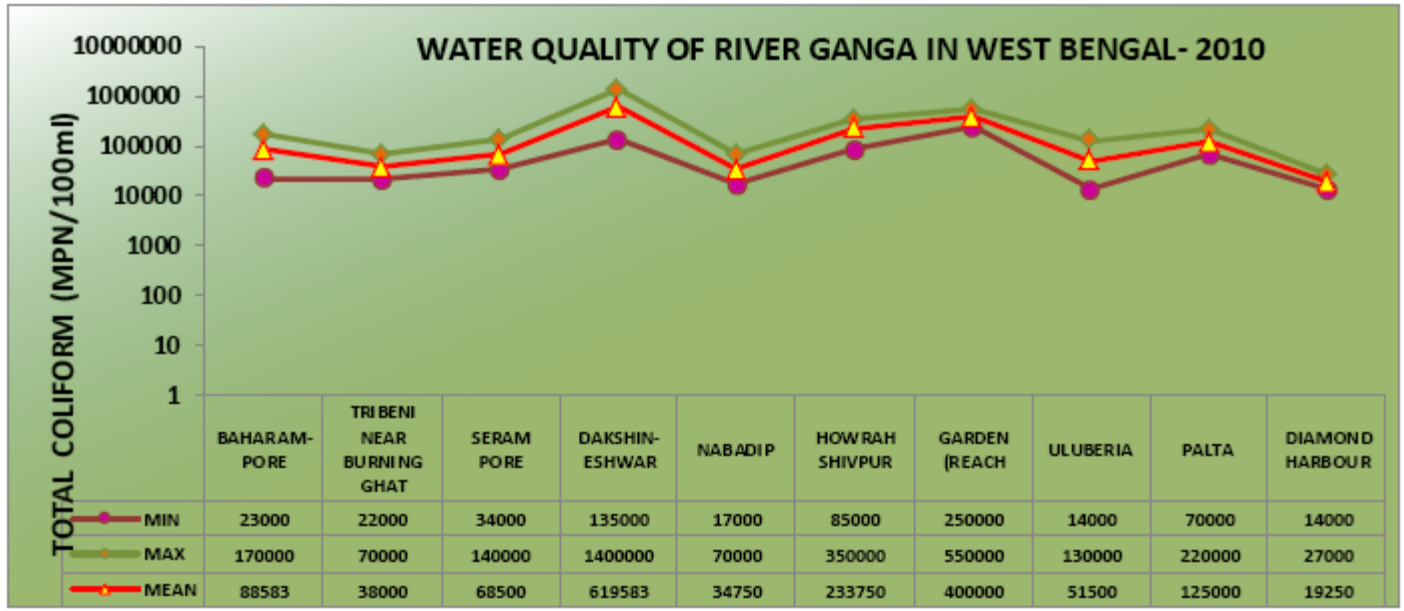

| | BAHARAM-PORE | TRIBENI NEAR BURNING GHAT | SERAM PORE | DAKSHIN-ESHWAR | NABADIP | HOWRAH SHIVPUR | GARDEN (REACH | ULUBERIA | PALTA | DIAMOND HARBOUR |
|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 1.2 | 0.8 | 1.5 | 1.1 | 1.0 | 0.7 | 1.4 | 2.0 | 1.1 | 1.6 |
| MAX | 2.1 | 2.9 | 2.8 | 6.0 | 1.7 | 3.2 | 3.0 | 5.3 | 2.5 | 6.3 |
| MEAN | 1.6 | 1.8 | 2.1 | 4.2 | 1.4 | 2.1 | 2.2 | 3.2 | 1.6 | 4.2 |

# WQ status of Ganga river in WB




| | BAHARAM-PORE | TRIBENI NEAR BURNING GHAT | SERAM PORE | DAKSHIN-ESHWAR | NABADIP | HOWRAH SHIVPUR | GARDEN (REACH | ULUBERIA | PALTA | DIAMOND HARBOUR |
|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 13000 | 14000 | 17000 | 85000 | 11000 | 55000 | 150000 | 11000 | 50000 | 8000 |
| MAX | 130000 | 50000 | 90000 | 400000 | 50000 | 150000 | 250000 | 30000 | 170000 | 17000 |
| MEAN | 63333 | 27500 | 41750 | 238333 | 21250 | 107500 | 200000 | 19583 | 87500 | 12500 |

**All stations > 5000 MPN/ 100 ml**




| | BAHARAM-PORE | TRIBENI NEAR BURNING GHAT | SERAM PORE | DAKSHIN-ESHWAR | NABADIP | HOWRAH SHIVPUR | GARDEN (REACH | ULUBERIA | PALTA | DIAMOND HARBOUR |
|---|---|---|---|---|---|---|---|---|---|---|
| MIN | 23000 | 22000 | 34000 | 135000 | 17000 | 85000 | 250000 | 14000 | 70000 | 14000 |
| MAX | 170000 | 70000 | 140000 | 1400000 | 70000 | 350000 | 550000 | 130000 | 220000 | 27000 |
| MEAN | 88583 | 38000 | 68500 | 619583 | 34750 | 233750 | 400000 | 51500 | 125000 | 19250 |

**All stations > 5000 MPN Per 100 ml**

# Concluding Remarks

- **Municipal wastewater** typically contains **99.93% water** and **0.07% total solids.** Of 0.07% TS, 50% Organic contains and balance 50% inert. Treatment is concern to remove organic contents, which can be used as nutrients for agricultural purposes. **Hence, treated effluents have a lot of potential for different beneficial uses such as, Urban, Agricultural, and groundwater recharge.**
- **Industrial wastewater** composition varies based on types of Industries and typically contains high COD, trace metals, and toxic elements and hence need mechanized treatment before allowing effluents to flow out of Industries.
- **NTT**, such as, **CW, Stabilization ponds, Phyto and Bio Remediation** techniques , which require considerable land foot print , can be used for Municipal Wastewater Treatment.
- **Wastewater** is not a waste, it has a lot of productive values, and can be regarded as **potential recourses of water.**


Thanks