Problem Statement: “What innovative, scalable, and sustainable solutions can be designed and integrated with existing policies to enhance water security, improve water use efficiency, and ensure water quality?”

- **Context:** Water scarcity is a growing issue in a climate change, population growth, and inefficient water use.
- **Impact:** Industries, Agriculture and Households waste significant amounts of water, leading to shortage and environmental damages.

Background:

- Delhi faces severe water shortages due to high demand and limited supply
- Overextraction of ground water, inefficient distribution, and pollution further worsen the crisis
- Climate change and unpredictable monsoons impact water availability

Major Issue: Yamuna

Yamuna river pollution- heavy metal levels in Yamuna exceed CPCB & BIS limits, with Ni(0.5mg/l), Zn(5.5mg/l), & Cd(1.5mg/l) far above levels. This pollution threatens public health aquatic eco systems.

Industrial & sewage waste- Delhi struggles with untreated sewage and industrial effluents, further degrading water equality and increasing disease risks.

Quality of water sources in Delhi has been a concern de to pipeline leaks particularly sewer lines that contaminate treated water. Groundwater resources are increasingly saline and contain elevated levels of Fluoride, Nitrate and Arsenic. High Ammonia levels in the Yamuna further exacerbate water supply issues in parts of the city.

Current Water Scarcity Issues in Delhi.

1.

High Demand
Delhi's water demand exceed by significant margin

2.

Rapid Urbanization
Increased population pressure beyond sustainable levels

3.

Infrastructure Leakage
Pipelines loss approximately 30% of supplies water due to inefficiencies.

4.

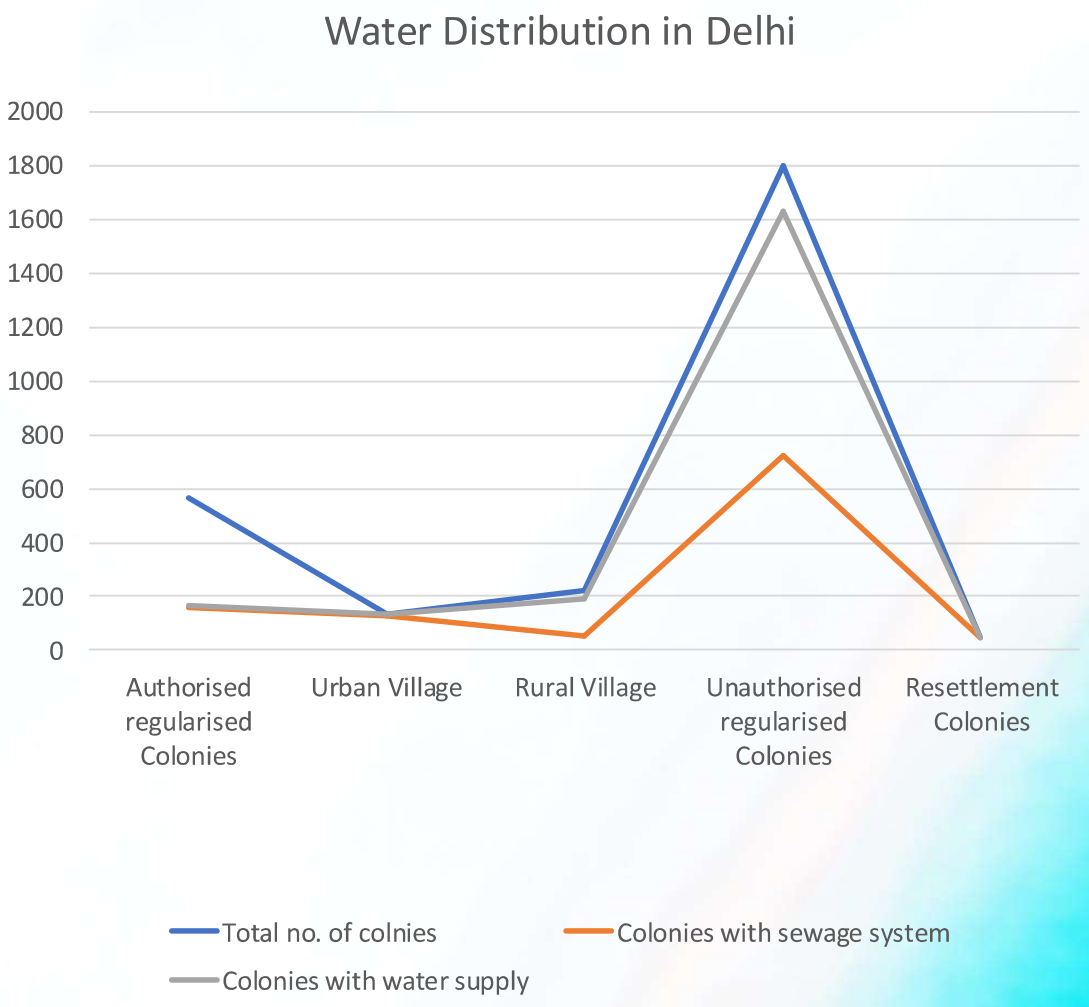
Pollution Challenges
Contaminated water sources limit safe and usable water available

5.

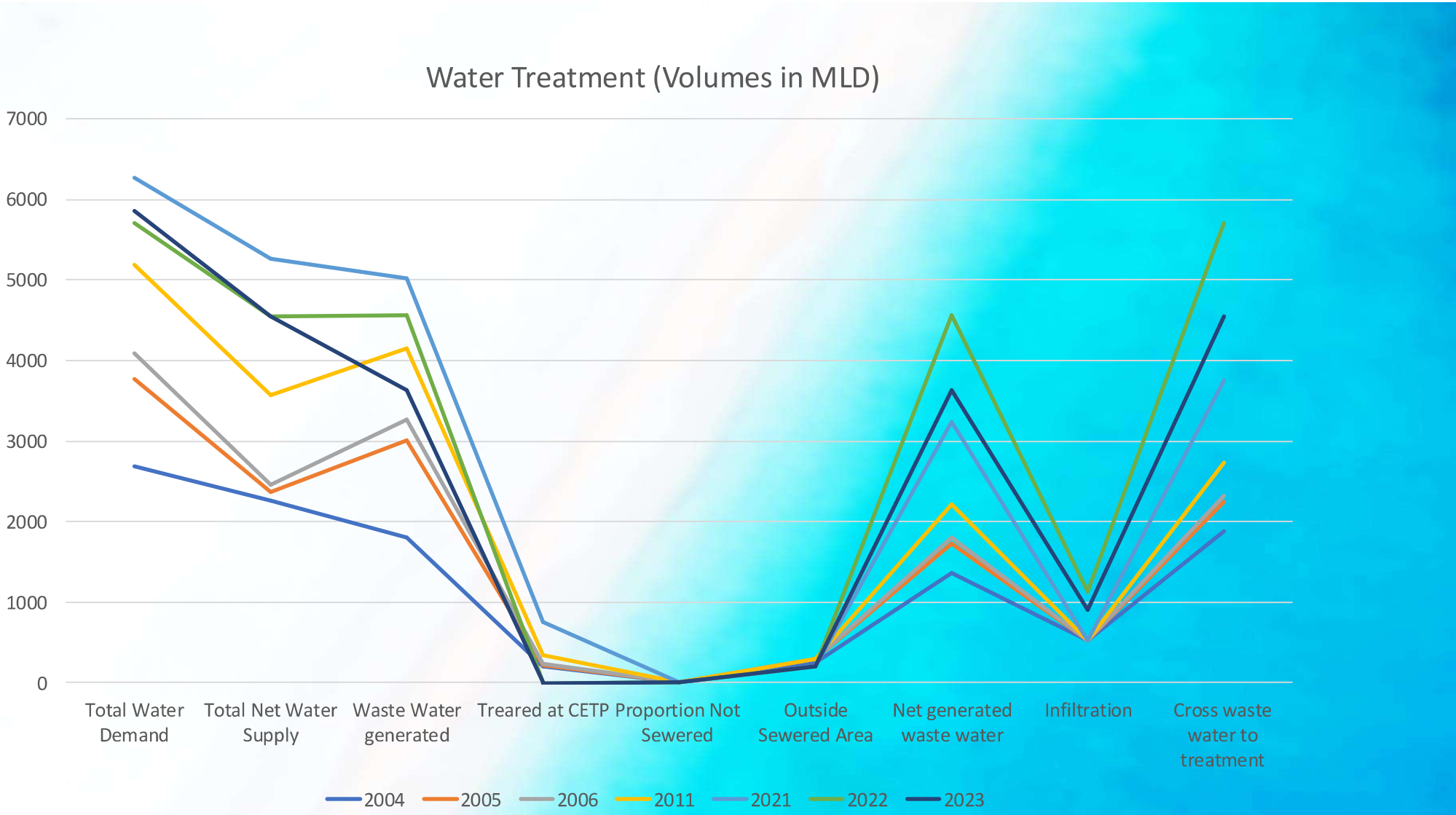
Seasonal Variability
Monsoon reliance creates stark water shortages during dry periods

6.

Groundwater Depletion
Over extraction of ground water leads to serious availability concerns



Water distribution in Delhi is managed primarily by Delhi Jal Board(DJB), which supplies water through pipelines, borewells and tankers. The city relies on Yamuna River, ground water & sources like the Bhakranangal & upper ganga canals for its water supplies. However, uneven distribution , water theft & pipelines leaks lead to shortages in many areas, especially unauthorized colonies & slums. While some regions receive water 24/7, others face irregular supplies, often forcing residence to depend on private tankers. Efforts are being made to improve water management through recycling, rain water harvesting and better infrastructure.


Water Treatment (Volumes in MLD)
7000
6000
5000
4000
3000
2000
1000
0
Total Water Demand
Total Net Water Supply
Waste Water generated
Treared at CETP
Proportion Not Sewered
Outside Sewered Area
Net generated waste water
Infiltration
Cross waste water to treatment
2004
2005
2006
2011
2021
2022
2023

Statistics:

1. Sewage generated: Delhi generates approximately 792 million gallons of sewage per day(MGD).

   Sewage treated capacity: Delhi has the capacity to treat around 667 MGD of sewage approximately 72% of the generated sewage.

   Untreated Sewage: A significant portion(around 260 MGD) of the generated sewage follows into the Yamuna river untreated.

2. Delhi has 42 sewage treatment plants. Many of which are not fully functional or meet required standards. Treatment capacity often for short of the cities actual sewage generation along these Delhi has 6 major water treatment plants which are responsible for treating row water from various sources like rivers and canals.

3. The combined capacity of water treatment plants in Delhi is around 946 MGD.

4. The population of the Delhi metropolitan area has shown significant growth over the past decade from 25, 039, 000 in 2014to 33, 807, 000 in 2024.

5. The Delhi water consumption in Delhi is estimated to be around 240 liters per capacity per day(LPCD), which is considered one of the highest in INDIA. Delhi's water availability is 935 MGD, while the total demand was 1140 MGD, resulting in a deficit of 141 MGD. These demands is also increasing over the years.

District	Drinking Water Quality	Groundwater Quality	Key Contaminants	Remarks
Central Delhi	Mostly meets BIS standards	Deep ground water levels	High ammonia nitrate	Pipeline contamination near old sewer lines
North Delhi	Bacterial contamination reported in some areas	Moderate groundwater depth(20-30 MBGL)	Fluoride, nitrate	Waterborne disease risk in some packets
South Delhi	Good Quality, but some localized contamination	Declining ground water levels (30-50mbgl)	Fluoride , arsenic	High demand causing Depletion
East Delhi	Reports of inconsistent quality	Ground water mostly saline	Ammonia , heavy metals	Industrial pollution affecting groundwater
West Delhi	Acceptable quality but sporadic complaints	Moderate to deep levels (20-40mbgl)	Nitrate , heavy metals	Leakage from waste dumpsites affects water

District	Drinking Water Quality	Groundwater Quality	Key Contaminants	Remarks
North West Delhi	Poor quality in outer areas	Ground water at risky depletion levels (50+ MBGL)	High fluoride, nitrate	Require better recharge methods
North East Delhi	Fails quality tests in many samples	High groundwater contamination	Bacterial, Pathogens, Ammonia	Heavy Yamuna pollutions impact
South West Delhi	Good quality nut pipelines leaks reported	High depletion (50+ MBGL)	Arsenic, nitrate	Needs better conservation policies
South East Delhi	Moderate quality, some supply complains	Mixed groundwater levels(10-40 MBGLl)	Ammonia, fluoride	Pipelines corrosion issues detected
Shahdara	Fails many BIS tests	Very saline groundwater	Heavy metals Ammonia	Industrial wastes sewage problems

District	Drinking Water Quality	Groundwater Quality	Key Contaminants	Remarks
New Delhi	Best water quality among districts	Limited Ground water reliance	Minimal contamination	Good infrastructure but high demand

Step Wise Solutions

1. Data Collection & Analysis
2. AI-Powered Solution Generation
3. Categorization of Solutions
4. Collaboration & Implementation
5. Crowdfunding & Awareness

Proposed Solution:

Our solution leverages Data Analytics & Artificial Intelligence to analyze water consumption patters, identify inefficiencies, and propose solutions tailored to different cost constraints. The approach categorize solutions in 3 sections.

❑ **Low Cost:** Affordable and easily implementable measures that require minimal investment

- Septic Tanks
- Reedbed System
- Aerobic Lagoons
- Mechanical Treatments(Removing Stones0
- Mechanical Barriers for stopping solid waste and biofilters

❑ **Moderate Cost:** Advanced technological interventions that require medium scale investments

- Constructed Wet Lands for controlled flow
- Aerobic Treatments
- Upgraded Filtration
- Enhanced Sedimentations
- Air Floatation
- Magnetic separation

❑ **High Cost:** Large scale infrastructure projects tat involves significant investments but offer long term benefits

- Membrane Filtration
- UV Disinfection
- Reverse Osmosis
- Micro Filtration
- Ultra Filtration
- Nanotechnology
- Ozonolysis

To ensure the effectiveness of our approach, we will take inspiration from successful global models such as Switzerland, Singapore and Netherlands which have pioneered water efficiency strategies . Additionally, we will collaborate with public and private organizations, NGOs, and government agencies to secure funding and implement sustainable solutions.

Technology Stack:

Our approach is powered by a combination of data analytics, Python libraries, and generative AI to extract insights and recommend optimal water management strategies

- Matplotlib & Seaborn : Used for data visualization , trend analysis , and identifying inefficiencies in water usage.
- Folium : Enables geospatial mapping to track water resources and identify areas with high wastage or scarcity.
- NumPy & Pandas : Facilitates data manipulation and trend forecasting.
- Generative AI : Simulates different water efficiency scenarios and provides data-driven recommendations for policy and infrastructure improvements.
- Tabulate & Matplotlib.myplot: Display data In tabular form and using data visualization support line charts and histograms.

Resources Indian ormation:

- Delhi Jal Board-Link
- Central Ground Water Board-Link
- Department of Environment in Delhi-Link
- World Health Organization (WHO)
- Bureau of Indian Standards (BIS)
- Central Pollution Control Boards (CPCB)
- Ministry of Jal Shakti (Government of India)
- Indian Council of Agricultural Research (ICAR)
- Environmental Protection Agency (EPA) (USA)
- National Institute of Hydrology (NIH), India
- International Water Association (IWA)
- JNNURM (Jawaharlal Nehru National Urban Renewal Mission) Reports
- State Pollution Control Boards (SPCBs)
- Research Articles and Journals

Thank You !

Let’s Make Every Drop Count.