Wastewater Management in India: The case of Delhi and Kanpur

ABOUT:

The Horizon 2020 EU-India project PAVITRA GANGA focuses on unlocking wastewater treatment, water re-use and resource recovery opportunities for urban and peri-urban areas in India. In collaboration with Central, State and local stakeholders and supported by industrial partners, the project aims to deliver cost effective and energy efficient solutions for the treatment and reuse of wastewater with resource recovery. The objective is to create policy and social support for innovative technologies and concepts through stakeholder engagement. Maximum impact will be created by considering people, planet and profit as the three pillars of the project.

KEY FACTS

- Various initiatives are being implemented by the Government of India such as Ganga Action Plan, Swachh Bharat Mission, AMRUT Mission, Smart City Mission, JNNURM, Namami Gange etc. to improve wastewater treatment and management in India.
- Lack of clearly defined targets and guidelines for water reuse, limited funds available for O&M of treatment infrastructure and cost recovery, inadequate monitoring and enforcement network affects wastewater treatment and reuse.
- Limited funding is available for implementation of advanced wastewater treatment in India and is a barrier towards achieving good quality of treated wastewater.
- Several challenges with regard to wastewater treatment, reuse and resource recovery are interrelated and overlapping in nature. They are noticed most prominently in economic priorities, implementation frameworks and social constraints. In addition, fragmented water governing structure serves as a key underlying factor contributing directly or indirectly towards most of the identified challenges
- Poor quality of treated effluents, lack of transportation network and inadequate monitoring systems are major constraints for reuse of treated wastewater for agriculture.
- The mix of industrial and domestic waste and high load variation of sewage discharged from authorized and unauthorized colonies significantly affects the performance of STPs located in Delhi.
- Policies and programs such as DJB's "Treated water reuse policy", "Waste to Energy" by MNRE have encouraged the reuse of treated wastewater and bio-gas and power generation STPs in Delhi such as Okhla, Rithala, and Keshopur STPs.
- In Jajmau, Kanpur, wastewater treatment infrastructure is not adequate to treat the increased volume of industrial effluent being generated from its tannery cluster. There is a mixture of sewage with industrial waste which constrains wastewater treatment, besides financial constraints and unreliable power supply.
- Only a few tanneries in Kanpur are able to operate chrome recovery technologies due to high operating cost. Thus, chrome finds its way into the irrigation channels and subsequently to the agricultural fields.
- Communities living downstream of Jajmau STP in Kanpur have been accustomed to using poor quality of treated water which has significantly impacted their health.

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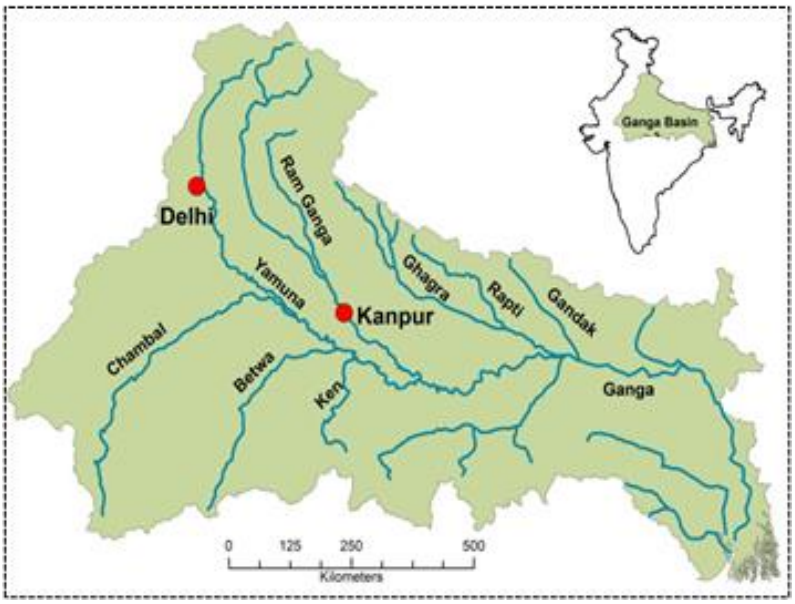
PROJECT LOCATION



DELHI:

The Barapullah drain in Delhi discharges about 1.25 million litres of wastewater per day into the Yamuna river. It receives wastewater with variable quality conditions from both households and domestic industries.

KANPUR:

Jajmau region of Kanpur has three wastewater treatment plants. More than 400 tanneries operate in the region. The treatment capacity available is largely insufficient for the generated wastewater. Analysis of sewage water shows high concentrations of Chromium.

Based on learnings from policy, regulatory and institutional framework analyses, consultation workshops with key stakeholders and an internal project co-creation workshop, the following information has been collated.

KEY REGULATIONS, POLICIES AND PROGRAMS FOR WASTEWATER MANAGEMENT AT NATIONAL LEVEL

Regulations

- The Environment (Protection) Act (1986) empowers the Central Government to frame rules to regulate environmental pollution, including discharge standards for STPs and CETPs.
- The Water (Prevention and Control of Pollution) Act (1974) aims to prevent and control water pollution by establishing Central and State Pollution Control Boards (CPCB and SPCB) to enforce and monitor regulations.
- The Central Pollution Control Board (CPCB) is the regulatory body for monitoring and enforcing regulations related to water quality. For surface water quality, "Water Quality Criteria for designated Best Use" developed by CPCB is used. However, for ground water quality, Bureau of Indian Standards (BIS) standards are followed. Discharge standards for sewage disposal and water quality discharge standards for different Industries, have been developed by CPCB.

Policies

- The National Water Policy (2012) emphasizes on freshwater scarcity, recycle and reuse of water, demand management, water pricing, and provision of water supply and sanitation.
- The Tariff Policy (2016) by the Ministry of Power, mandates the use of treated sewage in thermal power plants located within 50 km radius of a STP.
- The National Policy for Faecal Sludge and Septage Management (2017) promotes small-scale waste to energy (WtE) systems (mainly biogas systems) from faecal sludge.

Programs

- The Ganga Action Plan (GAP)-I (1985) focuses on pollution abatement, interception, diversion and treatment of sewage and industrial waste. GAP-II (1993) involves laying of sewers, construction of new STPs and rehabilitation of existing sewerage systems. Despite creating considerable STP infrastructure, the GAP was not able to achieve its overall objectives due to multiple institutional, technological, regulatory issues.
- Namami Gange (2014) is a Government of India's flagship program with a broader scope of effective abatement of pollution, conservation and rejuvenation of the Ganga.
- The 'Waste to Energy" program by Ministry of New and Renewable Energy finances large-scale Waste to Energy (WtE) systems, such as biogas plants (> 1 MW).

DELHI

Policy, Regulatory and Institutional

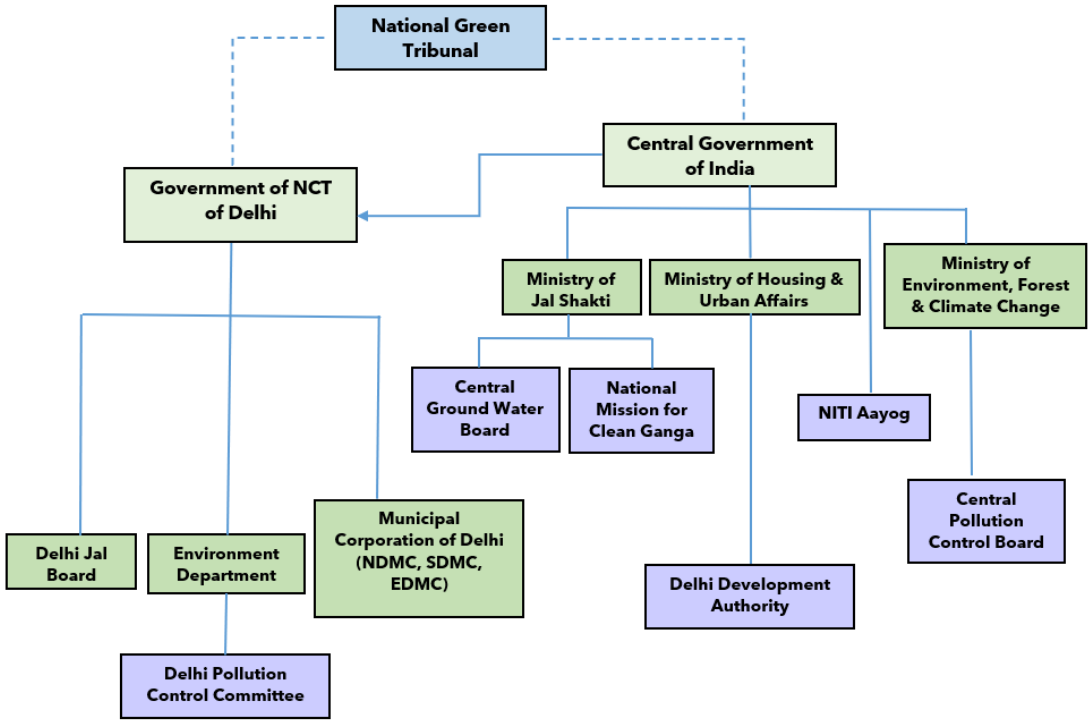


Fig: 1: Agencies involved in wastewater management in Delhi

- Delhi Jal Board (DJB) is the implementing agency for matters related to water supply, sewerage and sewage disposal and drainage in Delhi.
- The draft Master Plan of Delhi 2041 stresses on reducing the demand for freshwater through 100% treatment and maximum reuse of treated wastewater for non-potable purposes. Bulk reuse of treated wastewater is promoted for rejuvenation of river, lakes and other water bodies in the city; groundwater recharge by developing aquifer recharge ponds and lakes in the Yamuna floodplain, greenways along natural drains, biodiversity parks and land pooling areas; and for horticulture, irrigation, vehicles and road cleaning, firefighting, construction and industrial purposes.
- The Draft Water Policy (2016), Delhi mentions various emergent policy issues such as demand side management, prioritizing water allocation and promoting

water reuse. It mentions framing targets to increase reuse of recycled water to 35% of total sewage produced, by 2019, and increasing the same to 70% by 2024, and to 80% by 2026.
- Delhi Jal Board (DJB) Policy to Utilize Treated Waste Water for Horticulture and Other Purposes promotes the use of treated sewage for horticulture in public parks, institutional complexes, schools and hospitals etc.
- While there are charges for water connection in some areas of Delhi, sewage connection is free of charge. Low cost of provision of water and no sewerage charge are seen as constraints for generating funds for efficient operation and maintenance of water and wastewater infrastructure.
- A major barrier for wastewater reuse is the absence of guidelines with well-defined quality criteria and standards for reuse of treated wastewater.
- There is limited institutional capacity for operation and management of STPs and lack of clearly defined roles and responsibilities for wastewater management due to multiplicity of organizations involved in water supply, sewage treatment, building infrastructure, besides fragmented water governance structure.
- Further to the above-mentioned institutional and regulatory policy actors, more than 40 organisations representing civil society, public initiatives, private sector, educational institutes, international development agencies, and also research and policy advocacy, were identified among the key stakeholders regarding wastewater treatment, reuse and recovery in the Delhi Barapullah case area. This illustrates the systemic complexity both in terms of the current situation and achieving future aspirations for (waste)water management, reuse and resource recovery.

Technology

- In Delhi, there are two types of wastewater treatment processes, consisting of conventional sewage treatment plants and some decentralized systems. Most of the STPs are using the activated sludge process (ASP). In unauthorized colonies, septic tanks are present for sewage treatment and disposal.
- An interceptor system has been developed to pump sewage from septic tanks and transport it to STPs for treatment.
- Due to lack of space, laying of new sewage collection pipelines in unauthorized establishments is constrained.
- In peri-urban areas, open drains are present through which sewage flows that originates from various sources. The performance of STPs is significantly affected as other wastes (municipal solid waste, plastic waste etc.) are also dumped in these drains. Also, there is mixing of industrial as well as pharmaceutical waste into the sewage.
- High load variation of sewage, especially during morning, and complexity of sewage composition, results in the inefficient functioning of STPs. Failure of wastewater treatment systems may also be attributed to the failure of operation and maintenance process after implementation of technologies without proper training of personnel for O&M.
- Heavy metals and fecal coliform have been detected in vegetables irrigated with raw sewage. Also, the sludge generated from conventional STPs has very few users and is often left to build up in the STP grounds.
- The water quality monitoring stations as well as monitoring frequency is inadequate. There is also limited human resources to monitor water quality.

Wastewater Reuse and Resource Recovery

- In Delhi, treated wastewater from Okhla and Keshopur STPs are used for horticulture. Currently, about 20% of total wastewater generated is reused in horticulture, as per Delhi Jal Board.
- Constructed wetlands were used for treatment of wastewater in Sanjay Van (Delhi). Although the system functioned well initially, later problems of water stagnation and odour were observed due to excess volume of wastewater being fed into the system.
- NDMC has constructed 7 decentralized STPs in the New Delhi area, with treatment capacities of 100 to 500 KLD and the treated water is used for watering parks in the NDMC area.
- Treatment of wastewater for potable purposes will have to meet standards set by various agencies such as BIS, WHO etc. which is not easy to achieve. Hence, reuse of wastewater should initially be promoted for use for non-potable purposes such as horticulture, agriculture, industrial reuse, in metro depots, railway services etc.
- There is very little acceptance of the concept of "toilet to tap". However, downstream cities indirectly use wastewater of other cities for potable purposes via surface water dependent drinking water production facilities.
- Reuse of treated wastewater for agriculture is constrained by the lack of transportation network, poor quality of treated effluents, poor monitoring systems and the long distance between STPs and farm lands.
- There are STPs in Delhi (Rithala, Keshopur etc.) where sewage sludge is used to produce bio-gas and electric energy. The "Waste to Energy" policy by Ministry of New and Renewable Energy offers subsidies for the generation of power in wastewater treatment plants, which has aided energy generation in STPs.
- The demand for treated wastewater is low because of the small pricing difference between freshwater and treated wastewater. Low demand for treated wastewater arises due to the lack of an existing conveyance system from STPs to the site of use (such as agricultural plots, industries, etc.) and the high cost of building and operating a new conveyance system for the treated wastewater. Other reasons behind low demand are lack of confidence about water quality among end-users and inadequate citizen engagement and awareness generation.
- Other challenges associated with reuse and resource recovery include limited market for reuse of treated wastewater, under-utilisation of treated effluent, and limited infrastructure for reuse and resource recovery. The underlying causes for these issues are innovative solutions are being turned down, there is stigma around direct reuse, limited role of civil society (e.g. represented through residence welfare organizations) in governance, limited citizen participation, absence of business models and government schemes, difficult history of Delhi Jal Board to get industries to reuse treated wastewater, and limited funds to set-up a conveyance network for treated effluents.

Financing for Wastewater Reuse and Resource Recovery

- There is limited funding for implementation of advanced wastewater treatment which is a barrier towards achieving good quality of treated wastewater. The inadequacy of investments is driven by an insufficient mechanism for creating a buoyant market for the reuse of treated wastewater (with the price of freshwater being too low), less understanding about marketability of recovered resources from STPs and limited financial resources with the water authority, amongst others.
- Delhi Jal Board's capital budget estimates for 2021-22 is about INR 3033.50 Crore. This includes INR 340 Crore from Yamuna Action Plan-III and INR 22 Crore from Namami Gange. Out of this, INR 1782.08 Crore has been allocated to the sewerage sector. Critical

areas to be covered in sewerage sector includes completion of a 59 km long interceptor sewer project along the Najafgarh , Shahdara and Supplementary drains, laying of new sewer lines in unauthorized colonies, rehabilitation of peripheral sewers, augmentation of STPs etc.

- Under Yamuna Action Plan-III, rehabilitation of existing trunk sewers and rising mains is being taken up in Okhla, Rithala and Kondli drainage zone.
- DJB is exploring options for a possible PPP strategy to obtain the sources of financing (both operational and capital) to deliver wastewater services.

KANPUR

Policy, Regulatory and Institutional

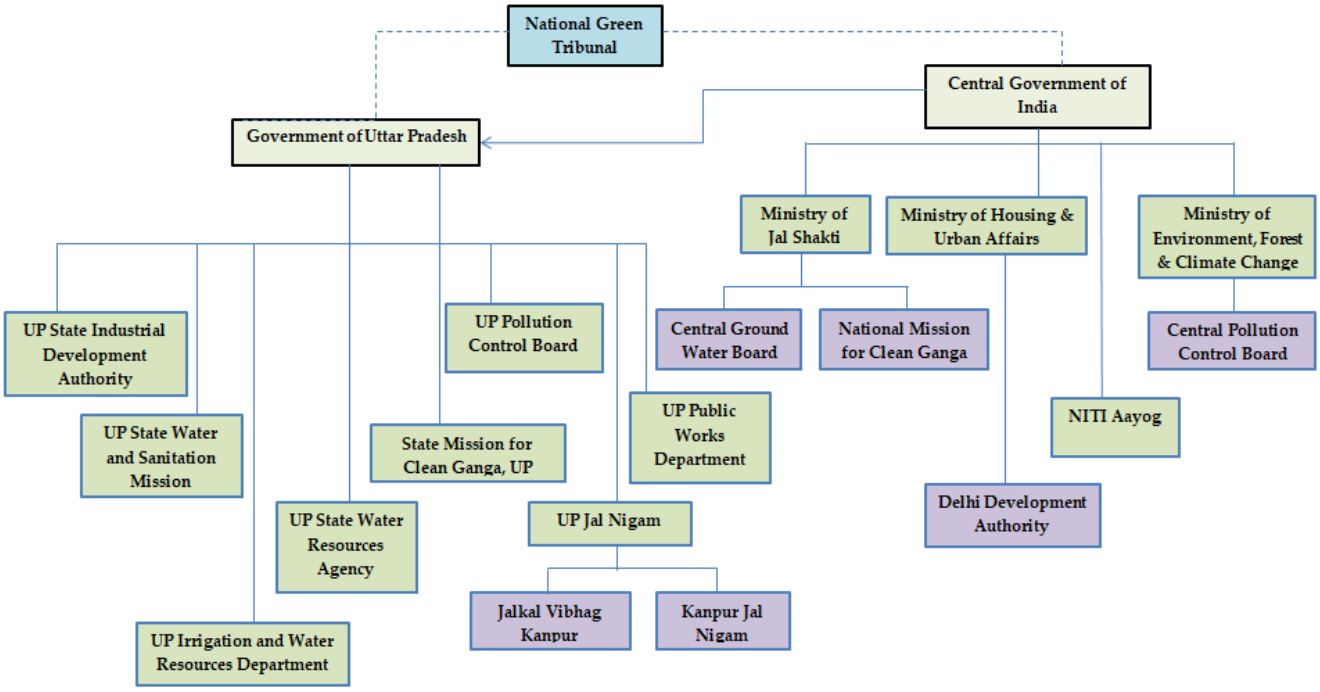


Fig: 2: Agencies involved in wastewater management in Kanpur

- The Ganga Action Plan-I led to the construction of three wastewater treatment plants in Jajmau, Kanpur. However, the design of the infrastructure did not consider the long-term development of the area. This has led to the poor performance of the treatment plants due to an excessive increase in wastewater volume.
- NGT has published stringent norms for wastewater disposal. The design parameters of existing STPs have also to be revised to achieve these standards. With the current infrastructure, it will take time to achieve such standards. The new standards can possibly be achieved in projects which are under implementation.
- Support from public and other stakeholders is required for achieving the stipulated norms of wastewater treatment. At present, the Government of Uttar Pradesh has started a scheme to connect every house to the sewerage network.
- There are no standards or guidelines for reuse of treated wastewater in agriculture. A Memorandum of Understanding has been signed with railways to reuse treated wastewater for cleaning operations.
- The Tariff Policy (2016) by the Ministry of Power mandates the use of treated sewage in thermal power plants which are located within 50 km radius of an STP. As of now, no thermal power plants are using treated wastewater in the Kanpur region. However, Panki Extension Thermal Power Station being developed in Kanpur will use treated wastewater from Bingawan STP.
- Various interventions have been recently initiated in Kanpur, under the Namami Gange Program that includes diversion of the Sisamau drain to Jajmau STP (60 MLD) and Bingawan STP (80 MLD) to prevent direct discharge into Ganga River, and creation of new 20 MLD CETP to treat tannery effluent.
- Further to the above-mentioned institutional and regulatory policy actors, more than 30 organisations representing the leather industry and private sector, civil society, public initiatives, educational institutes,

international development agencies, and research and policy advocacy, were identified among the key stakeholders regarding wastewater treatment, reuse and recovery in the Kanpur Jajmau case area.

Technology

- In Jajmau, there is a 130 MLD sewage treatment plant (STP) based on the activated sludge process; a 36 MLD combined effluent treatment plant (CETP) based on up flow anaerobic sludge blanket (UASB) and a 5 MLD pilot plant based on UASB. Several of these plants are reaching their end of life and requires rehabilitation. A fecal sludge treatment plants (FTP) being constructed in Bijnor under the AMRUT scheme. However, no such FSTP is being constructed in Kanpur.
- The wastewater discharge from the Jajmau area to the 36 MLD CETP exceeds the design capacity of treatment plants resulting into varying effluent quality discharged into the drainage channel. Additionally, limited use of primary treatment plants within the tanneries adds to the increase in load of wastewater to be treated at the CETP, resulting in low quality of treated wastewater.
- The complexity of the wastewater and disposal of toxic sludge from STP at Jajmau were perceived by the participants to be major constraints in wastewater treatment and reuse in Kanpur. Sewage has a mixture of toxic discharges from industries due to industrial ingression. It poses difficulty in meeting discharge norms.
- Inadequate load handling is a major cause of inefficient performance of STPs. Decentralized technologies like in situ treatment of drains is required to be implemented to reduce transportation and other associated costs of wastewater treatment.
- Jajmau STP (treats about 170-180 MLD) produces large amounts of sludge which is hazardous. A treatment, storage and disposal facility is being planned to be constructed for disposal of hazardous waste.
- The volume of industrial wastewater is less, but more toxic compared to sewage. Smaller industries cannot invest in high-cost technologies, due to lack of funds. So, suitable low-cost technologies should be in place for smaller industries.

Wastewater Reuse and Resource Recovery

- A 20 MLD Common Effluent Treatment Plant (CETP) is being commissioned in Jajmau with a chrome recovery unit (900 KLD) and a pilot zero liquid discharge (ZLD) (200 KLD) plant. The plant seeks to recyle and reuse a minimum of 75% of its treated effluent in industrial units of Jajmau and in agricultural and horticultural purposes.
- Currently, treated wastewater is being reused directly or indirectly for irrigation in Kanpur. In future it may be potentially reused for thermal power plants (TPP), railways, forestry, tanneries and in non-agricultural irrigation.
- Wastewater reuse is being promoted in tanneries to reduce the money for extracting ground water (in terms of electricity fee) in the Jajmau area of Kanpur.
- Since 1989, there is use of untreated wastewater in irrigation in the Jajmau area, which has deteriorated the quality of soil and groundwater. Due to the high cost of Operation and Maintenance, the proposal for zero liquid discharge in the CETP-STP was not implemented. Treated wastewater from the canal is readily available to be used by farmers located downstream of Jajmau STP.
- The farmers from the villages downstream of Jajmau STP are not financially well to do and not everyone can afford to buy drinking water cans which costs about INR 1 per litre of water. Deeper bore well has to be installed to pump water due to shallow groundwater contamination.
- There is an inadequate mechanism and infrastructure and high cost involved in

transportation of treated sewage from STPs to users.

- Sludge from tanneries contains about 12g/kg of chromium and is usually sent to a landfill. Additionally, the tanneries have no remedy for disposal of salt or hazardous slurry.
- Pilot projects are being implemented to explore possible usage of tannery by-products. For example, whips can be manufactured from raw trimmings and lime sludge can be used to produce bricks. Solidaridad (Kanpur) converted lime sludge of tanneries to bricks.
- Producing products from sludge that reduces its impact on the environment as well as creates a value for sludge needs to be encouraged, as disposal of sludge produced in STP and CETP has been a major issue.

Financing for Wastewater Reuse and Resource Recovery

- Jalkal Vibhag, Kanpur charges sewerage taxes and connection fees from local residents to cover the operation and maintenance costs of STPs. Additionally, tanneries pay for effluent discharged directly to the UP Jal Nigam.
- Authorities are considering applying the "polluter pays" principle to finance investments in wastewater management.
- The flagship programme of Government of India 'Namami Gange' with the budget of Rs. 20,000 crore aims to clean and rejuvenate river Ganga, 13 major drains in Kanpur have been completely tapped and industrial and sewage effluents have been diverted to CETPs.
- Under NGRBA, the government sanctioned an amount of Rs. 397.31 crores for allied works in sewerage of Kanpur city.
- Under the National River Conservation Plan (NRCP), both Central and U.P. State Governments are contributing Rs. 261.36 crore and Rs. 135.95 crore respectively for wastewater management in Kanpur.

IMPLEMENTING PARTNERS

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