# Rajkot, India

## Decentralized waste water treatment system for open streams

**In Rajkot, 40 percent of the city remains disconnected to existing sewage infrastructure. In such cases, untreated sewage is discharged into neighborhood streams, which flow into the Aji River, posing ecological harm to the surrounding communities and biodiversity. Under the Urban-LEDS project, in 2015 the City took measures to address Rajkot's wastewater challenges, beginning with the installment of a Decentralized wastewater Treatment System (DTS) in the Jilla Garden neighborhood. Today, among other benefits, the system treats sewage from 236 households saving 4,000 kilowatt hours of electricity and reduces GHG emissions by 15 $tCO_{2e}$ per year.**

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### Planning for a decentralized wastewater treatment system at Jilla Garden, Rajkot

Existing sewage treatment systems in Rajkot cater to only 60 percent of the domestic wastewater generated. Decentralized wastewater treatment systems (DTS) provide an ideal solution to treat wastewater directly at the source. This reduces the energy needed to pump wastewater from low-lying areas, and eliminates the harmful health impact of raw sewage released into nearby surface and ground water bodies. Additionally, such decentralized anaerobic treatment systems have the added benefit of producing biogas, which can be used as cooking fuel, or to power electrical fixtures within the neighborhood.

### Pre-feasibility assessment of the site for DTS

The Rajkot Municipal Corporation (RMC) identified the potential for developing decentralized waste water management systems, which would not only treat domestic wastewater from unconnected areas, but could also result in biogas generation. Two potential sites were identified by RMC and after a detailed analysis and consultations with the local community, the slum area next to Jilla garden was selected. A Terms of Reference was floated by ICLEI South Asia, under the Urban-LEDS project, for the selection of a technical agency whose mandate was to assess the feasibility of the DTS technology and design the system for the pilot area. Paradigm Environmental Solutions (PES) was selected to conduct the prefeasibility study and prepare structural designs, supervise construction and develop operation and maintenance protocols. In June 2015, ICLEI South Asia and the RMC issued a call for the procurement, construction, commissioning, operation and maintenance of a 100kLD DTS pilot project in the Jilla Garden area of Rajkot under the Urban-LEDS project. The selected contractor was mandated to construct the plant and also be responsible for the operation and maintenance of the plant.

The Jilla Garden, is a large slum-like settlement with 236 houses, characterized by mixed development, consisting of an economically weaker section of housing, small commercial establishments, eateries, and other local enterprises. At the time of the project, the area's untreated sewage (blackwater), water from washing (greywater), and stormwater (water from precipitation events), was discharged directly into a series of open drains/streams (vokhda), which flowed into the Aji River.

### Facts and Figures

**Location of DTS plant:** Jilla Garden, Rajkot Municipal Corporation, Gujarat, India (Pilot project under Urban LEDS project)

**Capacity of Plant:** 100 KLD

**Number of beneficiaries**: 236 households

**Cost of design, implementation, Operation & Maintenance (5 years):** Euro 66,120

**Potential GHG emission reduction:** 15 $tCO_{2e}$ per year

**Biogas generation potential:** 8,212 cubic meters per year

**Potential to substitute Liquefied Petroleum Gas:** 3,942 kg per year

**Potential to reduce energy consumed for pumping to centralized treatment system:** 4,000 kWh per annum

This series of local case studies is produced within the Urban-LEDS project funded by the European Commission, and implemented by UN-Habitat and ICLEI, which has the objective of enhancing and the transition to low emission urban development in emerging economy countries.

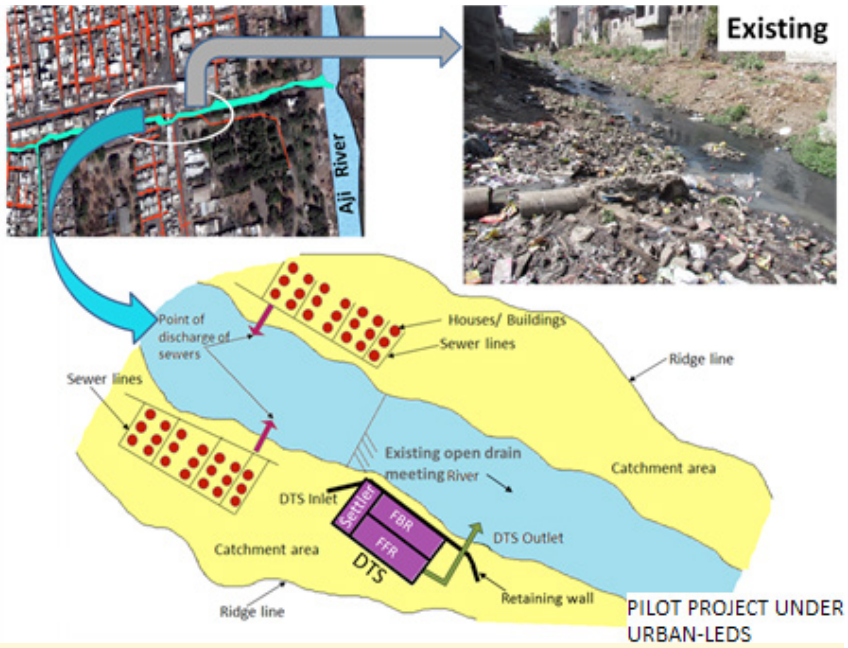


Image: Paradigm Environmental Strategies Pvt Ltd and ICLEI South Asia

**Figure 1: Location of DTS plant installed at Jilla Garden** - prior to the DTS untreated wastewater was channeled to a stream, which flowed into the Aji River. Today, users' wastewater is directed to the DTS system to generate biogas and treat water for gardening onsite.

The volume of sewage from 236 houses was estimated to be 94 kilo liters per day, assuming a per capita consumption of 100 liters per day in the area. This flow contributed approximately 14 percent of the total pollution into the vokhda.

Based on wastewater sampling conducted at four locations along the vokhda, the pollution from the Jilla Garden slum into the vokhda accounted for a biological oxygen demand (BOD) of roughly 98 milligrams per liter (mg/L). In India, the standard for treated wastewater discharged into inland water ways is 30 mg/L (as per Indian Standard 2490, from 1970).

## Implementation

Within ten months, ICLEI South Asia, the RMC, PES and Pooja Constructions, implemented a 100 KLD DTS plant at sub-ground level in the Jilla Garden. All through the construction period, continuous engagement with the local community resulted in a smooth and unhindered progress of the project. The local community supported the project primarily because of its potential to ensure cleaner and hygienic surroundings, with minimal or no inconvenience to the community.

A DTS wastewater treatment solution makes effective use of natural processes like gravity, temperature and time, to incite the needed microbiological activity. Today, the wastewater from the community is piped to a sump constructed at the bed of the vokhda. From the sump, the sewage is pumped to the DTS unit, the inlet of which is four meters above the sump's base.

The DTS unit comprises a settler integrated with an anaerobic fluidized bed reactor (FBR) and a tertiary fixed film reactor (FFR). Together, wastewater undergoes primary treatment (sedimentation and flotation), secondary treatment (anaerobic filters reduce the BOD by 70-90 percent), and tertiary treatment in aerobic/anaerobic media filters, for a combined retention time of 57.8 hours. The design standard for the treated water from the DTS is a BOD of 20 mg/L (well within the Indian Standard).

Further, to minimize inconvenience to the community, since the DTS unit is constructed below ground, parking space available prior to the construction (over the DTS unit) is still retained.

To ensure successful and continued operation post-implementation, the contract for the construction of the plant included an operation and maintenance contract for


Image: ICLEI South Asia

**Figure 2: DTS constructed at Jilla Garden**

### The Urban-LEDS Project

An Urban Low Emissions Development Strategy (Urban LEDS), or Low Emissions Urban Development Strategy, defines a pathway to transition a city to a low emission, green and inclusive urban economy, through its integration into city development plans and processes.

The Urban-LEDS project (2012 - 2016), funded by the European Commission, and implemented by UN-Habitat and ICLEI, has the objective of enhancing the transition to low emission urban development in emerging economy countries: Brazil, India, Indonesia, and South Africa.

For more information, please visit: **http://urbanleds.iclei.org/**

the DTS system for a period of 5 years. Municipal staff responsible for wastewater management in the ward (ward number 14, central zone), were trained to operate the DTS and to monitor the efficacy of the plant based on protocols that were developed.

## Outcomes of the DTS implementation and plans for up-scaling

At present the large-scale centralized sewage treatment system in Rajkot lacks sufficient capacity to treat all the domestic wastewater generated. The Jilla Garden pilot project demonstrates that **decentralized wastewater treatment is a viable, sustainable alternative to large-scale, centralized sewage treatment systems:**

- The DTS system has saved 4,000 kilowatt hours of electricity needed for conventional wastewater treatment, and reduced the GHG emissions by 15 tons of carbon dioxide equivalent ($tCO_{2e}$) per year.
- Deleterious health impacts from raw sewage flowing into the adjacent stream and from seeping into the ground water have been eliminated. In addition, the pilot shed light on the Aji River's pollution challenges, also encouraging the RMC to develop a Riverfront Development Plan to restore the river to a clean state.
- The DTS generates 8,212 cubic meters of biogas per year for thermal applications such as cooking.
- Treated wastewater from the plant is used for irrigating the adjacent garden, thereby reducing the use of piped water.

**Pilot projects are an effective means to demonstrate a low emissions development solution for scaling up.**

The successful implementation of the DTS has encouraged Rajkot to approve the technology for future implementation in treating untreated sewage, which is polluting the Aji River. As per the recently formulated General Development Control Regulations of Development plan – 2031 in Rajkot, implementation of DTS plants for upcoming new buildings is mandatory for securing an occupancy certificate, in the case of high-rise buildings with more than 100 units or with an area in excess of 20,000 $m^2$.

The city is now scaling up this best practice and replicating the DTS in several locations in the city, with a budgetary allocation of 7.85 Million USD, to treat raw sewage flowing into the vokhdas at several points and also to treat wastewater from SMART Societies (see below). RMC has invited communities to take part in the planning process and implementation of environment friendly projects in their community through the SMART Society Scheme. 115 civic society organizations in Rajkot were nominated as eligible for "SMART Societies" development, and are encouraged to adopt the DTS technology, to reduce the load on the existing sewage treatment plant. These societies generate 11.2 Mega Litter per Day (MLD) of raw sewage. Deploying the DTS technology has the potential to save 0.44MU (gigawatt-hour) electricity per year and 1,715 $tCO_{2e}$ GHG emission reductions. It also has the potential to generate 944,437 $m^3$ of biogas per year, which can replace 453,330 kg of

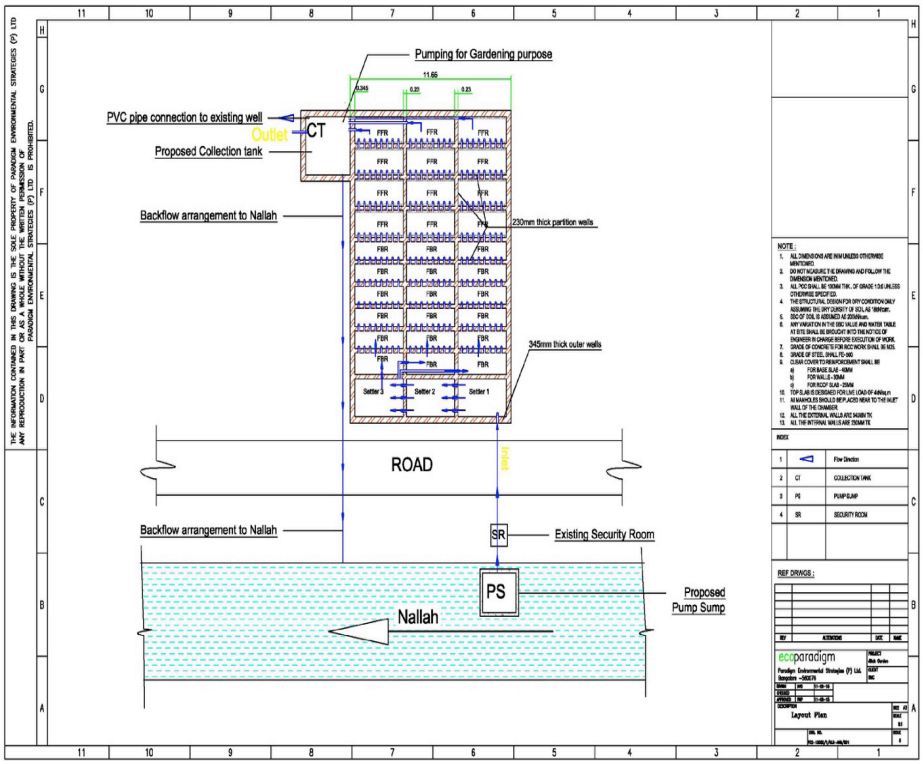


Image: ICLEI South Asia

**Figure 3: Plan view of the constructed DTS** - The wastewater stream is conveyed to a DTS unit comprising of a settler integrated with an anaerobic fluidized bed reactor and a tertiary fixed film reactor with a combined retention time (HRT) of 57.8 hours.

### Other key benefits of the DTS system

"*Involving the community is the key to initiating any successful change. Rajkot is spending lot of energy and money on treating the city's waste water through the centralized treatment plant. We hope that by implementing DTS plants, we may save energy and reduce GHG emissions from pumping of waste water and from the centralized waste water treatment plant.*"

- Mr. Vijay Nehra (IAS), Municipal Commissioner, Rajkot, 6th June, at the UNFCCC Climate Talks, Bonn, Germany

(http://unfccc6.meta-fusion.com/sb42/events/2015-06-06-16-00-iclei-paris2015-must-tap-the-potential-of-local-and-subnational-climate-action)

liquefied petroleum gas (LPG). As an upscaling strategy Rajkot plans to select 100 such societies each year and to use the SMART Societies network for wider implementation. The RMC shall provide the capital cost for construction, operation and maintenance; while residential societies will be responsible for the maintenance of the systems.

## Costs and Funding

The design, procurement, construction, and operation & maintenance costs are funded through grants from the ICLEI & UNHABITAT implemented Urban-LEDS project ("Promoting Low Emission Urban Development Strategies in Emerging Economy Countries"), financially supported by the European Commission:

- Design cost for the DTS project: Euro 9,440
- Procurement and Construction cost: Euro 49,740
- Operation & Maintenance cost for 5 years: Euro 6,940

### More related ICLEI Case Studies

- Enhancing 'Livability' through Urban Low Emission Development, ICLEI Case Study No. 175 - Rajkot. ICLEI: Bonn, 2016. Available online: http://www.iclei.org/fileadmin/PUBLICATIONS/Case_Studies/ICLEI_cs_175_Rajkot_UrbanLEDS_2016.pdf
- Nashik, India: Demonstrating the Urban NEXUS approach to optimize water, energy and land, Urban NEXUS Case Study No. 02. GIZ-ICLEI: Bonn/Eschborn, 2014. Available online: http://www.iclei.org/fileadmin/PUBLICATIONS/Case_Studies/Urban_NEXUS_cs02_Nashik_ICLEI-GIZ_2014.pdf
- El Alto, Bolivia: Large-scale ecological sanitation in the peri-urban District 7, Urban NEXUS Case Story No. 06. GIZ-ICLEI: Bonn/Eschborn, 2014. Available online: http://www.iclei.org/fileadmin/PUBLICATIONS/Case_Stories/Urban_NEXUS/06_Urban_NEXUS_Case_Story_El_Alto_ICLEI-GIZ_2014.pdf


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### Municipal Profile

**Rajkot Municipal Corporation**

Rajkot is the fourth largest city in the state of Gujarat, India, after Ahmedabad, Surat, and Vadodara. Rajkot lies between latitude 20.18 N and longitude 70.51 E. Rajkot has a population of nearly 1.3 million as of 2011 and is ranked 22nd in the list of global fastest growing cities and urban areas from 2006 to 2020. The city area has grown in area from 104.86 square kilometers ($km^2$) in the year 2011 to 129.21 $km^2$ in 2015.

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