

TREATMENT SYSTEMS AND PLANS

This factsheet summarizes existing treatment systems and future plans in eight CWIS cities on aspects of treatment plant capacity and utilization, treatment technologies, financing, operations & maintenance (O&M), and contract and staffing. These eight cities are diverse in population size and extent of sewer network coverage. This factsheet seeks to present treatment models and challenges cities face in the context of their differential treatment needs. A summary table follows on page 4 to provide city data at a glance.

Context

Population for the 8 CWIS cities range from 43,000 (Wai) to 3.8 million (Dakar Region). The African cities are the largest in the group—both Lusaka and Dakar have over 2.5 million population, and Kampala has a resident population exceeding 1.5 million. The population size of Khulna is very close to that of Kampala. Two of the Indian cities, Trichy and Warangal, have close to 1 million population, while Narsapur and Wai are both under 100,000 in size.

Half of the eight cities rely entirely on non-sewered sanitation and all are in South Asia—Khulna in Bangladesh, Warangal, Narsapur, and Wai in India. Dependency on sewer networks in the three African cities range from 8% in Kampala to close to 20% in Dakar. Meanwhile, Trichy has the highest coverage of sewer networks, at 45%. To allow better juxtaposition of treatment systems given the context, the following sections summarize city information by two groups—those with and without sewer networks.

Cities without sewer coverage: Khulna, Warangal, Narsapur, Wai

Three cities (all in India) are testing pyrolysis (thermal process) for treating Fecal Sludge (FS). In Wai and Narsapur, along with pyrolysis for FS treatment, a combination of Moving Bed Biofilm Reactor (MBBR) and phytoid (constructed wetlands) is being used for the treatment of wastewater. In Warangal, wastewater is treated through MBBR alone. Warangal is also testing a geobag approach. The fourth non-sewered city, Khulna, Bangladesh, utilizes vertical flow constructed wetland and sludge drying reed bed. Four Fecal Sludge Treatment Plants (FSTPs) in all four cities were constructed over the past three years using grants from the Bill & Melinda Gates Foundation (BMGF), except for the 10 KLD FSTP in Warangal which was constructed under the Corporate Social Responsibility (CSR) initiatives of Banka Biolo.

Warangal is planning on constructing a new 150 KLD FSTP financed by the Greater Warangal Smart City Corporation through a Hybrid Annuity Model (PPP). Alongside this, 3 new Sewage Treatment Plants (STPs) with a combined capacity of 120 MLD under the Smart Cities Mission¹ are under tendering process in Warangal. On the other hand, Khulna has plans to provide sewerage service and construct 2 STPs by 2025 under a loan from the Asian Development Bank (ADB).

The O&M costs are currently also grant based. Other than the 10 KLD FSTP in Warangal, which is operated by Banka Biolo, all FSTPs in the three Indian cities are currently operated by private contractors using BMGF funding. After a two-year period, O&M of the FSTPs will be tendered out. In Khulna, the Khulna City Corporation (KCC) is operating the FSTP, with one staff managing the entire operations as compared to five to seven staff in Indian cities. This is primarily due to the nature based solution being implemented in Khulna which has low operational and maintenance requirements. KCC is planning to introduce the PPP model for O&M, which will likely change the staffing and financing structure.

Total FS treatment capacity in these cities range from 15 KLD in Narsapur to 180 KLD in Khulna. The FSTPs in Warangal (25 KLD combined capacity) and Narsapur are pilot projects and small compared to the volumes of FS generation, especially in a larger city like Warangal. FSTP utilization rate in both cities is at 33% due to low uptake of desludging, which is considered as an emergency response rather than an essential service. Both cities have taken measures to increase the desludging demand, along with empaneling and training desludging operators. Similarly, total FS generation in Khulna exceeds the capacity

¹ Urban renewal and retrofitting program by the Government of India.

of the current FSTP, yet the capacity utilization is only 4.1%, which has already quadrupled from the 1% when it was operationalized in 2017. On the other hand, Wai has an FSTP of 70 KLD, which is expected to meet the full demand of the city's small population accounting for future growth. Having implemented scheduled desludging since May 2018, Wai currently utilizes 50–55% of its FSTP capacity and plans to employ additional trucks for scheduled desludging, which will also increase the FS volume desludged.

Cities with some sewer coverage: Trichy, Kampala, Lusaka, Dakar

All four cities have large STPs that were built several decades back—as early as 1930s–40s in Kampala, and upgraded later. These cities either have separate FSTPs along with STPs or accept FS at the STPs. Treatment infrastructures were mostly funded by a combination of sources including government budget and loans from International Finance Institutions (IFIs). Operating revenue comes from a mixture of government budget, tariffs, and tipping fees. In the African cities, a very small part of revenue is also generated through selling treatment byproducts—2% of the operating revenue in Dakar comes from treated effluent and biosolids, while Lusaka and Kampala are currently only selling biosolids at very low/ subsidized prices. In Lusaka, the low price is because the biosolids do not currently meet standards for agricultural use, but plans are underway for improvement. Dakar uses biogas generated from the WWTP to power the treatment plant itself and also generates distilled water while treating FS via omni-processor. Treatment plants in the African cities are owned and operated by the utilities with their own staff, with the exception of the FSTPs in Dakar which are operated by a private contractor under a PPP model. Meanwhile, the Trichy STP is owned and operated by the Tiruchirappalli City Corporation (TCC).

Combined treatment capacity (operational only) ranges from 26 MLD in Dakar to 58 MLD in Trichy. A common issue in all three African cities is that the treatment plants are receiving volumes above their designed capacities, undermining the effectiveness of treatment. In Dakar, some of the FSTPs are receiving as much as 648% of their designed capacities. Moreover, STPs that are not designed to treat FS, such as the Bugolobi STP in Kampala, have also been receiving FS due to the lack of treatment infrastructure. Meanwhile in Trichy, the STP utilization rate is 96%. Treatment pressure is lower in Trichy likely due to its larger treatment capacity both in absolute terms and relative to its population size. However, Trichy's close to full capacity utilization also shows the need for additional treatment infrastructure to meet future demand. Meanwhile, all four cities are tackling with low demand for desludging and illegal dumping issues, and will need more capacity to treat FS as these issues get resolved. This need will be much more pressing for the African cities. All four cities also have plans to construct additional treatment plants—Dakar is planning new FSTPs, Trichy is planning a new STP, while Lusaka and Kampala are planning both STPs and FSTPs, mostly leveraging various sources of IFI and donor funding.

Most of the STPs are either conventional STPs with settling tanks, anaerobic digester, trickling filter, and drying beds (Kampala, Lusaka and Dakar) or use waste stabilization ponds (Trichy, Kampala, Lusaka) for treatment. In Lusaka and Kampala, the FSTPs are based on thickening tanks and drying beds, while the Dakar FSTPs use drying beds and flocculation technology.

	Sewer + Onsite				Onsite Only			
	Kampala	Lusaka	Dakar	Trichy	Wai	Warangal	Narsapur	Khulna
Population	1,507,080	2,526,102	3,835,019	9,16,674	43,000	8,17,959	58,901	1,500,689
Population with sewer connection	8%	16%	20%	45%	0%	0%	0%	0%
Wastewater Treatment Plant (WWTP) capacity	5 Sewage Treatment Plants (STPs) totaling 40 MLD	4 operational STPs totaling 52 MLD; 1 ceased STP at 36 MLD	5 STPs totaling 26 MLD	1 STP at 88MLD, 58 MLD of which is operational	N/A	N/A	N/A	N/A
Fecal Sludge Treatment Plant (FSTP) capacity	N/A	2 FSTPs totaling 100 KLD	4 FSTPs totaling 640 KLD	N/A	1 FSTP at 70 KLD	2 FSTPs totaling 25 KLD	1 FSTP at 15 KLD	1 FSTP at 180 KLD
Total Capacity Utilization	>100%	>100%	>100%	96%	50-55%	33%	33%	4%

WWTP Hardware & Construction Year	1 conventional STP (1930s-40s); 4 Waste Stabilization Ponds (WSPs) (2014)	2 conventional STPs (1950s); 2 WSP (1970-80s)	5 conventional STPs (1989, 2007, 2009, 2003, 2017)	WSP (1987)	N/A	N/A	N/A	N/A
FSTP Hardware & Construction Year	N/A	Bio-digesters, thickening tanks, drying beds (2012)	Decanters, drying beds and flocculation (2007, 2008, 2009, 2017)	N/A	Phytorid and MBBR ² for WW & pyrolysis for sludge (2018)	MBBR for WW and pyrolysis for sludge (2017); Geobags (2017)	Phytorid and MBBR for WW and pyrolysis for sludge (2017)	Constructed wetland, sludge drying reed bed (2017)
FS+WW Co-treatment at WWTP	Yes, at two facilities	Yes	Yes	Yes	No	No	No	No
Reuse	Biosolids sold at low prices	Biosolids sold at low prices	Biosolids & effluent sold	Biosolids distributed (not sold)	Effluent given	Effluent given	Effluent given	No (biosolids under testing)
CAPEX funding source(s)	IFIs + Govt	IFI + Donor + Govt	IFI + Govt	Govt	Donor (BMGF)	Donor (BMGF and Banka Biolo)	Donor (BMGF)	Donor (BMGF)
OPEX funding source(s)	Tariff + govt subsidy+ donors	Tariff + govt subsidy	Tariff + govt subsidy	Govt subsidy	Donor (BMGF)	Donor (BMGF and Banka Biolo)	Donor (BMGF)	Govt subsidy
O&M Responsibility/ Execution	WWTP: Utility	FSTP & WWTP: Utility	WWTP: Utility FSTP: Utility/ private operator	Municipal govt	Municipal govt/ private operator	Municipal govt/ private operator	Municipal govt/ private operator	Municipal govt/ private operator

² Moving Bed Biofilm Reactor (MBBR)



CWIS FACTSHEET

The Bill & Melinda Gates Foundation's Citywide Inclusive Sanitation (CWIS) initiative supports eight cities across Sub-Saharan Africa and South Asia that are redesigning their urban inclusive sanitation service systems with a CWIS approach. The CWIS Factsheets are part of the Monitoring, Learning and Evidence (MLE) program, funded by BMGF, which is helping cities and the Foundation to measure and learn from CWIS implementation efforts. Each factsheet provides a short cross-city summary on topics that shed light on the CWIS outcomes of Equity, Safety and Sustainability and system functions of Mandate, Accountability and Resource Management.

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