TREATING BLACK FOR BLUE: PERSPECTIVES ON MANAGING URBAN WASTEWATER IN INDIA

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Overview

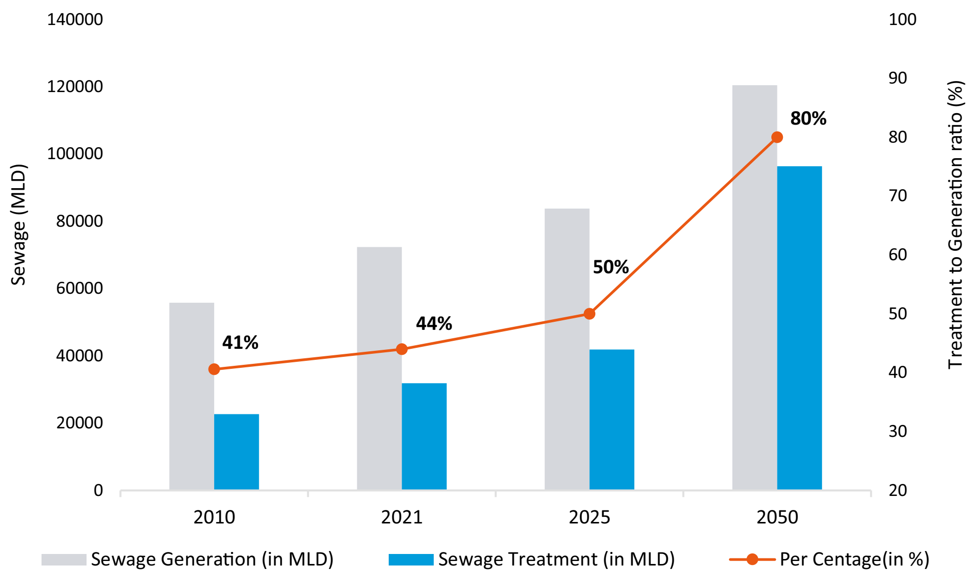
India has the capacity to treat only 44 per cent of the total sewage it generates per day. Out of the 72,368 million litres per day (MLD) of sewage we produce in urban centres, our installed treatment capacity is 31,841 MLD (CPCB, 2021). In class I (population above 1,00,000) and class II (50,000 to 99,999 population) cities, which represent a major share (72 per cent) of the total urban population, the actual treatment is lower than the installed capacity. Out of the estimated 38,254 MLD of sewage these cities produce, only 30 per cent is actually treated (CPCB, 2021). The untreated wastewater is then discharged into freshwater bodies such as rivers.

The discharge of partially treated or untreated wastewater is taking a heavy toll on river health, which is a critical source of fresh water. As per recent water quality monitoring reports from the Delhi Pollution Control Committee (DPCC), the stretch of Yamuna that passes through Delhi continues to be one of the most critically polluted in the country (DPCC, 2022). The river's water quality deteriorates substantially by the time it exits the city. The situation is no different for other rivers passing through urban areas, with the Central Pollution Control Board (CPCB) identifying 351 polluted stretches across India with Biological Oxygen Demand (an indicator of faecal contamination and organic pollution) above the prescribed limit of 3mg/l (CPCB, 2018).

Rapid and unplanned urbanisation, rise in industrial growth, and shifting consumption patterns have intensified India's water demand, far exceeding the available supply of fresh water. As per our analysis using the Central Water Commission (CWC) estimates on basin-wise water availability (CWC, 2021), 11 out of the 15 major river basins in India will experience water stress by 2025, with annual per capita renewable water availability below 1700 cubic metres. Hence, it is essential to explore alternative sources of water to address the demand and supply gap. Treated wastewater is a highly underutilised resource that offers an avenue to address the scarcity of fresh water and at the same time improve the water environment if managed properly.

Reuse potential of treated wastewater

In India, the reuse of treated wastewater holds immense potential considering the scale of wastewater generation, which is likely to increase exponentially over the years. Further, India has made substantial progress in strengthening its operational wastewater treatment capacity with an increase of over 40 per cent from 2014 to 2020 (CPCB, 2021). According to our analysis based on population projections, sewage generation is estimated to increase from 55,812 MLD in 2010 to 1,20,472 MLD in 2050. Further, given the enhancement in operational treatment capacity, the sewage treatment capacity as a percentage of total sewage generation will



Source: Authors' analysis, data from Niti Aayog Demographic Scenario 2025 (Niti Aayog, 2019) and CPCB (2021)
(Projected Sewage Generation = Urban population X 185 X 0.8)

Figure 1 In 2050, sewage treatment capacity in India is estimated to be 80% of sewage generation

rise from 41 per cent in 2010 to 80 per cent by 2050. This implies that about 96,378 MLD of treated wastewater will be available for reuse by 2050 (Figure 1). Hence, there is a significant opportunity for the reuse of treated wastewater across different sectors, especially for non-potable use.

many others do not meet the prescribed effluent water quality standards (CPCB, 2021). In some cases, STPs are underutilised since the sewerage network does not cover unauthorised colonies and sub-urban areas (CSE, 2014). Many urban utilities are unable to scale up wastewater treatment capacity as the capital and operating cost of infrastructure is high.

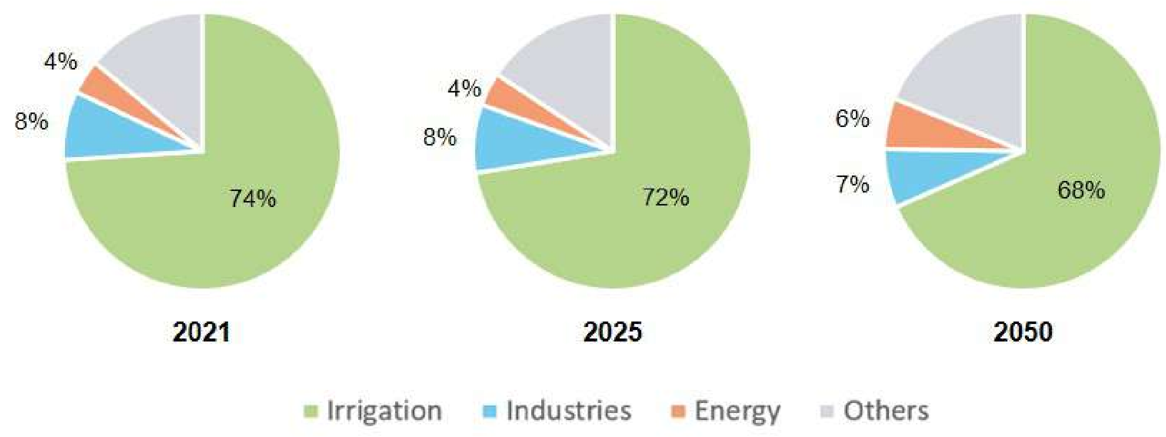


Figure 2 Potential opportunity to reuse treated wastewater, especially for irrigation

The amount of treated wastewater that can be readily made available for reuse across different sectors in India is presented in (Figure 2). This estimate is based on the actual wastewater treatment capacity installed in India, apportioned as per the ratio of (current and projected) water demand over the years in three major sectors – irrigation, industries, energy, and others.

The analysis suggests that the water demand for the irrigation sector, in proportion to the total water demand, will witness a gradual fall and that of the industrial and energy sector will steadily rise. Such changes in the future could be attributed to factors such as efforts towards improving water use efficiency in irrigation, and increasing water demand from the growing economic sub-sectors. Nevertheless, the agriculture sector retains its relative dominance, accounting for 68 per cent of total water demand in 2050. Thus, the reuse of treated wastewater for irrigation presents an opportunity to reduce pressure on groundwater extraction which is a major source of irrigation, and minimise fertiliser use on account of the inherent nutrient value of wastewater.

A number of Indian states have formulated state-level policies on the reuse of treated wastewater. States such as Rajasthan, Gujarat, and Haryana have prepared comprehensive policy documents that identify sectors for reuse, and define allocation mechanisms and pricing principles, with provisions for exploring public-private partnership models for wastewater treatment projects. Yet, there is a gap in terms of the effective implementation of the policies and mainstreaming of treated wastewater reuse.

Challenges in the reuse of treated wastewater

The current state of treatment and subsequent reuse of treated wastewater, even in the major urban agglomerations of the country, is inadequate. According to the CPCB, many sewage treatment plants (STPs) do not function at maximum capacity and

Nevertheless, some initiatives are being undertaken by local urban authorities to promote the reuse of treated wastewater. For example, as part of a project initiated by the water board in Delhi, artificial lakes are being constructed near existing STPs with the aim to recharge groundwater in the city. The water in the constructed lakes is sourced from the treated wastewater from the respective STPs. It is estimated that about 50 per cent of the treated wastewater in such artificial lakes would recharge groundwater and can be extracted through tube wells installed in the surrounding areas for irrigating nearby farms, and watering urban parks (DDA, 2022). Also, the authorities have set up a sludge treatment plant at one of the existing STPs to process the residual sludge from it and convert it into ash. The ash can be moulded into interlocking paver blocks for use in construction. However, such efforts are only a few examples of wastewater management in urban areas of India.

Way forward

There is no doubt, wastewater management in India requires a holistic shift from a 'use and throw – linear' to a 'use, treat, and reuse – circular' approach (Kim, et al., 2018). Strengthening governance plays a key role in mainstreaming the reuse of treated wastewater. But there need to be some targeted interventions to achieve this.

First, institutional synergy is needed between the centre and state for the effective implementation of wastewater treatment and mainstreaming its reuse. The existing state-level policies in India on reuse of treated wastewater do not define the treated wastewater reuse quality standards for specific uses. Hence, a comprehensive national framework is a crucial instrument for addressing such gaps, acting as an umbrella document for promotion of wastewater management and governance of its reuse.

Second, appropriate public-private partnership models need to be promoted to develop financially viable treated wastewater reuse projects (Bassi et al., 2022). For this, approaches promoted under the National Mission for Clean Ganga to scale up wastewater treatment infrastructure and reuse should be looked at. Such projects can be made financially viable if the technology adoption is undertaken considering the market potential of the intended purpose for which treated wastewater would be reused.

Third, freshwater needs to be priced to create more demand for treated wastewater. In many Indian cities, domestic water is supplied for free or is highly subsidised. As a result, there is no demand for treated wastewater even in areas that experience water scarcity on a regular basis. Charging freshwater on a pro-rata or consumption basis will create institutional demand for treated wastewater, especially for irrigating gardens, meeting non-potable water demand in hotels and hospitals, for use in anti-smog guns, etc.

Fourth, an effective pricing mechanism for treated wastewater should be put in place based on the market potential of treated wastewater. It will help reduce/recover the wastewater treatment cost and thus contributes towards making such projects commercially viable.

Fifth, low-cost nature-based wastewater treatment technologies such as waste stabilisation ponds should be promoted. They do have a large land requirement in comparison to electromechanical technologies. This can be made available in small towns where the population density is low and there is a low demand for building new infrastructure. Also, being low in energy usage, such technologies have a low carbon footprint.

To conclude, there is a vast potential for making reuse of treated wastewater for non-potable purposes. For instance, a quick estimate based on the current wastewater treatment capacity and water demand for irrigation suggests that the amount of treated wastewater currently available for use in the agriculture sector is sufficient to irrigate 1.4 million hectares of land which is equal to about 9 times the area of Delhi. This land can further generate revenue from the agricultural produce obtained through irrigation using treated wastewater, along with additional benefits such as the economic value of nutrients recovered from wastewater and energy savings from reduced groundwater pumping. Hence there is immense un(der)tapped potential for reusing treated wastewater that can promote circularity in urban wastewater management.

References

Bassi, N., Kumar, S., Kumar, M. D., Van Ermen, S. & Campling, P., 2022. Promoting wastewater treatment in India: Critical questions of economic viability. Water and Environment Journal, 36(4), pp. 723-736.

CPCB, 2018. Restoration of Polluted River Stretches, Delhi: Ministry of Environment, Forest, and Climate Change, Government of India.

CPCB, 2021. National Inventory of Sewage Treatment Plants, Delhi: Ministry of Environment, Forest, and Climate Change, Government of India.

CSE, 2014. Decentralized Wastewater Treatment and Reuse: Case studies of implementation on different scale – community, institutional and individual building, Delhi: Centre for Science and Environment.

CSO, 2018. EnviStats India 2018 (Supplement on Environmental Accounts), Delhi: Ministry of Statistics and Programme Implementation, Government of India.

CWC, 2021. Report on Water Quality Scenarios of Rivers, Delhi: Ministry of Jal Shakti, Government of India.

DDA, 2022. Master Plan for Delhl 2041, Delhi: Government of India.

DPCC, 2022. Water Quality Status of River Yamuna, Delhi: Delhi Pollution Control Committee.

Kim, N., Das, S., Neog, K. & Sugam, R. K., 2018. The Perfect Storm: Pathways to Managing India's Water Sector Sustainably, Delhi: United Nations Resident Coordinator's Office.

NITI Aayog, 2019. Composite Water Management Index, Delhi: Government of India.