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Process Study Of Liquid Waste Management In Indore City Of Madhya Pradesh

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Abstract: In 2017, the city sewerage network was planned and developed in phases. The immediate demand for the year 2021 was materialized and taken as the base year for further system augmentation was planned in two phases – short term(2035) and long term (2050) and comprises the construction of new STPs; strengthening of primary network; replacement of pipe network, more than 30-50 years old and reduce carrying capacity; and road restoration. The thought of this project evolved over the decade due to the deterioration of water quality in the Kanh and Saraswati rivers. It started with the BRTS corridor project that initially proposed a 30 km long road along the river banks. Thereafter, Simhastha 2016 inspired IMC to formulate an action plan for the diversion of grey and black outfalls to improve the quality of water reaching Ujjain from Indore. Then, in 2017-18, the project was again undertaken under the AMRUT scheme. The Indore Municipal Corporation (IMC) decided to formulate a comprehensive plan for holistic sewerage coverage and sanitation in the city by diverting 100% black and grey water outfalls with zero pumping. With the aim of river rejuvenation at its heart, the city has pledged to take on the following measures in this regard: A decentralized sanitation system, Reuse of treated wastewater, River rejuvenation through treated wastewater, and Ensuring encroachment-free and GVP-free water bodies. An important aspect of the project to note here is that the citizens of Indore came forward to contribute to the project by investing their own time, money, and resources. Their sheer motivation and firm resolution to abide by the rules of safe and clean sanitation is evident in their efforts towards solid waste management and now towards Total Sanitation. Now the whole 100% of households are covered under the city sanitation system. 100% of non-domestic establishments are covered by the city sanitation system. 100% of CT, PT, and Urinals are covered by the city sanitation system. There is improved access to safe sanitation for slums and squatters. Encroachment by slums and squatters along the rivers and drains has reduced. There is safe and scientific disposal of black water.

Keywords - Indore Municipal Corporation (IMC), Sustainable Development Goal (SDG), Open Defecation Free (ODF), Sewerage Treatment Plant (STP), Effluent Treatment Plant (ETP).

I. INTRODUCTION

Wastewater generation in Indore city

Like many other Indian cities, Indore developed beside rivers named Kanh and Sarswati and its tributaries. There are also 4 ponds, approx. 134 wells, and 6 major and 23 minor natural storm water drains. The city is spread across 276 sq. km and divided into 22 administrative zones and 85 wards. Wastewater in the city is generated from 5.61 lakh households, besides commercial establishments, and industries (IMC's DPR V-1, 2017and sewerage network plan, 2024). Two types of liquid wastewater are generated in the city classified as black water and grey water. Grey water includes wastewater from households, any run-off from buildings and roads, and rain during monsoon; black water includes municipal wastewater from communities (also called sewage); and industrial wastewater called effluent. All the households in the city have been brought under toilet facility.

Table 1: Brief sanitation profile of Indore city (IMC's DPR V-1, 2017, and sewerage network plan, 2024)

Category	Value
Population (MC) 2024	32 lakhs
Area	276 sq km.
Total units covered by sewerage system	99.5% of total (5,61,071 units) Connected to sewerage network- 5,58,561 Connected to septic tanks with soak pits-439 Connected to twin pits- 2071
Slum population	2,3510 (0.8% of total)
Slum HH coverage by sewerage system	4,702 (0.9 % of total) Connected to sewerage network- 4,181 HHs Connected to septic tanks with soak pits- 35 HHs Connected to twin pits- 486 HHs Connected to CT/PT- 0 HHs

Sanitation Profile

As per the manual of the Central Public Health and Environment Engineering Organisation (CPHEEO), 80% of the water supply is to be taken towards sewage generation. Under the Swachh Bharat Mission, all households are now covered under the toilet facility. The total capacity of all Sewerage Treatment Plants (STPs) located in the IMC area is 412.5 MLD having primary, secondary, and collection systems of 2125 km. The sewerage generation is approximately 367.8 MLD, which is 135% of demand. All 4,89,307 households, 51,503 commercial units, 20,261 mixed units, 140 standalone urinals, and 320 community toilets / public toilets are covered by the city sewerage system, septic tank with soak pits and twin pits.

Table 2: Present supply and water demand for the project area (IMC's sewerage network plan, 2024)

Total Pop. Of Yr. 2024	Total water supply in MLD in CITY SCADA Data	Tube well water supplied by 50000 in MLD	Total water supplied in MLD ML
32 lakhs	415	20	435

Grey water and black water from the households are treated at the STPs. The industrial effluents are treated at an Effluent treatment plant (ETP) with a capacity of 4 MLD. The human waste from septic tanks is also treated at the STPs.

Table 3: List of Sewage Treatment Plants with design capacities (IMC's sewerage network plan, 2024)

Sl. No.	Name and location of STP	Design capacity (in MLD)
1	Pratik Situ STP	8
2	Nahar Bhandhara STP	11
3	Radha swami Ground STP	6
4	Zoo STP	35
5	Bijalpur Talab STP	7
6	Kabitkhedi STP	12
7	Kabitkhedi STP	78
8	Kabitkhedi STP	245
9	Harsiddhi Garden STP	10
10	Pipliyana Talab STP	0.5
Total		412.5 MLD

II. PROBLEM STATEMENT

Before the initiation of interventions, Indore City faced the challenge of liquid waste management. It resulted in contamination of land and soil, contamination of surface water bodies due to untapped outfalls, contamination of underground water table and aquifer due to percolation of wastewater, and finally contamination of air due to foul odor. There were issues related to people's awareness and willingness of the community to connect with sewerage networks etc. Swachh Bharat – Urban provided the right policy direction to address the challenge of liquid waste management in the city.

The city regards its water resources as an important subsystem of its city system due to various social, environmental, and economic reasons. This is important because households cannot manage black water and grey water on their own. Unsanitary living conditions cause deterioration in Quality of Life, livelihood opportunities, circle rates of property, and overall development potential of an individual as well as the city.

An efficient and decentralized city sanitation system discourages- contamination of land and soil, contamination of surface water bodies due to untapped outfalls; contamination of underground water tables and aquifers due to percolation of wastewater; and finally, contamination of air due to foul odor.

From the environmental perspective, it checks disruptions in the river ecosystem and the ecosystem of natural storm water drainage channels and systems.

Rapid and haphazard urbanization of the city, like the rest of the towns in India, has over-stressed the water bodies. Unplanned development areas and earlier interventions of connecting the sewerage to the drains and rivers have led to the deterioration of the water bodies.

III. STUDY AREA

Given the extensively wide expanse and importance of the water bodies in the city, it is imperative to safeguard their cleanliness and environmental health. Being non-perennial/ intermittent rivers, the action plan for maintaining water quality is different from that of the perennial rivers. The focus is on maintaining a safe and clean water flow in the rivers throughout the year. With river restoration as its primary goal, the city has committed to implementing the following actions.

- 100% sewerage coverage and decentralized city sanitation system
- Reuse of treated wastewater
- Water reuse network infrastructure
- River rejuvenation through treated wastewater
- Beautification, plantation, and riverfront development

All the above-mentioned interventions are the major apparatuses of efficient water resource management.

Once the sanitation system is in place, the treated water that forms the output of the treatment plants can be used for the other two major interventions, i.e., water reuse and river rejuvenation. This has various associated social and environmental cost benefits. This will also ensure improvement in ecosystem services provided by these water bodies to the city.

IV. PROCESS FRAMEWORK AS PER NATURE OF INTERVENTIONS

The challenge of liquid waste was seen as one that needs to be addressed through an integrated approach needing techno-managerial and social solutions. The processes are undertaken for technical interventions, management interventions, and social interventions to achieve the overall program goal.

Social interventions: -EMPOWER Process

- Educate through IEC activities
- Mobilizations from residential and commercial locations
- Preparing the communities by fixing sewerage lines
- Organizing into mohalla committees, riverside cleanliness committees
- Work in collaboration with IMC, NGOs, CBOs, etc.
- Execute and monitor the implementation
- Rule formation and compliance with the newly formed norms

Management interventions: - Planning, Implementation, and Monitoring Process

- Planning – Assessment of primary line, decentralized infrastructure requirement, and gravity-based conveyance system
- Implementation – Repairing of primary lines, laying sewerage lines, Segregation of sewage from storm water, Segregation of industrial wastewater from sewage, Sewerage connection to last mile, Removal of encroachments through slum rehabilitation, Primary treatment by institutions and industries, Riverfront development, promoting reuse of treated water, Operations, and maintenance, Scheduled cleaning and maintenance

- Monitoring – Strong grievance redressal and feedback mechanism

Technical Interventions: - INNOVATE Process

- Identifying the routes of wastewater flow
- New sewerage Networking
- New infrastructure development
- Observe the quality of water daily
- Vying to bridge the gap between requirement and installed capacity
- Aligning with the standards of the latest technologies
- Technologies for sewerage treatment
- Awareness of reusing treated water

V. RESULTS AND DISCUSSIONS

Novelty in Liquid Waste Management in Indore

The Indore Municipal Corporation (IMC) has been steadfastly committed to the Swachh Bharat Abhiyan since its inception and working to continue its efforts for long-term benefits. Similar to Solid waste management, the Liquid waste management project of Indore is novel in its various aspects which include the following:

- Participation of multiple-stake holders
- Citizen participation
- Zero-pumping drainage to STPs
- GIS-based planning
- Scalable and Replicable

Financial Sustainability

Financial sustainability is important for a program to continue over the long term without being financially constrained to provide services continually to its target group. The liquid waste management program of Indore Municipal Corporation (IMC) also needs to be IMC also needs to be analyzed in the same light. The broader aspects to be considered include: -

- Profitability or surplus of revenue over expenses
- Liquidity or the ability to meet cash requirements
- Efficiency services with the least amount of human, material, and financial resources
- Effectiveness in using its resources adequately to fulfil the program goal.

Cost Benefit Analysis

The total revenue earned by the Municipal Corporation through sanitation part of property tax- Jal mal nikaskar, sale of treated water, savings from self-consumption of treated water, and CSR funding. Expenditure was providing a profit. Adding to savings from treated water and avoiding generating fresh water from river Narmada, savings would add to an overall profit.

Social Cost Benefit

Different social benefits are accruing to different communities. The farmers receive treated water for agriculture and irrigation purposes at a much lower cost than earlier. Dependence on groundwater has reduced. Private partners such as industries and commercial agencies are receiving water for industrial and non-potable nondomestic uses at a much lower rate than before. The people who were earlier living along the rivers and drains are now able to save costs on health due to reduced illnesses. Their property rates have also seen a hike due to a drastic change in the connotation of the words “nallah facing” or “river facing”. The local communities now have a public place for gathering, holding meetings, playing various outdoor games, etc. The citizens now have accepted water bodies as an integral part of their lives and do not tolerate any kind of littering or garbage dumping around them. With the river and nallah spaces turning into spaces for social recreation and livelihoods, they have enhanced the social benefits for communities.

Environmental cost-benefit

The emerging changes have been in the environment, health, economy, and quality of life. The ecosystem services provided by the water bodies have deteriorated over the last century. This has been altered by the project. Now the water bodies have become close to the hearts of the people. The fishes which were once visible had vanished due to polluted water. Now the fish have started breeding in the clear water. It proved to be an ecological replenishment of the water bodies. The groundwater table of the city has been in the news for its depleting levels. This project of such a large scale is bound to replenish the underground water aquifers

and also improve the quality of water present in them. Since all outfalls are diverted to a scientific treatment system, the black or grey water does not percolate into the ground and pollute the underground water table anymore.

Replicability

The Indore model can be replicated in other cities and cab be scaled up or down in terms of length and capacity of the system, as per the local conditions. The Indore model makes use of the natural topography of the city and requires zero pumping. This makes this mode easily replicable and cost-effective. Also, the robust revenue model of the project makes it easier to adopt operate, and maintain efficiently.

Scalability analysis

The period of four years from 2016 to 2021 is taken as the project implementation period. The time before 2016 is considered pre-intervention time and the time after 2020 is considered to be post-intervention time. We shall identify the scope of using treated water in the future as per the need and demand/ or in terms of water quality. The treated wastewater from the STPs is not potable water, as of date. This project can be up scaled to include additional water treatment to achieve drinking water portability. Total revenue earned by selling 15% of Treated waste water. If up scaled to sell 50% of treated wastewater, it will generate huge revenue per year. To upscale this project and to provide recycled water of potable quality, it is imperative to phase out the project. We have assumed a short-term horizon period of five years.

The long-term objectives that the up-scaled project aims to achieve include the expansion of the existing reuse water network to include a potable water supply for drinking purposes, establishing a Recycled Water Treatment Plant for further treatment of treated wastewater, reducing the cost of procuring Narmada water for treatment and use as potable water, expanding the reach of treated wastewater by including more villages and neighbouring ULBS, and Community participation can be increased.

VI. CONCLUSION

Multiple factors led to the success of Indore and enabled it to achieve water-plus status. The pre-intervention situation was that of challenges on the technical, managerial, and social front. Technical challenges were related to the lack of technical infrastructure for liquid waste management which included a lack of linkage with drainage system, lack of proper water treatment facilities, and pollution of water bodies. On the managerial front, there was a lack of proper planning, implementation, and monitoring systems in place. On the social front, there was a lack of awareness of liquid waste management including linking with drainage systems and disposal of wastewater. Interventions in technical, managerial, and social front led to improved technical infrastructure, implementing – managing, and monitoring systems, and community awareness and participation.

The following are the success factors in liquid waste management.

- Alignment with protocols such as Water Plus, ODF, ODF+, and ODF++, under SBM-U led to the success
- Behaviour change a key to achieving long-term change
- Cooperation of stakeholders with varied expertise
- Delivering on multiple fronts

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