

Municipal Wastewater Management Public Health Security A Neighborhood of Shivpuri MP

Ar. Manisha Jain¹, Ar. Harshita Mishra², Dr. Anjali Patil³

¹Architect, Graduated from IIT Roorkee, Roorkee, Uttarakhand, India

²Architect and Environmental planner, Post-graduated from SPA Bhopal, MP, India

³Architect and urban Planner, Post-graduate from COEP Technological University, Pune, Maharashtra, India

Abstract

Indian cities are suffering from inefficient policy execution owing to the country's rapid urbanization, which in turn causes haphazard expansion and poor management. The inefficient management of wastewater is one issue that results from ineffective mechanisms. Shedding light on the health impacts of mismanaged wastewater, this paper is carried out with the aim of identifying the degrees of vulnerability pertaining to municipal wastewater disposal and management of public health and the environment. The paper involves understanding wastewater management in the city, resulting in the identification of related Urban Challenges, followed by the analysis of public perception and health-related issues faced by them through a questionnaire-based structured survey of a highly impacted residential zone. A sample of 528 HH was collected and conclusions were drawn. After identifying the major causes of improper wastewater disposal and its impacts on human health and the environment, the governance structure for wastewater management and government initiatives are discussed and the gaps are identified. The paper concludes with feasible recommendations and proposals.

Keywords: Municipal Wastewater Management (MWM), Public health, Environment, Governance, Decentralized wastewater systems, Private Public Partnerships (PPP)

1. Introduction

Living with inadequate infrastructure is a typical urban feature that is becoming more prevalent. Limited access to fundamental services like clean water, sewage, and sanitation puts human security at risk from harmful exposures that have a negative impact on the environment and health. People with poor socioeconomic conditions are more susceptible to these risks because of poor governance and residential setting. Although there is increasing awareness of the detrimental effects that wastewater has on the local environment and human health, urban managers have not given adequate priority to health security challenges and social vulnerability associated with long-term damaging processes.

1.1 Urban Wastewater – A Global Scenario

Inadequate wastewater removal is linked to a number of water-borne and water-related diseases, including a class of illnesses where water or wastewater serves as a habitat for disease vectors or hosts [1]. Every year, there are around 1.7 billion instances of pediatric diarrheal illness worldwide. It is a health burden that is largely preventable [2]. Dysentery, trachoma, schistosomiasis, conjunctivitis,

hookworm disease, malaria, and Japanese encephalitis are additional water-related and water-washed diseases linked to inadequate water, cleanliness, and hygiene. These increase the burden of disease on disadvantaged populations [3]. The management of India's tremendous wastewater burden is a huge challenge. With a rise in population and urbanization, it is rising steadily. According to estimates, the country produces roughly 72368 MLD of wastewater, of which only 20236 MLD is processed, despite the installed treatment capacity of 31842 MLD which itself is insufficient. [4]

1.1.1 United Nations Sustainable Goals on Wastewater Management

- Goal No. 3: Good health and well-being (Reducing pollution-related disease)
- Goal No. 6: Sanitation and clean water (Decreased water pollution)
- Goal No. 7: Obtaining inexpensive, clean energy (Waste to energy)
- Goal No. 11: Sustainable cities and communities (Decrease the negative environmental impact of cities per capita)
- Goal No. 13: Climate action (GHG emissions reduction)

1.2 Wastewater Management in India

In India, only 28 percent of the total wastewater generated is treated, the remainder is disposed of at nearby waterbodies without any proper treatment. The installed capacity for treatment is 44% but that too is not fully functional. Only 64% of wastewater treatment installed capacity is being used which is approximately 20236 MLD. [4].

1.2.1 Policies Regarding Wastewater in India

There is no specific Act in India that addresses wastewater management specifically in terms of devoted legislation. However, the Water (Prevention and Control of Pollution) Act of 1974 contains laws that address wastewater as a source of pollution. This Act established the Central and State Pollution Control Boards, which are in charge of preventing and managing water pollution.

Table - 1: Policies regarding Wastewater Management in India [5]

YEAR	ACTS, POLICIES, SCHEMES, PLANS
1977	The Water (Prevention and Control of Pollution) Cess Act
1986	The Environment (Protection) Act
2006	The National Environment Policy
2008	National Urban Sanitation Policy
2013	The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act
2013	The National Guidelines on Zero Liquid Discharge
2013	The Coastal Regulation Zone Notification
2014	Swachh Bharat Mission
2015	Atal Mission for Rejuvenation and Urban Transformation (AMRUT)
2016	The National Water Mission (Ministry of Power's Tariff Policy)
2016	Ministry of Housing and Urban Affairs (MoHUA)
2016	The National Water Quality Monitoring Program of India
2016	Swachh Sarvekshan

2. MUNICIPAL WASTEWATER MANAGEMENT IN SHIVPURI, MP

Shivpuri City, located in Madhya Pradesh State, is run by the Municipal Council.

Morena, Gwalior, and Datia border Shivpuri on the north; Jhansi, Uttar Pradesh, on the east; Kota, Rajasthan, on the west; and Guna, on the south. Shivpuri, the district's administrative hub, is located 113 kilometers from Gwalior and 98 kilometers from Guna on NH-3 (the Agra-Bombay National Highway).

- A 23 km sewage line was installed in the city's sewer system in 1940. The system is currently broken since it is congested. As a result, Jadhav Sagar Lake receives all of the city's wastewater [6].
- Before the implementation of the ODF mission, only 50% of the toilets in homes were equipped with septic tanks or soak pits. SMC estimates that 50% of the HH did not have access to restrooms [6].
- Furthermore, the city has 26 Sulabh facilities with 202 seats for safe defecation. However, they are not properly maintained, resulting in their abandonment [6].
- By the National Lake Conservation Plan (NLCP), the SMC created a Detail Project Report (DPR) with M/s Dalal Mott McDonald for the city's improved sanitary practices in 2006. M/s Multi Mantech International Pvt. Ltd., Ahmedabad was placed with Shivpuri Municipal Council for technical facilitation as per Terms of Reference (TOR) (w.e.f.18/12/07). The implementation started in 2011 [7].
- The project included installing a sewage network, building a sewage pumping station, a sewage treatment plant (with a 20 MLD capacity), de-weeding and de-silting storm water drains, treating catchment areas, installing low-cost toilet blocks, chain-link fencing, developing bathing ghats, and installing floating fountains. It also included public participation and awareness-raising activities [7].
- The Government of India (GOI) approved the planned sewer lines and sewage treatment plant (STP) in 2009. These initiatives follow the DPR that was created by the NLCP. The initial budget of the project was 51.99 crores. Till now an amount of 111.55 crores have been spent on the project with a further demand of 9 crores for the implementation of the project [8].
- Wastewater generation was estimated to be 21.36 MLD and 29.34 MLD for short (The year 2015) and long (The year 2035) periods of time respectively, based on population projections, water demand, and CPHEEO criteria [9].
- Current population of Shivpuri in 2023 as per the census projection is 2.46 Lakhs generating 26.78 MLD wastewater daily.

2.1 Natural Drainage of City

The natural drainage system of the city goes from west to east. Two significant natural Nallas that cross the city carry rainwater runoff and sewage. Before discharging their contents into Jadhav Sagar Lake, these natural Nallas converge. These Nallas come from the bus station and the Maniyar Talaab region.

2.2 Topography of City

Shivpuri is 464 meters above the Mean Sea Level (MSL) in altitude. With a very slight inclination of less than 1°, the slope generally runs from west to east. The terrain is depicted in Fig. 1 below. The map also shows the path of the proposed sewer line.

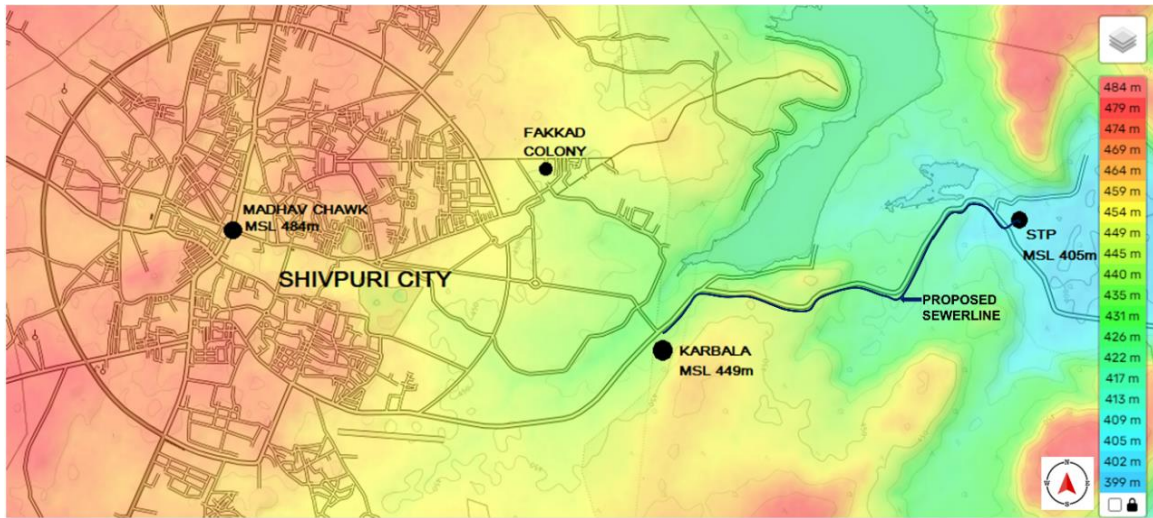


Fig. 1: Topography of the City [10]

2.3 The Lithology of the City



Fig. 2 shows the Lithological map showing the path of the proposed sewer line. [11]

2.4 Population

Future Population 2021-2031	
	City
2011	179,977
2021	233,000
2022	239,000
2023	246,000
2024	253,000
2025	260,000
2026	267,000
2027	275,000
2028	283,000
2029	291,000
2030	299,000
2031	307,000

Fig. 3: Population projection [12]

3. ISSUES AND GAPS

The main issue covered in the paper is the health risks to the people living in neighborhoods that are not connected to the proposed wastewater treatment plan and what future provisions could solve the problem of safe disposal of municipal wastewater generated in such neighborhoods to provide health security. The paper also discusses delays in the proposed wastewater disposal system and improper governance in terms of dysfunctional wastewater disposal project even after 12 years.

3.1 Gaps observed

3.1.1 Delay in Implementation

The main reasons found after qualitative research are:

- The path of the main wastewater disposal line from the city passes through ferogenic and laterite soil which is difficult to excavate. This points to an unsuitable selection of site for wastewater treatment plant. The soil type in the region has been shown in the lithology map.
- The main focus while selecting the site for laying the network was the topographic slope and lower stream. The planning lacked attention to land lithology.

3.1.2 Insufficient Wastewater Treatment Capacity

The designed wastewater plant capacity is 20MLD. District Environment Plan 2021 of Shivpuri itself states, "Wastewater generation has been estimated to be 21.36 MLD and 29.34 MLD for short (The year 2015) and long (The year 2035) periods of time, based on population projections, water demand, and CPHEEO criteria respectively." Fig. 3 shows the growth in population. As per the population of 2023, total wastewater generation in today's context comes to 26.57 MLD whereas the proposed treatment plant has a capacity of 20 MLD only.

3.1.3 Governance

According to the Swachh Bharat Mission website, 24.2% percent of 1,417 villages in Shivpuri district have been declared ODF. Overall in MP, 17,549 villages have been declared ODF so far. Shivpuri City has also been declared ODF.

On analysis, the following gaps were observed in the actual implementation of ODF.

- There is no regular water supply. People even go out to fetch the drinking water.
- A beneficiary gets Rs. 12,000 from the administration to construct a toilet.
- Rs. 12,000 is not enough to construct a toilet, septic tank, and soak pit as the sewer line has not been laid.
- The key issue is not toilets but the lack of a proper sewage system.
- There is a lack of governance as physical verification is not done after the construction of the toilet.

4. Exclusion of non-notified slums

Shivpuri has a number of non-notified slum areas inhabiting a large population. This population is not a part of the planning process and poses great responsibility to the Municipal council as these locations have no basic infrastructure like roads, tap connections in houses, drains, and wastewater disposal facilities. Regularization of these slums is a must for the safe living conditions of the residents so that residents can benefit from the government interventions.

SITE SELECTION

Shivpuri City is divided into 39 wards. Older wards are densely populated and form the core of the city whereas outer areas or fringe areas have comparatively dispersed populations. As per the 2011 census, Shivpuri Municipal area had 33,803 households which at a 2% growth rate comes to 42,870 households in 2023. The mean household size is 5.2.

The paper is focused on Ward No. 38 having both formal and informal settlements. It has a very diverse demography consisting of the Priyadarshni Colony, Housing Board Colony, Chhatri road colony, Bha-daiya Kund, and Fakkad Colony.

Fakkad colony, the study area has a population of 2893 residents comprising 526 HH. Total wastewater generation is 0.31MLD. Total households having toilet facilities are 248 out of 526 having septic tanks for night soil disposal. In the absence of drains, grey water runs and gets accumulated on the streets, resulting in water logging. This water logging serves as the breeding ground for disease-causing insects and mosquitos which pose a threat to public health and the environment.

Samples have been collected from 216 households from the study area and 312 households in Ward no 38 excluding the study area, for a comparative study of issues and problems. For the sample size, a confidence level of 95 was taken along with a 5% margin of error.

HOUSEHOLD SURVEY ANALYSIS

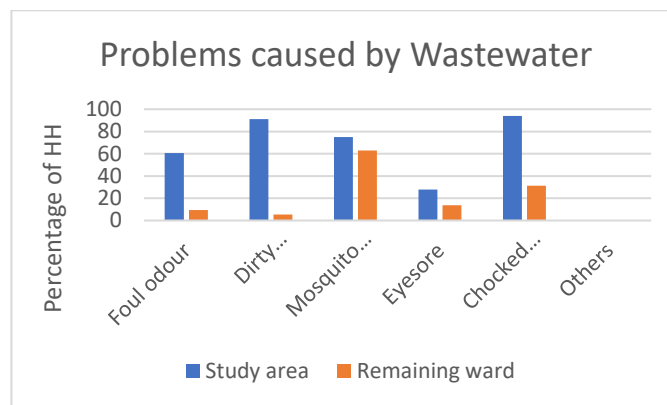


Figure 4: Comparison of problems due to improper wastewater management in the study area and remaining ward.

Figure 4 shows a considerable increase in problems like foul odor, dirty water logging, mosquito, and other insects breeding, an eyesore, and choked drains in the study area in comparison to the remaining ward area which has provision of drains, roads, water supply and other infrastructure.

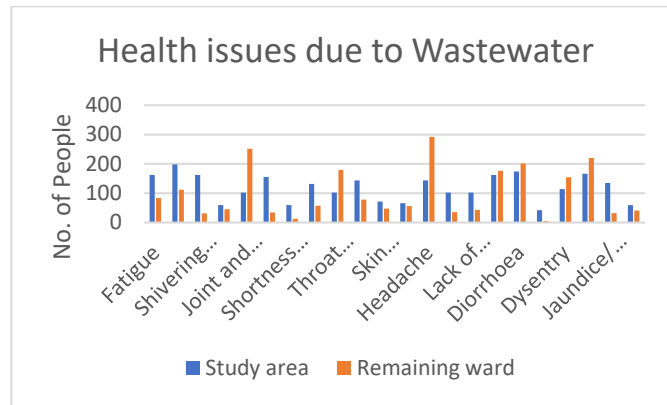


Figure 5 shows a higher percentage of health issues like fatigue, shivering due to fever, perspiration, cough, shortness of breath, nose irritation, eye irritation, skin problems, dizziness, lack of appetite, cholera, dysentery, jaundice, hepatitis, typhoid. The remaining ward area too has some problems like joint and muscle pain, throat irritation etc.

From these figures, it is clearly observed that problems due to improper wastewater management are posing a serious threat to the health of residents. Suitable provisions are needed in the locality for the safe disposal of wastewater.

4. PROPOSALS TO IMPROVE PUBLIC HEALTH IN THE NEIGHBORHOOD AREA THROUGH SUITABLE WASTEWATER MANAGEMENT

4.1 Regularization of Neighborhood

The neighborhood needs to be regularized to achieve a legal status so as to get the benefits of Government policies for the basic amenities like road infrastructure, water supply, drains, and safe wastewater disposal.

To regularize the property, a Property ID can be issued to each property. This will help the Government to collect data for this neighborhood and then make a proper scheme for the safe water disposal of wastewater from household units.

4.2 Decentralized Wastewater Treatment System

This neighborhood is not part of the presently proposed wastewater disposal system and needs a suitable disposal system to prevent residents from exposure to wastewater lying in public spaces for public health security. A decentralized system can be a suitable solution to the problem of wastewater management.

4.3 Public-Private Partnership

A DWAT can be installed by inviting investors and stakeholders by selecting a suitable model. Various models are Build-Own-Operate (BOO), Build-Operate-Transfer (BOT), Design-Build-Operate-Transfer (DBFOT), Build-Operate-Lease-Transfer (BOLT), Operate-Maintain-Transfer (OMT) and Lease-Develop-Operate (LDO).

4.4 Revenue generation

To operate and maintain the Wastewater Treatment Plant, and wastewater disposal tax can be collected from the residents. Effluent from the plant can be sold out for agricultural use as fertilizer. The neighborhood has a scarcity of water and treated wastewater can be reused for flushing toilets, watering plants, washing vehicles, and likewise.

CONCLUSION

Wastewater management is a problem that is getting worse every day, especially in expanding cities forming small neighborhoods which are not part of existing wastewater disposal infrastructure which can be because of insufficient treatment capacity of plant or non-inclusion of the area in the planning procedure. This causes major public health issues and environmental threats. By providing suitable wastewater disposal arrangements like DEWATS for such neighborhoods, health issues and environmental problems can be managed efficiently. DEWATS also takes less time to install and implement. Their O&M cost is also less. There are numerous potentially beneficial rules and mechanisms in place, but they are not currently producing results because they are not being implemented and monitored properly. Through good governance, this issue can also be resolved. By guaranteeing that the duties and procedures created and advised at various levels of the wastewater management industry are carried out, the city and the nation as a whole would advance significantly.

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