Data-Driven Insights into Indore's Storm Water Drainage and Sewage System Performance

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*Abstract*— This study proposes modernizing Indore's storm water drainage and sewage system through the integration of technical solutions and Data Visualization techniques. A comprehensive literature review and data analysis were conducted to evaluate the feasibility and impact of these solutions. The findings of this study will provide insights into the most effective approaches for improving the system's operations and infrastructure. The proposed solutions will be assessed based on their practicality, cost-benefit, and environmental impact. The results of this study will contribute to the development of a more efficient and sustainable Storm water drainage and Sewage System in Indore, benefiting both residents and the environment.

Keywords— Data Visualization, Storm Water drainage, Sustainable, Sewage System, feasibility

# Introduction

Water management is a critical issue in India, and the recent declaration of Indore as the first Water Plus city in India has raised concerns about the country's wastewater management policies.

A closer inspection reveals that the city's sewage and storm water drainage system faces significant challenges, including insufficient infrastructure, water body pollution, and encroachments. Therefore, it is imperative to analyze the system's performance, identify the root causes of these issues, and propose data-driven solutions for improving the system's efficiency.

The city has a total water supply of around 383 million litres per day, out of which 75% is turned into wastewater generated from households and business establishments. However, only a small fraction of this wastewater is treated, and the rest is released untreated into the environment. As a result, untreated wastewater is being released into rivers, leading to pollution and environmental damage. The prescribed standards for wastewater release into a river include a Biochemical Oxygen Demand (BOD) of 10mg/l and MPN counts of less than 2500/100ml for coliform bacteria.

One of the major issues with Indore's wastewater management system is that much of the wastewater flows into natural nullahs running across the city, while the rest flows through underground sewers to the Kabitkhedi sewage treatment plant. This system is functional till the 1950s when the waste water (domestic and toilet) used to go to sewers, while rainwater went to the nullahs. However, the stormwater drains that were constructed eight years back to collect rainwater are not sufficient to cover the 275 square kilometers within Indore's municipal limits. As a result, rainwater now directly seeps through the surface or into underground sewers.

When there are heavy rains, the city opens manholes to allow excess rainwater to pass through. Unfortunately, this has a catastrophic effect on the already stressed sewerage system, as the rainwater carries mud and debris, which accumulates in the underground sewers. This leads to choking of sewers and drainage chambers, and the sanitary workers have to work extra hard to de-silt the chambers. In most areas, the stormwater and wastewater drains are the same, and any damage to the drainage pipes leaks water into the soil, thereby polluting underground water. This polluted water reaches water bodies, which is dangerous for public health.

A qualitative risk assessment approach was used to identify the agents of concern, microenvironments of concern, possible sources/pathways, and routes of exposure. The main agents of concern are chemical and biological agents found in sewage waste, including nitrates, phosphates, heavy metals, and harmful pathogens. The microenvironments of concern are areas where people are in contact with the river, such as outdoor bathing, recreational areas, and homes and streets during sewage overflow. The possible sources/pathways of exposure include ingestion, dermal contact, inhalation, and contact with contaminated food. The routes of exposure include ingestion, dermal contact, and intravenous exposure.

The exposure assessment identified susceptible populations, including children, the elderly, and immunocompromised individuals. Children are particularly vulnerable to harmful pathogens and may experience long-term adverse health effects such as cancer or developmental disabilities. A pilot study was proposed to determine the risk of adverse health effects attributable to sewage pollution in Indore's water supply. The study would involve comparing the disease outcomes of slum dwellers in Indore who are in daily contact with the water supply to those in other cities with less severe sewage problems.

To conclude, the sewage pollution in Indore's water supply poses a significant risk of exposure to harmful agents for people who use the public water supply or live in slum areas near the river. Further research is needed to better understand the extent of the health risks and to develop effective interventions to mitigate them.

Old localities in Indore, such as Ahilyapura, Juna Risala, Jinsi, Kandilpura, and Bada Ganpati, have open (surface) drains that either merge with underground sewers or fall into the Piliyakhal nullah, which receives almost 60% of the sewage from these areas. On the other hand, there are many areas that have backlines (sewers laid between two buildings or at the rear) that receive wastewater from individual buildings through sanitary pipes. However, about 48% of such backlines have been encroached on by residents, and people throw kitchen waste and garbage minutes after sanitation workers clean backlines, making it difficult to clean them when they get choked

In the case of Indore, which generates 400 million litres per day of sewage wastewater, the daily expenditure of treating this water at the STPs is approximately Rs 80 lakhs, leading to an annual expenditure of Rs 292 crores. This cost is prohibitively high, accounting for 23% of the city's annual revenue expenditure, which is already stretched thin in providing other municipal services.

One reason for the high costs of wastewater treatment is the mixing of grey and black water in centralized sewage systems. Grey water, which comes from bathrooms and kitchens, is less polluted than black water, which comes from toilets. Treating both types of water together in STPs increases the costs beyond control.

Black water from toilets can be treated in decentralized biogas plants to produce energy and manure instead of polluting the environment. This would allow most households and offices to manage their own wastewater treatment, reducing the need for centralized sewage systems and STPs. Municipal bodies would only have to take care of public toilets and wastewater from slums.

The municipal corporation's current provisions show that the allocation made for water supply, sewerage, and sanitation and solid waste management is less than 35% of the total budget outlay. This lack of adequate funding and a general sense of apathy are major challenges that need to be addressed for the wastewater management system to be improved.

In conclusion, this research paper aimed to provide data-driven insights into the current state of Indore's storm water drainage and sewage system performance using data science algorithms. The paper developed a dynamic dashboard for 24/7 digital monitoring and analysis, and employing machine learning approaches for further detection, analysis, and prediction of sewage data. The study suggests exploring more supportive measures for related water management challenges, which can be addressed by leveraging technology and data science. The research highlights the need for advanced analytical tools and monitoring systems to enable efficient and effective management of sewage and water systems in Indore, and similar urban centers.

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