SEPTAGE MANAGEMENT IN JHANSI TOWN

Towards Inclusive Urban Sanitation in Uttar Pradesh

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Maps used in this document are not to scale.

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- AMRUT—Atal Mission for Rejuvenation and Urban Transformation
- CPCB—Central Pollution Control Board
- DPR—Detailed project report
- DUDA—District Urban Development Authority
- FSTP—Faecal Sludge Treatment Plant
- FS—Faecal Sludge
- FSSM—Faecal Sludge and Septage Management
- FY—Financial Year
- I&D—Interception and Diversion
- IEC—Information, Education & Communication
- KLD—Kilo Litre Per Day
- MLD—Million Litre per Day
- O&M—Operation and Maintenance
- RWH—Rain Water Harvesting
- SBM—Swachh Bharat Mission
- STP—Sewage Treatment Plant
- SBR—Sequencing Batch Reactor
- ULB—Urban Local Body

Executive Summary

Located in Uttar Pradesh, the historic city of Jhansi has been a front-runner in addressing the treatment of septage and sewage, as well as rejuvenating its water bodies. Owing to its geography, Jhansi faces the dual challenge of water scarcity and dominance of rocky strata which makes the laying of underground sewerage networks is difficult. The report covers the various initiatives that Jhansi has taken over the years in the water and sanitation sector.

The study talks about the planning, implementation, sustainability and inclusivity aspects of the sanitation and lake rejuvenation work being done in Jhansi town over the last few years. It also addresses the upcoming challenges, and provides recommendations for improvement.

Jhansi town is representative of at least 80 towns in Uttar Pradesh that have a population of more than 100,000.

Findings

Septage Treatment

Jhansi took the unconventional path of non-sewered sanitation and started the journey towards Faecal Sludge and Septage Management (FSSM) in 2017. The salient features of Jhansi's initiative for septage management are as follows:

- In 2018, Jhansi became the first city in Uttar Pradesh to establish a Faecal Sludge Treatment Plant (FSTP) of six kilo litres per day (KLD).
- Jhansi was the first city to draft the FSSM bye-laws in 2017, which were later passed in 2023.
- Jhansi opted for a non-mechanized septage treatment system, for ease of operations, and low operation and maintenance.
- The city adopted a unique, incremental approach towards septage management. The city started with Faecal Sludge Treatment Plant (FSTP) that had a treatment capacity of six kilo litres per day (KLD) and further expanded the treatment capacity to 18 KLD. An additional 32 KLD plant is being operationalized.

- Jhansi signed MoUs with four nearby ULBs (20–30 kilometers from Jhansi) for the treatment of their septage without any tipping fees/additional charges.

- The operation and maintenance (O&M) cost of the 18 KLD FSTPs is borne by Jhansi Nagar Nigam from its own sources of revenue.

- Around 30–40 per cent of the septage desludging services are provided pro-bono by the private operator to government institutions for emptying their septage. Due to this, meeting desludging expenses is a challenge for the private desludger. The cost is compensated from the funds provided by the Jhansi Nagar Nigam for the operation and maintenance (O&M) of the FSTP.

- The desludging charge for emptying a septic tank is Rs 3,000 per trip which is unaffordable for the urban poor.

- Jhansi is unable to provide desludging services in its old city area and in urban poor settlements where the width of roads is between 2–3 meters, making them inaccessible.

Interception and diversion-based wastewater treatment

Under Swachh Bharat Mission 2.0, towns are supported in the construction of interception and diversion of used water that flows into the main nallas of the town, and its treatment at one sewage treatment plant. The nallas contain the supernatant effluent from septic tanks, as well as storm water, grey water as well as other septage and sewage.

A 26 MLD STP at Phuj River that is under construction is expected to run at the full design/treatment capacity at the base year itself. However, it does not have scope for expanding its treatment capacity. With a rise in population, the sewage flow in drains is expected to increase over time. This will result in wastewater flowing into the Pahuj river and eventually, polluting the Ganga. The planning of wastewater treatment infrastructure needs to factor in the population growth as well as the requirements of the future.

Water flowing through the nallas of Jhansi enter the Pahuj river and then the Ganga. The following works have been done to prevent the discharge of wastewater into the river:

- Existing interception and diversion-based sewage treatment plant (STP) with a treatment capacity of 26 million litres per day (MLD) near Laxmi Taal

  - Intercepted and diverted the sewage flowing in four drains to the 26 MLD STP. The plant started running at 80 per cent of its design treatment capacity within the second year itself.
  - The infrastructure of the sewage treatment plant is based on advanced Sequencing Batch Reactor (SBR) technology which is highly energy intensive and leads to high operation and maintenace (O&M) cost.

  - The annual O&M cost of the STP is very high—around Rs 5 crores (including 12.5 per cent Jal Nigam centage and 18 per cent GST), and an additional Rs 2 crores for electricity requirements.

- Under construction interception and diversion-based 26 MLD STP near Pahuj river:
  - Jhansi is tapping another four drains with interception-based sewers, and establishing one more sewage treatment plant (STP) with a capacity of 26 million litres per day (MLD).

  - Until the new 26 MLD STP becomes functional, Jhansi has undertaken in-situ wastewater treatments in drains through bioremediation & phytoremediation.

- The covering of drains is in progress to prevent dumping of solid waste.

- The Jhansi Master Plan, 2031 (draft) does not consider current or future wastewater generation, and the treatment facilities required for the same. No strategies or solutions have been proposed in the Master Plan for septage and wastewater management

Reuse of treated biosolids and wastewater

- Treated water from FSTP is being reused for horticulture. The biosolids are being sold to an NGO at 32 paisa per kilogram for gardening purposes.

- Four million litres per day (MLD) of tertiary treated water from the 26 MLD STP is diverted to Laxmi Taal through a gravity pipeline for its rejuvenation. The remaining treated water is diverted through a gravity channel to Narayan Bagh for gardening purpose.

Ground water recharge and rejuvenation of lakes and water bodies

Due to unplanned and unregulated urbanization, parts of the existing lakes and water bodies, and other unoccupied public spaces, are facing rampant encroachment by private developers or migrant residents.

The dumping of solid waste and discharge of sewage into water bodies has not only resulted in the death of these waterbodies but has also led to the formation of land parcels that have become easy targets for land encroachers.

The following remedial actions have been taken by the town administration to address this issue:

- Rejuvenation of water bodies
  - The rejuvenation of four major water bodies has been undertaken by diverting the incoming sewage to sewage treatment plants (STPs), and developing the surrounding areas for recreational purposes.
  - The treated water from STPs is being channeled into waterbodies for their rejuvenation.
  - Water body rejuvenation projects have been primarily conceived as part of the waterfront development project, instead of a holistic water body rejuvenation and restoration project.
- Groundwater recharge
  - Jhansi Nagar Nigam (JNN) has focused on government buildings to install rain water harvesting (RWH) system of total 1,660 cubic meter volume in 100 buildings.
  - The rain water harvesting (RWH) systems were planned without conducting a geotechnical survey. It only collects the rooftop water and neglects rainwater from other paved and unpaved areas of the premises.
  - The groundwater table in Jhansi varies between 30–60 meters. The depth of borewells in the rain water harvesting system is taken as 40–50 meters when it should be 10–15 meters above the groundwater table.

- The Jhansi Master Plan, 2031 (draft) does not provide details regarding the city-level recharge potential of rain water which is done by analysing the storage capacity of aquifers.

Recommendations

Overall, Jhansi has taken various steps to mitigate the challenges that exist in wastewater and septage management, groundwater recharge and water body rejuvenation.

However, there are challenges around sustainability, affordability and outreach that must be addressed by the town administration in order to ensure that the investments made in different treatment systems benefit the most excluded among the population and reach the inaccessible parts of the city.

Operation and maintenance (O&M) of upcoming sanitation treatment systems

- The cost of operating non-mechanized faecal sludge treatment plants (FSTPs) is not high. The cost of operating and maintaining the two STPs would depend on the pumping and electricity costs of the interception and diversion-based collection and conveyance of used water, and the electricity cost of plant operation. After some period, the operation and maintenance (O&M) expenses of both STPs are to be drawn from Jhansi municipality's own source revenue that currently constitutes only 25 per cent of Jhansi's annual budget. Meeting the O&M costs, therefore, will pose a challenge.

- The same situation will prevail in other towns in Uttar Pradesh that are gearing-up for interception and diversion-based STPs under SBM 2.0. Therefore, small and medium towns should focus on treatment solutions that accrue a low O&M cost, with a combination of both FSTPs and STPs.

Faecal sludge and septage management

- **Septage collection from the inner parts of the old city cannot be done. The inner parts of the old city need a shallow sewer system to replace septage collection.** One of the major challenge of the septage management in Jhansi (and many other India towns) is providing desludging services in old and congested parts of the town. The supernatant flowing from the septic tanks have an outfall in small drains, outside residential houses along narrow lanes. Widening the lanes within the old city is also not possible. Feasibility studies need to be conducted to test the viability of a shallow sewer system and then replicated.

- **Compulsory scheduled desludging of septic tanks by all public toilets and all institutions** (**private and public**). As the new 32 KLD FSTP is being operationalized, Jhansi Nagar Nigam (JNN) is required to ensure that more households, institutions and commercial properties regularly desludge their septic tanks. To ensure that the required septage reaches the new 32 KLD FSTP, the town administration needs to make sure that all public toilets and institutional septic tanks are emptied every six months or at least once a year. Also, the desludging of all household septic tanks should be done on a regular basis, at least once in three years.

- **Department of Urban Development** (**DoUD**) **should evaluate the effectiveness of the combining desludging services and the operations and maintenance of faecal sludge treatment plants** (**FSTP**)**.** In the absence of private desludging operators and to provide desludging services, Jhansi Nagar Nigam awarded the desludging work to a single private operator who is also operating and managing the FSTP. The viability of having a single contractor for all septic tank desludging services who also manages the FSTP needs to be evaluated by the State Septage Management Cell in Department of Urban Development, Lucknow. It also needs to assess if this model works for other towns like Jhansi or if it reduces fair competition, thus increasing the fee for desludging services.

- **Affordability and viability of desludging fee**. The current flat desludging fee of Rs 3,000 fixed by the Jhansi Nagar Nigam (JNN) is not affordable for poor and disadvantaged people. Therefore, a **differential pricing model for desludging fees** should be ensured so that all strata of the urban population can access the sanitation service. Further, pro-bono services that are being provided need to be minimized as much as possible.

Interception and diversion-based wastewater treatment

- **Characterization and regular monitoring of used water.** This needs to be done regularly for biochemical oxygen demand (BOD), chemical oxygen demand (COD) and any chemical contamination. To ensure that the interception and diversion-based treatment systems work.

- **Assessment of operation and maintenance** (**O&M**) **and the costs involved.** The costs of pumping and electricity required for the interception and diversion system needs to be assessed. Also the risk of solid waste dumping in nallas that may choke the STP needs to be evaluated.

- **Co-treatment of septage with the 26 MLD STP should be prioritized**. For future planning, the town administration should focus on strengthening FSSM services and grey water management rather than opting for sewerage system for the whole city, which will be too expensive and time consuming, given the rocky strata and undulating terrain of Jhansi.

Strengthening urban planning for water and wastewater management

In the absence of urban planning principles (laid out in the City Master Planning process), our cities are unable to deal with urban development led by real estate builders. Large informal settlements and slums are denied the entitlement of basic housing and access to public places. Basic infrastructures such as water supply, sewerage systems and storm water drainage are difficult to provide in congested settlements.

Water is emerging as a major issue in urban India. The large built-up environment of our cities is limiting groundwater recharge and large run-off of rainfall.

- **Addressing water sufficiency and efficiency**. Bundelkhand and Jhansi suffer from a chronic shortage of water. The cost of pumping and electricity to secure water from distant sources is very high. Given the dependence on groundwater, this resource should be carefully managed. Water conservation in Jhansi needs to be guided by an understanding of hydrogeology and shallow aquifers of the city. This is crucial in addressing groundwater recharge in a safe and usable manner. By analysing rainfall pattern, and undertaking geotechnical/ hydrological surveys, the Jhansi Master Plan needs to identify the city-level recharge potential and propose an implementation strategy.

- **Treated wastewater for recharging groundwater and rejuvenation** of lakes needs to be factored in at the planning stage of wastewater management. A monitoring mechanism also needs to be established to ensure a planned recharge and reuse of harvested ground water.

- **The Jhansi Master Plan 2031** (**draft**) needs to factor in the demand and supply of water for fulfilling the current requirements and ensuring source sustainability to meet future needs. It should also meet the prescribed quality standards laid out by the Central Pollution Control Board (CPCB). The Master Plan should also identify current gaps, future requirements and strategies for managing the wastewater and septage generated from urban areas. The plan needs to factor in treated wastewater while planning water requirements, and

set targets for the reuse of treated wastewater. A long-term water, wastewater and storm water management plan is required for Jhansi. The Jhansi Master Plan needs to identify concrete measures to improve urban water, wastewater and storm water management.

- **A water sensitive Jhansi. Jhansi should aim to become a water sensitive city** that commits itself to a just and equitable access, use and reuse of water. Such an approach defines priorities beyond septage management, rain water harvesting and lakes rejuvenation. The aim of urban water management should be to address inequities in water accessibility that exists in urban settlements, and take it as the basis for planning interventions to improve the urban water supply, and for storm water and wastewater management. That there is no "leap frogging" to becoming a water sensitive city, without addressing infrastructure deficiencies, especially for the less privileged residents of our cities is something that should be understood by planners and administrators. It is imperative that we understand the differential ways in which environmental setbacks and climate change impact people from different socio-economic strata in a city, with the less priveleged being the most harshly affected. We need to streer urban planning towards mitigating the systemic issues of inequity instead of focusing only on design interventions, place making and beautification as the outcomes of a water sensitive city.

1. Background

Jhansi's terrain is dominated by rocky strata which makes the laying of an underground sewerage network a challenge. Nearly 80 per cent of the population is dependent on on-site sanitation systems, whereas the remaining 20 per cent directly discharge their excreta into the environment. Therefore, the city decided to take concrete measures to manage faecal sludge that was earlier being disposed all over the city.

Jhansi has taken various innovative approaches for safely managing wastewater and faecal sludge by establishing Fecal Sludge Treatment Plants (FSTP), undertaking waterbodies rejuvenation projects, interception and diversion of drains (I&D) for treatment of sewage in STP, reuse of treated products and also mechanized cleaning of drains, which is very unique and is the first such initiative in Uttar Pradesh.

Aim and purpose of the study

The aim of the research study is to document and analyze the challenges and achievements of Jhansi city in the water and sanitation sector. The study covers the planning, implementation, sustainability and inclusivity aspects of water and sanitation. In terms of population, Jhansi is representative of around 80 towns in Uttar Pradesh (UP) that have a population of more than 0.1 million. The study will benefit more than 80 towns in UP where FSSM infrastructure are coming up. UP towns are facing various challenges when it comes to managing sanitation infrastructure and providing desludging services as it is the first time that municipal authorities are being engaged in managing the liquid waste of the city. This document presents the various challenges faced by the Jhansi Nagar Nigam (JNN) and the approach adopted by them to overcome the shortfalls. The steps taken by JNN to overcome the challenges may benefit other urban local bodies (ULB) in managing the water and sanitation in their towns.

Scope of study

The study has conducted primary data collection, literature review, discussion with officials and contractors, and interaction with community members to understand the FSSM initiatives taken by Jhansi. The study covers the following aspects

- The study documents and critically analyzes achievements and shortfalls of Jhansi's santitation initiatives.

- how decisions were made and the timeline of implementation of various initiatives
- enabling factors, outcomes
- current status of desludging operations

- Analysed future plans for sanitation services in the expanding city limits, peri-urban areas and nearby villages.

- Findings, learning and recommendations
  - Recommendations for becoming more inclusive, sustainable and sensitive towards the necessities of women, the urban poor, marginalized, and providing a safe environment for all.

2. Jhansi city profile

Introduction

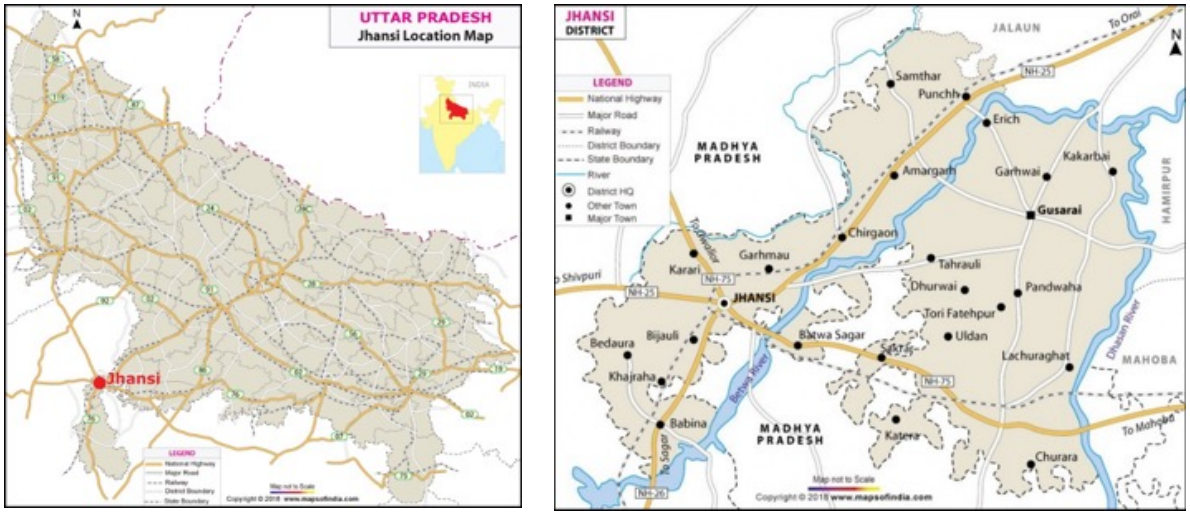
Jhansi lies in the southern region of Uttar Pradesh—also called Bundelkhand—and is situated between the banks of the Pahuj and Betwa river. Jhansi is the administrative headquarters of Jhansi district and Jhansi division.

Jhansi grew in popularity during the reign of the Marathas because of the heroics of its valiant queen, Rani Lakshmi Bai who fought the British during the Indian Mutiny of 1857. The Jhansi Fort was built in 1613 and currently houses a collection of sculptures that depict the history of Bundelkhand. The original walled city of Jhansi grew around its stone fort which crowns a neighbouring rock.

Jhansi is well connected to all other major towns in Uttar Pradesh by road and railway networks. The National Highways Development Project has supported the development of Jhansi. The Srinagar to Kanyakumari, North–South corridor passes through Jhansi as does the East–West corridor. Consequently, there has been a sudden rush of infrastructure and real estate development in the city.

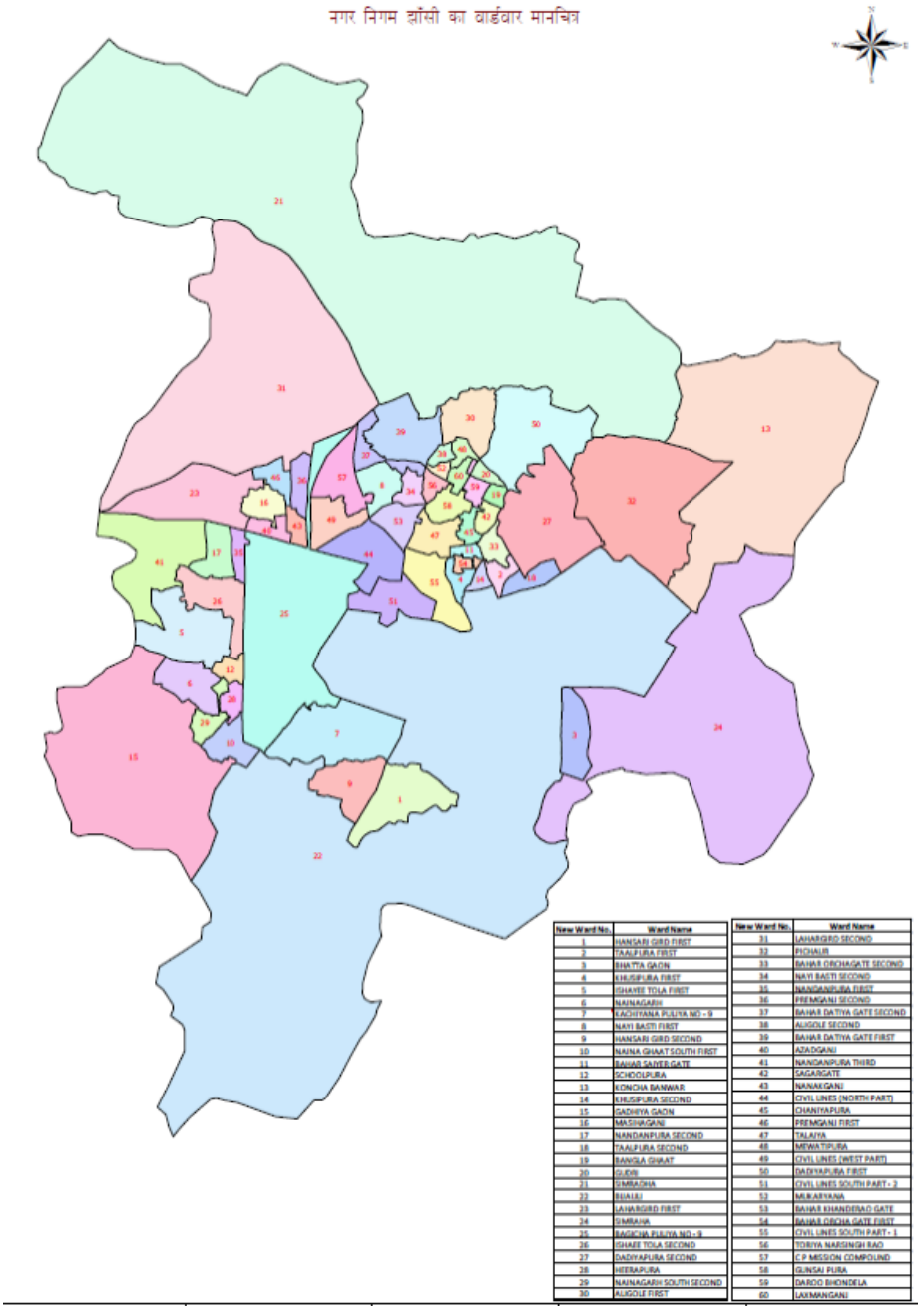
The city encompasses an area of 167 sq km approximately. The entire city is divided into five sanitary circles and subdivided into 60 wards. Jhansi, one of the Smart Cities, was adjudged the fifth cleanest city of Uttar Pradesh in the Swachh Survekshan 2022 rankings.

Map 1. Maps showing the location of Jhansi



As Jhansi is on a rocky plateau, the temperature runs in extremes. Temperatures reach as low as one degree celsius during the winter, and can go upto 48 degrees celsius during summer. Jhansi receives ample rains during the monsoon season which is useful for its irrigation needs. The average temperature during the rainy season is around 36 degrees celsius while the average rainfall is about 35 inches a year.

Map 2. Ward map of Jhansi Nagar Nigam



New Ward No.	Ward Name
1	HANSARI GIRD FIRST
2	TAKIPURA FIRST
3	BHATTA GAON
4	KHUSIPURA FIRST
5	GHANTE TOLA FIRST
6	NAINAGARH
7	KACHIYANA PULIYA NO - 9
8	NAYI BASTI FIRST
9	HANSARI GIRD SECOND
10	NAINA GHAT SOUTH FIRST
11	BAHAR SAIYER GATE
12	SCHOOLPURA
13	KONCHA BANWAR
14	KHUSIPURA SECOND
15	GADHIYA GAON
16	MASHAKGANJ
17	NANDANPURA SECOND
18	TAKIPURA SECOND
19	BANGLA GHAAT
20	GURDI
21	SIMRADHA
22	BIJAULI
23	LAHARGIRD FIRST
24	SIMRAHA
25	RAKCHA PULIYA NO - 8
26	GHANTE TOLA SECOND
27	DADIYAPURA SECOND
28	HEERAPURA
29	NAINAGARH SOUTH SECOND
30	ALIGOLE FIRST

New Ward No.	Ward Name
31	LAHARGIRD SECOND
32	PICHAUR
33	BAHAR ORCHAGATE SECOND
34	NAYI BASTI SECOND
35	NANDANPURA FIRST
36	PREMGANJ SECOND
37	BAHAR DATIYA GATE SECOND
38	ALIGOLE SECOND
39	BAHAR DATIYA GATE FIRST
40	AZADGANJ
41	NANDANPURA THIRD
42	SAGARGATE
43	NANAIGANJ
44	CIVIL LINES (NORTH PART)
45	CHANTIYAPURA
46	PREMGANJ FIRST
47	TALAIYA
48	MEWATPURA
49	CIVIL LINES (WEST PART)
50	DADIYAPURA FIRST
51	CIVIL LINES SOUTH PART - 2
52	MUKARYANA
53	BAHAR KHANDERAO GATE
54	BAHAR ORCHA GATE FIRST
55	CIVIL LINES SOUTH PART - 1
56	TORIYA NARSINGH RAO
57	C.P MISSION COMPOUND
58	GUNSAI PURA
59	DAROO BHONDELA
60	LAXMANGANJ

Demographic

According to the 2011 Indian Census, the population of Jhansi city was 505,693 and Jhansi Urban Agglomeration has a population of 547,638. The current population of the city is approximately 0.6 million. According to the 2011 Census, Jhansi has a sex ratio of 905 females for every 1,000 males. The total number of literates in Jhansi city was 373,500, which constituted 83.02 per cent of the population. The ST/SC population was 110,318 and 1,681 respectively and made up 28.14 per cent of the population.

Soil and topography

The topography of the city also plays a key role in the locational analysis for any provision of services and facilities. Jhansi is located in the plateau of central India, an area dominated by rocky reliefs and minerals underneath the soil. It has an average altitude of 284 meters. The city has a natural slope in the north as it lies on the south western border of the vast Tarai plains of Uttar Pradesh. The elevation rises on the south. The region relies heavily on monsoon rains for irrigation.

Agriculture

The land is suitable for various species of citrus fruit and crops including wheat, pulses, peas, and oilseeds. The government is constructing a network of canals for irrigation in Jhansi and Lalitpur, and some part of Madhya Pradesh, as part of the ambitious Rajghat canal project. The trade of agricultural products including that of grain and oilseeds, is of economic importance for Jhansi.

Economy

Jhansi is a major commercial, tourist and educational center. There are 245 small-scale industries in Jhansi city. In addition to this, there is a major industrial area located at Bijoli. Major industries include stone crushing, agro-based food products, cotton textile, furniture etc.

Urban poverty and slums

According to the District Urban Development Authority (DUDA), Jhansi city had 73 slums in 2011. The total number of households in Jhansi was 17,620, in which a population of 99,500 resided. This comprised 19.68 per cent of the total population of Jhansi city. 72 per cent of the informal settlements were located within the city. Many informal settlements are located on the hilly terrain and are difficult to access in the absence of a proper road because of which city authorities find it difficult to provide certain services like piped water supply and sanitation facilities. The latest data on slums is not available with Nagar Nigam and DUDA.

Water supply

Jhansi city depends primarily on the Betwa river (Matateela dam) for water supply, from where it draws around 110 million litres per day (MLD). Apart from the Betwa river, Jhansi also draws water from the Pahuj river (10 MLD) and from tube wells (8–10 MLD). Another scheme for providing 195 MLD of water under AMRUT is in progress. According to the Central Ground Water Board (CGWB) 2021–22 report, the water quality of Jhansi city is comparatively better than the rest of the district where it showed high levels of electrical conductivity (EC), total hardness and calcium.

During summer, due to a fall, in the groundwater level, Jhansi faces water scarcity issues.

Sanitation

Jhansi city was declared open defecation free in 2019. The current population of 0.6 million people generate around 64 MLD of wastewater. Due to the rocky strata, the city does not have a sewerage network. The current available treatment capacity is also not adequate. Most of the households have septic tanks, mostly without soak pits. Sewage is discharged into open drains, which meet the Pahuj river, leading to water pollution. The city has taken a few initiatives to improve wastewater and faecal sludge management in its area.

3. Municipal finance

To understand the financial health of Jhansi Nagar Nigam, the last three financial years i.e. year 2020–21, 2021–22, 2022–23 were analysed. The current accounting system has been transferred to double entry accrual system i.e. credit and debit heads are maintained on cash receipt/payment basis. Expenses on new projects are treated as capital expenditure and expenses towards maintenance are treated as revenue expenditure.

Jhansi Nagar Nigam (JNN) majorly depends upon central and state finance commission funds, central government schemes (AMRUT, SBM) and state government schemes; that constitutes around 70–75 per cent of its total income. While the income from its own sources (tax, non-tax, user charges) varies between

Table 1: Budget of Jhansi Nagar Nigam for the past three years

Amount in Lakhs INR			
	FY 2020-21	FY 2021-22	FY 2022-23
Opening balance	33,849.36	25,377.93	19,266.05
Income			
• Income revenue	2,855.08	2,826.85	3,894.70
• Income capital	12,907.74	9,744.13	11,881.00
• Income suspense	176.70	461.77	322.30
Grand total of income without opening balance	15,939.52	13,032.75	16,098.00
Grand total of income with opening balance (A)	49,788.88	38,410.68	35,364.05
Expenditure			
• Revenue expenditure	12,533.14	14,977.34	14,401.00
• Capital expenditure	1,1603.04	6,282.38	3,868.00
• Suspense expenditure	308.47	413.06	6.95
Grand Total of Expenses (B)	24,410.95	21,617.74	18,275.95
Closing Balance (A-B)	25,377.93	16,792.94	17,088.10
Grand Total	49,788.88	38,410.68	35,364.05

Source: Nagar Nigam, Jhansi

20–25 per cent. The property tax collection rate is around 90 per cent, which is very good. The major portion goes out as revenue expenditure into maintenance, salaries of staff, solid waste management, IEC etc. The maintenance cost of FSTP (6+12 KLD) is also borne by ULB through their own funds.

However, for financial sustainability, the Jhansi Nagar Nigam should focus on increasing the income from their own sources, and also explore other sources of funding like Corporate Social Responsibility (CSR), municipal bonds etc.

4. Institutional arrangements

The primary responsibility of providing civic services, including water supply and sanitation, rests with the state government and more specifically, with the local municipal government. Jhansi Division, Jal Sansthan of Uttar Pradesh deals with the operation and maintenance of water supply and sewerage system while Jhansi Nagar Nigam deals with solid waste management, social infrastructure such as community toilets, health and medical services and basic civic services. UP Jal Nigam carries out the functions of preparation, execution, and promotion of water supply and sewerage schemes.

Agencies involved In providing urban services

- Department of Urban Development, Government of Uttar Pradesh
- Director of Local Bodies, Government of Uttar Pradesh
- Public Works Department
- State Pollution Control Board
- UP Tourism Department
- Superintendent of Police, (Traffic)

Urban local bodies

- Jhansi Nagar Nigam (JNN)
- Jhansi Division, Jal Sansthan, UP
- Jhansi Smart City Limited (JSCL)

Parastatal bodies

- UP Jal Nigam
- Jhansi Development Authority (JDA)
- UP Housing and Development Board, Jhansi
- District Urban Development Agency (DUDA)

Institutional responsibilities

Table 2: Sector-based responsibilities of various government departments of Jhansi

Sector	Planning	Implementation	O&M
Land use/ Master Plan/ Building Byelaws	JDA	JDA	JDA
Water supply	UPJN/ JDA/ UPHDB for colonies developed by them/ DUDA for slum area	UPJN/ DUDA for Slum	Jal Sansthan
Sewerage/septage management	UPJN/JNN	UPJN/JNN	Jal Sansthan/JNN
Solid Waste Management	JNN	JNN	JNN
Storm Water Drainage	JNN	JNN	JNN
Parks/Playground/Beautification of Road Intersections/Urban Forest	JNN, Forest, JDA, UPHB	JNN /JDA/Housing Board/Forest	JNN/JDA/Housing Board/Forest
Slum Development	JNN, DUDA	DUDA	DUDA

Municipal-parastatal coordination

There is a lack of coordination between urban local bodies and parastatal agencies in areas such as sewage management. The real problem is noticed at the planning and implementation stage. No clearly defined mechanism exists to take up such works in an integrated manner taking into account local factors such as ULB's financial health, skilled human resources, geographical factors etc.

5. Initiatives for safe management of faecal sludge and used water

Faecal sludge and septage management

In Jhansi, 80 per cent of the households are dependent on on-site sanitation systems, which needs to be emptied regularly. Most of the septic tanks, typically without soak-pits, are not as per the standards and the effluent flows into open drains. A few households discharge their toilet waste directly into open drains. Due to a lack of awareness and regulatory mechanism, households empty their septic tanks in 15–20 years. Until 2015, Jhansi Nagar Nigam (JNN) used to provide desludging services to households at a fee of Rs 700 per trip. The emptied sludge was disposed off into open lands outside city limits which posed a serious issue on the health and environment.

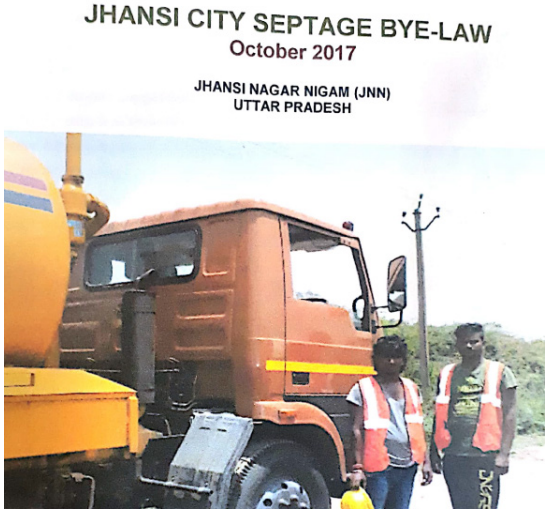
As Jhansi has a rocky strata, comprising mainly granite, it is difficult to lay underground sewer pipelines for the conveyance of sewage for further treatment. As a consequence, the city has actively explored an alternative approach for the management of liquid waste. In a pursuit of that, the Municipal Commissioner of Jhansi Nagar Nigam (JNN) visited the Faecal Sludge Treatment Plant (FSTP) in Devanahalli, Karnataka in an exposure visit organized by CDD Society, a non-profit organization in Bengaluru. It's a nature-based plant which treats faecal sludge and septage using simple technology like stabilization tank, integrated settler with anaerobic baffle reactor, planted gravel filter and sludge drying beds. The treatment system also consists of a co-composting unit where the dried sludge from the SDB is composted with municipal solid waste. The treated water is being used for gardening purposes within the plant premise. The plant doesn't use chemicals or electricity for pumping and has very low operation and maintenance (O&M) requirements. The Municipal Commissioner of Jhansi Nagar Nigam also understood the key enablers in the success of faecal sludge management at the city level—like the importance of institutional strengthening, working with desludging operators, public awareness, stakeholder engagement, and other the monitoring aspects.

Planning phase: Considering the unfeasibility of a centralized sewearge approach and after analysing the benefits and applicability in the context of Jhansi, JNN decided to start their journey towards faecal sludge and septage management. The

aim was to set up a treatment facility that had zero or minimum energy and O&M requirements to run the plant. In 2017, Jhansi Nagar Nigam (JNN) drafted the Jhansi City Septage Bye-Laws in October 2017. The bye-laws was later passed in 2023 and mandates the emptying of septic tanks every three years.

Parallelly, Jhansi Nagar Nigam also initiated the process for the identification of and engagement with private desludging operators, and the preparation of a detailed project report (DPR) and tendering process for the construction of a FSTP. A 6 KLD design capacity FSTP was proposed in the DPR which consisted of planted drying beds for sludge stabilization/dewatering and Integrated Settler and Anaerobic Filter and Horizontal Planted Gravel Filter for the treatment of liquid steam. The capital cost of the plant was funded through ULB's own funds (14th FC fund). The land was allocated in Bijoli industrial area at the periphery of the city, which is around 12 km from the city center. The work was awarded to the Indore based firm, Purna Pro Enviro Engineers Pvt Limited in 2017. After receiving the work contract, the contractor also visited the Devanahalli FSTP. Further, they visited the CDD society office in Bengaluru to understand more about the planning and technical aspects of a faecal sludge plant. Later, CDD deployed a team to Jhansi to provided technical support and oversee the construction of the plant.

Challenges during the construction phase: Due to a delay of six months in awarding the land, the work was delayed in the initial phase. The land was provided in Bijoli area, which is at the periphery of the city. An undulating terrain with a small hill at the site posed another challenge. The cutting of rocks and the process



Photograph 1. Draft septage bye-laws, 2017

Photograph 2: FSTP Site (6+12KLD)

Photograph 3: Public protest during construction of FSTP

of levelling the land took a lot effort and the construction of the plant could only begin by the end 2017.

Once the construction started, the contractor faced protests from the local public and councillors. The residents had a concern that the plant could create an unhealthy, foul-smelling and unlivable environment in their area. The police had to intervene as a crowd of 200–300 started protesting to stop the construction of the FSTP. To address this issue, Jhansi Nagar Nigam (JNN) officials, together with the contractor, started a massive door-to-door Information, Education and Communication (IEC) campaign to raise awareness about the plant, presenting the example of the successful Devanahalli FSTP. Officials assured the residents that there would not be any foul smell. Instead, the plant would be developed as a Resource Park with plants, selfie points, a walking area etc. Nagar Nigam officials did a series of group meetings with society members and elected representatives. After taking the public in their confidence, the work started in full swing. The construction was completed within a period of six months and the plant started its operations in 2018.

Understanding the treatment process: With the outlay of Rs 2 crores through 14th FC funds, the Jhansi FSTP was constructed on the nature-based system, and treats septage without the usage of any chemicals. It uses a simple mechanism which makes the plant simple to operate and maintain. It does not require highly skilled personnel to run the plant. The plant also has solar panels to meet the electricity requirements of the operator room.

Photograph 4: Faecal sludge and septage treatment process in Jhansi

Photograph 5: Faecal Sludge Treatment Plant (6+12 KLD), Jhansi

Treatment system description

After receiving the request from households, the sludge is transported to the FSTP. At the plant, the sludge is directly applied to the 'Planted Drying Beds (PDBs)' which are loaded with layers of sludge to get dewatered and stabilized through multiple biological and physical mechanisms. The percolate from PDBs is further treated in the 'Integrated Settler and Anaerobic Filter (AF)' in which settler is a primary technology for wastewater and AF comprises three chambers in which pipes enable water to reach the tank's bottom where the suspended solids undergo

anaerobic degradation. For tertiary treatment, the liquid enters into a Horizontal Planted Gravel Filter (HPGF), after which it into polishing pond. HPGF is made from planted filter materials consisting of a graded gravel bed. The HPGF is necessary for removing the odour and colour to enrich wastewater with oxygen. The final treated water is collected and stored in a polishing pond, which serves as the tertiary treatment, and reduces pathogens using solar radiation.

Innovative and inclusive approach at FSTP

Reuse of treated bio-solids as manure: The treated bio-solids are used for plants in parks and road medians. For further exploiting the nutrients of bio-solids and developing a revenue model, Jhansi Nagar Nigam (JNN) installed a crusher machine in 2022, for converting the dried bio-solids into a fine powder. These can be further packed and sold for reuse as manure. Recently, JNN has partnered with an NGO (National Jan Kalyan Trust) for the sale of bio-solids at the rate of 32 paisa per kg.

Reuse of treated water for road cleaning and gardening purpose: The treated water from the polishing pond is utilized for road cleaning purpose through mechanical road cleaning vehicles. The excess treated water is used for gardening in the FSTP premise.

Selfie point and walking area: A selfie point and wonder park has been developed at the plant using waste material. To walk around the plant, shaded and paved pathways were also developed.

Photograph 6: Co-composting unit at Jhansi FSTP

Photograph 7: Use of treated water in road cleaning

Photograph 8: Selfie point at FSTP

Photograph 9: Best city in innovation and best practices award to Jhansi Nagar Nigam

Plan for engagement of transgender for operation and maintenance (O&M) of the plant: JNN is also planning to involve a transgender group for the operation and maintenance of the plant. Usually, this section of the population is secluded from society and have limited work opportunities. The plant's day-to-day maintenance does not require in-depth technical understanding. However, capacity building and hand-holding support will be required while engaging transgenders for the work.

Established as proof of concept in UP: With the coordinated efforts of JNN, the Jhansi FSTP has been established as the proof of concept for FSSM in UP. After successfully operationalizing this plant, Jhansi Nagar Nigam won the Best City in Innovation and Best Practices award in Swachh Survekshan 2019, received under the chairmanship of the President of India. The initiative has also been praised by the Chief Minister of Uttar Pradesh. Till date, more than 5,000 officials have visited the plant and learnt from the city-level approach taken by the city. After running the plant at full capacity for four years, the plant was further expanded with 12 KLD treatment capacity in 2022.

32 KLD FSTP UNDER AMRUT MISSION

Under the AMRUT program, another FSTP of 32 KLD is being constructed in *Mustara Chowk* area, which is around 10 km from the city and is easily accessible. The construction of the plant has been completed and the operator has started the trial run. It has been constructed by J M Enviro Tech Pvt Ltd under the supervision of Jhansi Jal Nigam. The plant is based on mechanical dewatering (screw press) process followed by constructed wetlands and UV treatment of liquid stream. The solids from the screw press goes to the drying beds for further drying process. The treated water is used for watering plants in roads by Nagar Nigam vehicles. The plant runs on green energy provided by a 25KW capacity sola panel system.

Operation and maintenance challenges: The plant capacity is more than the current requirement of the city with demand desludging practice. The plant is currently facing a challenge of receiving inadequate septage and runs at full capacity during the trial run period. It is essential to run the plant at maximum capacity (70–80 per cent) to check if all the treatment units are functioning properly and the end result meets the standard. City authorities, together with the operator, are working to get septage from community toilets and government institutions on a priority basis.

The current O&M model of the plant also needs to be restructured. The current model says that emptying 5,000 HHs every year at the desludging fee of Rs 2500 per trip, which is highly optimistic as it comes to a total 16 trips per day by three vehicles (considering 300 working days in a year). The desludging fees of Rs 2,500 is also considerably highed than other cities and is unaffordable for the urban poor. So, the current O&M model is financially not feasible. City authorities and private operator should work out the optimum O&M cost required for the plant and vehicle; and accordingly fix an affordable desludging fee.



Photograph 10: Photos of 32 KLD FSTP

Operation and maintenance: The plant is operated and maintained by the Purna Pro Enviro Engineers Pvt Limited. Currently, the plant is running at its full design capacity. JNN pays 4.62 lakhs INR/month (Rs 2.62 lakhs for 6 KLD and Rs 2 lakhs for 12 KLD) from their own funds, for the operation and maintenance (O&M) of the plant. The plant has, six staff members, four guards, one supervisor and one service engineer for maintenenace. JNN has also provided PPEs to all staff members. The O&M cost of the desludging services is supposed to be generated by the operator through desludging fees/charges.

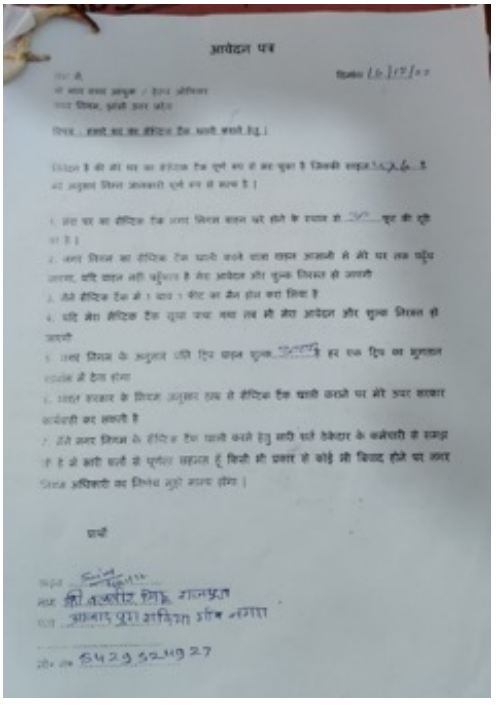
However, as mentioned by the private operator, due to 30-40 per cent of the desludging services to government institutions being provided on a pro-bono basis, the plant is unable to meet desludging expenses and the cost is being compensated from the funds provided for the FSTP O&M.

Managing city-level desludging operations

Before 2014–15, desludging services were provided by JNN at Rs 700 per trip. The emptied sludge was disposed off into open lands outside city limits. This posed a serious threat to health and the environment.

After 2015, to streamline desludging services across the city, desludging operations have been contracted out to a single private operator. The private operator used to charge Rs 1,000 per trip. Since the completion of the FSTP in 2018, the emptied sludge from septic tanks is being taken to the treatment plant by the private operator.

Jhansi Nagar Nigam (JNN) owns desludging vacuum machines that have a capacity of six kilo litre (KL) and two kilo litres (KL) respectively that are being operated and maintained by a private operator since 2015. Currently, Jhansi



Photograph 11: Application form for booking desludging services

Photograph 12: Booking receipt for desludging services

Photograph 13: Desludging operator's office at the Nagar Nigam

practices demand-based desludging and the usual demand is met by the two available desludging vacuum machines. The household registers the desludging service either by calling at the toll-free number 14420 or by booking a request at the Nagar Nigam office.

With the construction of new FTSP of 32 KLD, two vehicles of four kilo litre capacities, and one vehicle of one kilo litre capacity have also been added. However, to ensure that the required septage comes to the plant, the Jhansi Nagar Nigam (JNN) needs to further strengthen and regulate desludging in the city. The Septage Bye-Laws of 2023, Jhansi, mandates the emptying of a septic tank every three years. But it has to be supported by strong door-to-door campaigns to raise awareness among the public about regular desludging and also by keeping desludging fees affordable for everyone, including the urban poor through cross subsidizing.

JNN has also signed MoUs with nearby (20–30 kilometers) four ULBs, namely Baragaon NPP, Baruasagar NPP, Chirgaon NPP and Katera NP (60 kilometers). They can discharge their FS into the Jhansi FSTP without any tipping fees.

Affordability of desludging services: In 2018, Jhansi fixed desludging fees at Rs 1,500 per trip. However, the current desludging charges for a vehicle with a capacity of six kilo litres is Rs 3,000 rupees and Rs 1,500 per trip for a vehicle with a capacity of two kilo litres. These charges are high in comparison to other cities. Also, the charges are unaffordable for the urban poor and low-income communities. During the discussion with Nagar Nigam officials, it has been suggested that by cross subsidizing they can reduce the desludging fees for the urban poor, so as to achieve equity in sanitation service benefits. When desludging fees are uniform and high, urban poor households do not empty their septic tanks regularly, which impacts the efficiency of the septic tank. Eventually, effluent with high organic component flows into the drains.

Providing desludging service in urban poor areas: To access the containment structure in narrow lanes, the desludging vehicles have an extension pipe with a length of 100 feet. However, if the distance to the containment/septic tank is more than 100 feet, it is difficult to provide desludging service. Jhansi old city area has many such places (narrow lanes with moderate terrain), which cannot be accessed by bigger desludging vehicles (truck mounted 6Kl and 2 KL vehicle). As per the discussion with the desludging operator, around 30–40 per cent of the area in Jhansi is unserviceable by current desludging vehicles.

Photograph 14: Households in Panchkuiyan, Indrapuri

One such area is Panchkuiyan, Indrapuri area. The area has 50–80 households in a narrow lane of 2–3 meter width terrain. This area is inaccessible by truck mounted desludging vehicles due to which households have not emptied their septic tanks since more than 15 years. The outlet of the tanks is connected to the small open drain, which further connects to the larger city drain.

Likewise, households in Taliya area, Kasai mandi area, Narayan Bagh road, Shivaji Nagar, Purana Sahar, Itwari ganj, etc. have similar characteristics. Following are the observation from these area:

- Narrow road width, 2–3 meters wide
- Good flow in drains owing to natural slope in the city
- Households have septic tanks with outflow connected to the open drain
- In many cases, there is no provision for access cover to septic tanks

Photograph 15: Sanitation situation in a congested areas of Jhansi

- Many households discharge their toilet waste directly into open drains
- Low desludging frequency, 15-20 years
- Due to inaccessibility, households empty septic tanks through other means
- High strength wastewater flowing in open drains
- Dumping of solid waste in open drains

To mitigate these challenges, Jhansi Nagar Nigam (JNN) has floated a tender for providing a specialized desludging vehicle which can access the narrow lanes and have high suction power. However, even then, there could be some area left which will remain unserviceable. To prevent solid waste dumping, JNN has also initiated the practice of covering open drains.

Interception and diversion (I&D) of sewage treatment plant (STP) in Jhansi

To treat wastewater flowing through open drains, Jal Nigam constructed an interception and diversion-based STP with a capacity of 26 million litres per day (MLD). The plant is based on Sequential Batch Reactor (SBR) technology and has been operational since January 2022. The plant was constructed under the Jal Sanrakshan Yojna and is running at 70 per cent of its capacity. The STP treats domestic wastewater from nearby areas which was earlier flowing into Laxmi Taal. The current flow in the drain has increased to around 32–35 MLD. Jal Nigam has proposed for another STP since expansion is not possible in the existing STP site.

Photograph 16: Water sample at the outlet

Map 3: Map showing location of STP

As per Jal Nigam reports, the existing plant is functioning well and the treated effluent meets the CPCB standards. Around four million litres per day (MLD) tertiary treated water from the STP is being diverted into Laxmi Taal through a gravity pipeline for reuse in lake rejuvenation (currently on hold due to rejuvenation work at lake) and the remaining 22 MLD is diverted through a channel to Narayan Bagh, where some quantity is used for gardening purposes. The channel carrying the remaining treated water later meets the irrigation canal.

Photograph 17: Interception and diversion based STP of 26 MLD capacity

Operation and maintenance challenges: The STP is based on advance SBR technology which is highly energy-intensive and leads to high operation and maintenance (O&M) cost. The O&M of the sewage treatment plant for the first year was the responsibility of the contractor and the cost was included in DPR package. The yearly O&M cost of the plant is around Rs 7 crores (including 12.5 per cent Jal Nigam centage and 18 per cent GST) out of which around Rs 2 crores is only for electricity (to be directly paid by Jal Nigam). The electricity cost of the plant has not been paid for a long time. While the plant is nearing the completion of a year of operation, Jal Nigam is still lacking clarity on the arrangement of O&M funds for the next year. The request for the same has been submitted to the state by Jhansi Jal Nigam divisional office.

NEW 26 MLD INTERCEPTION AND DIVERSION-BASED STP UNDER SMART CITY MISSION

At present, the city does not have an existing underground sewerage system. There is provision for a septic tank in every household. Effluent from septic tanks flow into different nallah/drains which ultimately flows into the Pahuj river. Jhansi Smart City Limited (JSCL) is constructing an interception and diversion-based STP of 26 MLD (based on SBR technology) capacity near the Pahuj river to treat domestic wastewater by tapping four drains. Currently, the condition of drains is very poor due to dumping of wastewater and solid waste, as evidenced in the images below images.

The project is funded under the Smart City Mission. The project cost includes capital cost (Rs 75 crores) and 10 year of O&M cost (approx. INR 25 crores + INR 20 crores for electricity to be borne by Nagar Nigam). Moving onward, O&M cost of the plant will be a challenge for JNN.

Photograph 18: Condition of drains in Jhansi city

Map 4: Location of STP and SPS in Jhansi

In-situ wastewater treatment in drain through bioremediation and phytoremediation

Jhansi Smart City Limited (JSCL) has begun the construction of another interception and diversion-based STP of 26 MLD capacity, and four pumping stations to reduce the pollutant load of the Pahuj river. Under this project, four drains will be tapped and diverted to 26 MLD STP for treatment. However, it will take time to build and operate the sewage treatment plant. According to National Green Tribunal (NGT) norms, in-situ treatment of wastewater drains is required until all drains are tapped.

To curb the pollution in the Pahuj river, Jhansi Nagar Nigam (JNN) decided to implement in-situ treatment in open drains through bioremediation and phytoremediation as an interim remedial measure until the STP becomes functional.

Following four drains will be treated through bioremediation/ phytoremediation before they reach the river:

- drain with a capacity of 10 million litres per day (MLD) near Aala Ghat

Map 5: Map of drains entering the Pahuj river

- drain with a capacity of one million litres per day near Prabhu Dayal Aashram
- drain with a capacity of 11.5 million litres per day near Shivpuri Road
- drain with a capacity of 3.5 million litres per day drain near Shivpuri Road

Jhansi Nagar Nigam (JNN) carried out a feasibility study along with the assessment of potential sites for in-situ bioremediation. The survey and detailed project report of the project was prepared by Regional Centre for Urban and Environmental Studies, Lucknow. The total project cost was around INR 3.5 crores. The work has been completed on one drain (*refer below images*), and is in-progress in the remaining drains.

The work in 3.5 MLD drain was completed around 1.5 months ago. The testing of water at outfall is yet to be done.

Photograph 19: Bio-remediation and phyto-remediation processes in Jhansi

Key challenges in operation and maintenance (O&M)

The work in-situ treatment is also facing the following challenges:

Direct discharge of toilet waste: Many households residing along the drain are discharging their toilet waste directly into the open drain. This has been banned under the Swachh Bharat Mission. This practice will also affect the treatment efficiency of the in-situ treatment system installed along the drain.

Solid waste dumping: Although screens have been installed at many places to collect solid waste, solid waste dumping remains a major issue. Solid waste get clogged in the gabions wall, effecting their treatment efficiency. Also, due to irregular cleaning of screens, the solid waste accumulates near the screens.

Photograph 20: Direct discharge of toilet waste into an open drain

Photograph 21: Visible solid waste in drains attract stray animals

6. Managing water resources

The following section analyses the various initiatives taken by JNN to manage their water resources.

Restoration and rejuvenation of water bodies under the Smart City Mission

Jhansi, along with Bundelkhand as a whole, has been facing water scarcity. However, there are a number of ponds and lakes that can be utilized to minimize the gaps in demand and supply. During the Chandela dynasty the construction and use of ponds and lakes flourished. However, with time, the conditions of these ponds and lakes have deteriorated significantly. The quality of water in these ponds pose a great threat to the groundwater quality, aquatic ecosystems, the surrounding flora and fauna, and to human health. Due to the lack of a treatment system within the city, sewage from households has been flowing into water bodies leading to eutrophication and degradation of the water quality. Jhansi has four major pond/lakes in the city, namely, Pani Waai Dharmshala, Laxmi Taal, Antia Talab and Bijauli Lake. To rejuvenate, conserve and maintain these water bodies and improve groundwater quality and quantity, the Nagar Nigam of Jhansi has initiated rejuvenation work for four major pond and lakes. The restoration work is being done by Jhansi Smart City Limited (JSCL) under the Area Based Development (ABD) component of Smart City Mission.

Key issues leading to degradation of ponds and lakes in Jhansi include:

- **Lack of planning and management:** The number of lakes has been gradually decreasing as some of them have been converted into residential localities. Most of the live lakes and ponds have silted up due to faulty land management in the catchments. Overflow of sewage during the monsoon season has led to the degradation of these water bodies.

- **Anthropogenic stress:** Many lakes and ponds of Jhansi have been lost in the process of various anthropogenic activities and population pressures that have resulted in unplanned urbanization and expansion. Some ponds have been reduced to cesspools due to direct discharge of liquid waste and unregulated dumping of solid wastes.

- **Degradation of water life:** A continuous eutrophication of water life and its flora and fauna leads to the degradation of the quality of water and underwater species.

- **Fading connection between citizen and lake:** There is a lack of awareness for a clean and green environment. This leads to the degradation of ponds, lakes and waterbodies. People throw their wastes in ponds and pollute them. Urgent initiatives are needed to educate people on conservation of water heritage sites and on ways in which they can be used effectively.

Following are the key objectives of the project:

- To prevent wastewater from entering the pond
- To improve the quality of water and introduce fish culture to the pond
- To improve and beautify the surrounding façade of the ponds for religious and tourist activities and to promote citizen participation
- To create recreational activities in and around the pond
- To improve access and connectivity to the pond by providing street lights on both sides
- To introduce safety and security measures inside and around the pond

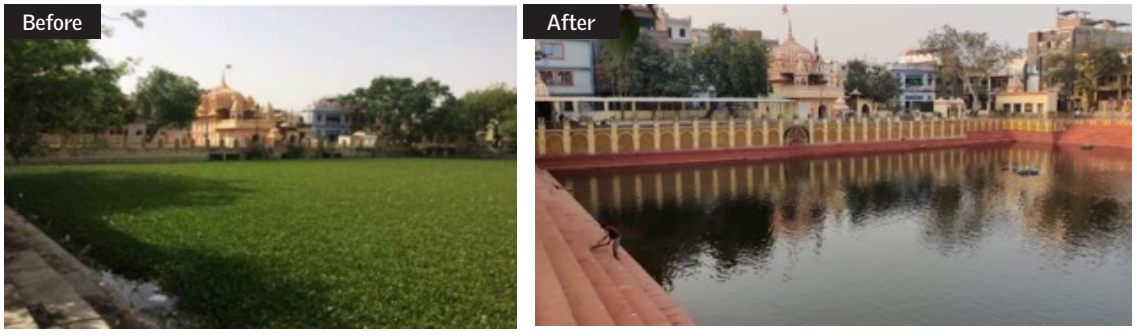
Pani Wali Dharmashala (rejuvenation completed in 2022)

The Pani Wali Dharmshala is an almost square shaped stepwell structure made of stone and bricks. It is a reservoir and an ancient source of groundwater for the people of Jhansi. The surrounding area is predominantly residential. JNN intercepted and diverted all the drains to a major drain nearby called Natbali ka Nala. During the dry season, wastewater doesn't enter the pond, however due to the siltation of the drain the storm water runoff flow exceeds the capacity of Natbali ka nala and overflows into the pond. In order to avoid this the drain has been de-silted, cleaned and strengthened. Also, a pumping station was constructed to pump out water that is logs around the pond during rains into a nearby drain. Direct discharge of wastewater from the nearby building was also stopped to prevent pollution.

The project cost of the work was around Rs 4.3 crores which includes operation and maintenance cost for five years. The work includes de-weeding and de-silting, interception and diversion of waste water, restoration of stepwell and enhancing drain capacity. The work was done carefully so that it does not impact the shallow aquifer, and the source can be retained. As the water level reaches a certain level, the excess water is taken out with water tankers and used for various purposes.

Perception of local community after rejuvenation: Local people are happy with the restoration work. Post restoration, many local people visit the area for walks and to socialise. School children from Lokmanya Tilak Girls Inter College were also very happy with the work as they use it the most. However, the open drain near the pond continues to be a site for dumping of solid waste and poses a challenge.

View towards Lokmanya Tilak Girls Inter College



View towards Shiv Temple

Photograph 22: Rejuvenation work at Pani Wali Dharmshala

Photograph 23: Natbali ka Nala

Laxmi Taal (work to be completed by June 2023)

Laxmi Taal is one of the oldest lakes of the city and holds historical significance. Located in old Jhansi, the lake was built in early eighteenth century and is surrounded by seven temples and 1 *Mazaar*. It was the main source of water in the city that flourished within the walls of Jhansi fort. The Mahalakshmi temple is located on the banks of the lake and is known as one of the oldest temples in Jhansi, dating back to the eighteenth century. Laxmi Taal was an important place of religious gathering within the city of Jhansi. However, its importance has diminished over time.

Key challenges: This lake is highly abused by local people who pollute it with solid waste and wastewater. The lake has been widely affected by rapid urbanization happening inside the city. Due to the rapid pace of urbanization, dry land around the lake has been encroached for construction of residences. This has created a serious contamination problem for the lake as many of the sewers from these neighborhoods enter the lake.

Nutrient content of the lake bed is high due to the release of wastewater into the lake. Hence, both floating and fixed weeds and water hyacinths have been observed in the lake. In addition to this, there is a historical accumulation of silt in the lake bed. A continuous eutrophication of water life and its flora and fauna leads to the degradation of water quality and underwater species.

Approach: JNN is aiming to develop the lake and its surroundings by introducing recreational activities around. The initiative has been undertaken to restore the aquatic ecosystem and improve ground water recharge while also introducing the area as a recreational space for the public. There are six major drains which were earlier flowing into the Laxmi Taal. These have been recently tapped and are being pumped through a pumping station for treatment at the 26MLD interception and diversion-based sewage treatment plant (STP). Bypass channels have been constructed to divert any storm water runoff or sewage inflow outside the lake in Narayan Bagh area. The lake has been de-silted and cleaned off solid waste and floating water hyacinth.

The total project cost is approximately Rs 50 crores, which includes around Rs 4 crores as operation and maintenance cost for 5 years.

The proposed plan includes

- Development of Bund wall
- Entrance Plaza

Photograph 24: Water hyacinth in Laxmi lake

Photograph 25: Encroachment in the lake catchment area

Map 6: Map of Laxmi Taal area

Photograph 26: Restoration work in progress

- Parking
- Boating Deck
- Vendors Space
- Viewing Decks
- Landscaping in Parks
- Laser/Light & Sound Show
- Under Water Lights
- Golf Cart/E-Vehicle
- Floating Fountains

The concept plan has been conceived as the waterfront development project, rather than holistic water body rejuvenation and restoration aspect. A focus should have also been given to understand the hydrogeology and shallow acquires of the given area. So that the restoration work (de-silting) doesn't effect, leading to long term loss of the shallow aquifers.

Map 7: Proposed plan of Laxmi Taal

Antia Talab (work to be completed by June 2023):

Antia talab/pond is said to have been constructed during the reign of the Chandela rulers. Adjacent to the pond are many temples, including an ancient Shiva temple. Antia talab is one of the oldest sources of water for the residents of the densely populated city of Jhansi. The pond is somewhat trapezoidal in shape, and is approximately 9.5 acres in area and 7–8 meters in depth at the centre. The pond is surrounded by mixed-use areas and is dominated by residential activities, commercial and small-scale industries. The commercial activities are majorly focused on private coaching classes and tuition centers for school and college students. Tuition institutes along the periphery of the lake attract a significant student population.

Earlier, JNN had taken steps to improve the physical and environmental conditions of the pond. In 2015, authorities contracted the project on public-private-partnership basis to a private agency namely, Garden Group for 25 years. Silt removal, construction of covered drain to carry waste water from the neighbourhood and construction of boundary wall was done as initial steps towards restoration. However, there is seepage at some points in the boundary wall and residents continue to throw solid waste into the pond, polluting it.

To address these issues, JNN initiated the development of the pond and diversion of the sewage into a nearby drain.

Photograph 27: Cafeteria at pond's corner

Map 8: Proposed plan for Antia lake

The total project cost stands at approx. Rs 10 crores, which includes around Rs 0.7 crores as O&M cost for five years. The work includes the construction of:

1. Café and restaurant
2. Viewing deck
3. Boating plaza
4. Entrance plaza
5. Community green
6. Four and two wheeler parking
7. Focal island
8. Street furniture

Bijauli lake development

Bijauli Lake, also known as Chandeli Lake is situated in the Bijauli Industrial Area. Built by the Chandela rulers, the lake is about 20 feet deep and is enclosed by a ghat at one end. Rainwater constitutes the main source of water for Bijauli Lake. Four drains from the city flow into the lake.

Photograph 28: Images of Bijauli Lake

The Bijauli Lake Development project is aimed at beautification, improving the water quality and establishing city-level recreational space for the public. The capital cost of Rs 11 crores, will be borne by the Nagar Nigam through 15th Finance Commission fund. The project is expected to reach completion by June 2023. Major works under the project include:

- De-weeding and de-siltin
- Decentralized wastewater treatment plant of 200 KLD (constructed wetland-based)
- Boundary wall, entrance gate, paving, interlocking
- Fountain, seating area, deck for visitors, food court

Rain water harvesting (RWH)

A few decades ago, the areas around commercial and residential buildings used to be unpaved, and the rain falling on these areas would percolate into the soil and remain there. This water would then be drawn through shallow open wells. With the development and proliferation of urban settlements, the percolation of rainwater into the soil has almost entirely stopped, although the quantity of water drawn from the soil below has increased manifold. Consequently, open wells and relatively shallow borewells have started drying up. However, in a few places the groundwater is easily accessible through borewells and dug wells all over the year. The locals mentioned that the water table varies from 100–160 feet, which further drops to 200–220 feet during peak summer.

Photograph 29: Rainwater harvesting in Jhansi

The following are a few reasons which necessitated the project:

- Drought, which is a common calamity in Jhansi during the summer
- Increased use of water and over extraction of groundwater, resulting in depleting groundwater table.

- Prevent the pollution of rainwater from flowing into drains carrying sewage, thereby reducing the load on treatment plants.
- Improvement of groundwater potential and proportionate reduction in dependence, and ultimately on an energy-intensive water recovery.

The average annual rainfall in the city is about 900 mm. Due to being situated on high ground and having a good natural slope, the rainwater flows easily through the city. To conserve rainwater and replenish the groundwater table, JNN implemented the rainwater harvesting project through the Smart City Mission in the Area Based Development (ABD) area. JNN installed these systems in 100 government buildings. The recharge structure includes modular tanks enclosed in a geo-textile fabric which promotes the percolation of water through the soil at a shallower depth along with 40–50 meters deep borewell. The initiative focused on public areas rather than only on private properties. The project capital cost was around Rs 9 crores and it was completed in December 2022.

However, the location of the RWH systems were identified without conducting detailed topographical and geotechnical surveys. To achieve better results, JNN should have undertaken aquifer mapping to identify recharge and discharge zones within the city and the systems should have been installed accordingly in a recharge zone as extensive recharge in an active discharge zone would create a problem for city dwellers.

For RWH, a modular tank technology approved by the Central Ground Water Board (CGWB) was used which has very limited O&M requirements, is easy to install and has a liftetime of more than 50 years. The total cumulative volume of pits, installed in 100 government buildings is around 1660 cubic meters. The rooftop area varies from 50 square meters to 5000 square meters.

Covering storm water drains

Jhansi is dominated by rocky plateau. Being situated on high ground, the city of Jhansi has always been well drained because of the natural slope. Jhansi does not face a problem of water logging or overflows during monsoon (except in few areas like Sangam vihar, Gariya Gaon etc.) and the water gets drained with ease. Some of the areas in the city have well-constructed drains, but only a few of them are covered. Local residents dump their domestic solid waste in nearby drains. Wastewater also finds its way directly into open drains, posing an environmental health hazard. In many places, drains have been encroached by shops or houses, making it difficult to clean and maintain the flow of wastewater. There are 63 drains in the city out of which 36 are big and 27 are small drains. There is no regular arrangement of cleaning these drains. Annual cleaning of drains start from the first of April every year before the start of the monsoon season. The storm water drains located within the city have been constructed from natural stones, while those in the outskirts are made of earth (kuchha drains).

So, under Smart City Mission, Jhansi Nagar Nigam initiated the rehabilitation of all drains within Area Based Development (ABD) area (13 ward out of 60). A detailed study and survey has been done to understand the natural topography, rainfall intensity, and watershed area of Jhansi. In this initiative, 110 kilometers of drains (width ranging from 0.11 mt. to 4.8 mt.) will be covered with heavy duty perforated RCC covers. Also, a new drainage line of 11.4 kilometers will be constructed. Storm water from the road will enter the drains through inlet openings provided at regular intervals.

The total proposed cost of the project is around Rs 2 crores, and the expected time of completion is June 2023. However, merely covering drains will not resolve the issue, until Jhansi Nagar Nigam establishes a system of regular cleaning and maintenance.

Photograph 30: Encroachment and direct discharge of wastewater into a drain in Shivaji Nagar

Photograph 31: Removal of encroachment over Kasai Mandi Nallah

Photograph 32: Direct discharge of wastewater into an open drain in Bada Gaon area

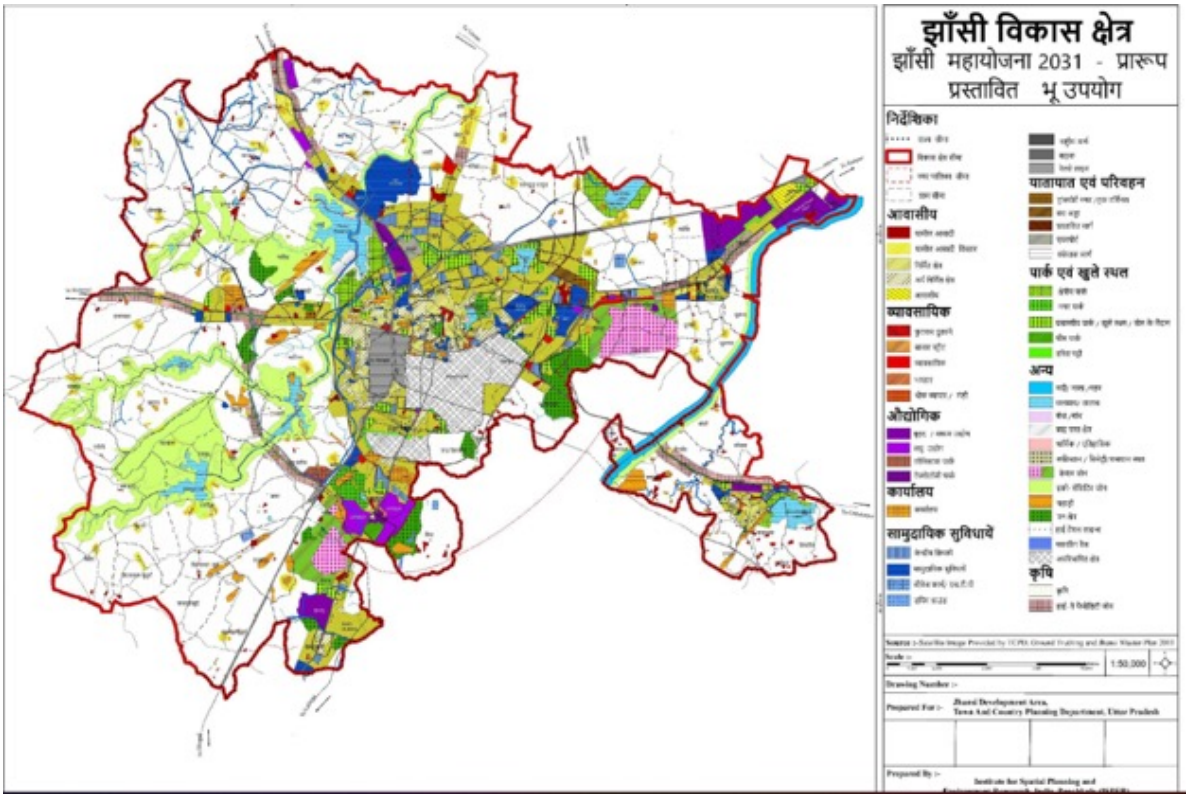
Photograph 33: Dumping of solid waste into open drains

7. Does Jhansi need an underground sewerage system?

Jhansi lies on the plateau of central India, an area that is dominated by rocky strata with some slope. The geographical conditions makes it difficult to lay an underground sewerage network. The City Sanitation Plan, 2014 suggested the laying of a sewerage network along with septage management. The Master Plan, 2031 of Jhansi did not mention anything about long -strategies for wastewater management in the city. It has only reserved two parcels of land—of 30 hectare each— in the eastern and southern part of Jhansi.

Despite having unfavorable conditions for an underground sewerage network, the Jhansi Jal Nigam has proposed the plan for an underground sewerage network

Map 9: Map showing the location of land reserved for STP in Master Plan 2031



for the entire city. The plan has been prepared under AMRUT as a City Water Action Plan (CWAP) for sewerage/ septage management in Jhansi. The plan is yet to be submitted and approved. The total length of the network is around 1,200 kilometers, with the total project cost of approximately Rs 1800 crores. The project also includes the establishment of one STP of 61 MLD capacity.

During discussion with the Jal Nigam, it was apparent that the project cost was too high due to higher excavation cost in the rocky plateau. The project would also be time consuming. Due to these factors, the projected cost of the initiative would increase by around 1.5 times. The old town of Jhansi is congested and the laying of sewers would be very difficult. Jhansi already has an FSTP of 18 KLD, which is working at full capacity. Another FSTP of 32 KLD is also ready to take the septage. The desludging services are accessible and strong within the central city area to meet the demand for desludging (except for approximately 30 per cent of congested areas). So, instead of opting for a sewerage network for the whole city, Jhansi can further strengthen the FSSM services in the core city area and plan for a sewerage network in peri-urban and newly developing areas.

8. Key learnings and recommendations

1. **Faecal sludge and septage management:** Jhansi adopted a unique incremental approach, instead of directly establishing huge treatment facilities. After successfully running the 6 KLD FSTP, Jhansi further expanded the treatment capacity to18 KLD, through 14th Finance Commission (FC) funds. Jhansi focused on nature-based, low energy intensive and low O&M cost solutions. In the absence of private operators, JNN awarded the desludging work to one single private contractor for providing desludging services across the city. With strong political will and administrative leadership, JNN also passed the FSSM bye-Laws in 2023 to strengthen FSSM services. Jhansi is also reusing the treated water for horticulture and selling the biosolids to an NGO at 32 paisa per kilogram for gardening purposes.

   However, access to desludging service in urban poor settlements needs to be further strengthened. In Jhansi, 30–40 per cent of the areas have narrow road width (2–3 meters) and to serve these areas special desludging vehicles should be procured. Also, the desludging charges (Rs 3,000 for 6KL and Rs 1,500 for 2KL) are unaffordable for the urban poor. For equitable services, differential pricing and a cross subsidy-based desludging model should be developed as per Jhansi context.

2. **Interception and diversion of drain and used-water/wastewater management:** To prevent the surface and subsurface water from pollution, Jhansi has intercepted and diverted the wastewater in 26 MLD STP for treatment. Earlier, these drains were flowing into Laxmi Taal. Now, 4 MLD of treated water from the STP is being diverted to Laxmi Taal for its rejuvenation, through a gravity pipeline. JNN is also tapping four major drains that flow directly into the Pahuj river and setting up another new 26 MLD STP, which will run in full capacity at the base year itself. Both STPs are based on SBR technology, which is very energy-intensive. Parallel to this, Jhansi Jal Nigam has also proposed a sewerage network for the whole city and a 61 MLD STP, despite the rocky strata in Jhansi's subsurface.

   This gives the impression of the lack of a long-term integrated planning approach. Various initiatives have been taken in a piecemeal manner without taking a larger city-level management approach. No study has been done to

map all the city-level drains. Both STPs lack scope/land for expansion and fail to consider the future increase in the wastewater generation. While planning, the mapping of drains, a population projection should be done. Apart from this, a larger city-level planning study should be conducted that considers peri-urban areas, urban poor settlements, existing infrastructure and future needs. New projects should be planned in a manner that they complement the existing infrastructure.

3. **Managing the water resources:** Being a water scarce region, Jhansi understood the significance of its old heritage of water bodies for water conservation as well as the importance of the community's connection to their water bodies for their sustainability. Due to encroachment, solid waste dumping and discharge of sewage, these water bodies were dying. To mitigate these challenges, JNN initiated the rejuvenation and beautification of these water bodies. For conserving water during monsoon, Jhansi adopted the unique approach of focusing on government buildings for rain water harvesting (RWH). JNN installed RWH system in 100 buildings, with a total cumulative volume of 1660 cubic meter.

   However, these initiatives have been planned and implemented without city-level aquifer mapping. In the absence of aquifer mapping, excessive de-silting of ponds/lake could hamper the subsurface and result in the permanent loss of aquifers. Similarly, while finalizing the location for rain water harvesting, aquifer mapping could've helped in identifying the recharge and discharge points in the city, resulting in improved outcome of RWH systems.

4. **Gender inclusion in sanitation and skill development:** To empower women and make them feel, JNN can include women's groups in the management of sanitation services. For example, the management of 'Pink toilets' can handed to self-help groups (SHG) working in the area. The SHG groups can also be involved in the operation and maintenance of faecal sludge treatment plants (FSTPs). The operation and maintenance of the faecal sewage treatment plant does not require highly skilled human resource. Through the National Urban Livelihood Mission (NULM), JNN can facilitate skill development of the family members of sanitation workers. That will help them find alternate livelihood options.

5. **Promoting cross-learning among other ULBs:** Jhansi Nagar Nigam has been supporting the cross-learning of challenges, shortfalls and approaches with other Urban Local Bodies (ULBs). Till now around 5,000 officials have the Jhansi FSTP and have learnt from the integrated approach taken by the city.

The report presents the journey of Jhansi which was the first city of Uttar Pradesh to set up a Faecal Sludge Treatment Plant (FSTP) for managing urban water and sanitation. Jhansi has pioneered in urban water and sanitation management by strengthening institutional frameworks, streamlining desludging services, reusing treated products, and rejuvenating lakes and heritage water sites structures.

The report covers the planning, implementation, sustainability, and inclusivity aspects of sanitation initiatives and lake rejuvenation work that have been undertaken by Jhansi over the last few years. It also addresses upcoming challenges, and provides recommendations for improvement. The report lays the pathway for many medium-sized towns of Uttar Pradesh and India that are starting their journey towards wastewater and septage management.

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