SEPTAGE MANAGEMENT IN BIJNOR TOWN

Towards Inclusive Sanitation in Uttar Pradesh

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Maps in this report are indicative and not to scale.

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- AMRUT—Atal Mission for Rejuvenation and Urban Transformation
- BNPP—Bijnor Nagar Palika Parishad
- BA—Bijnor Area (includes Bijnor core area and Bijnor Expansion Area)
- BEA—Bijnor Expansion Area
- BIS—Bureau of Indian Standards
- CAPEX—Capital Expenditure
- CPCB—Central Pollution Control Board
- CPHEEO—Central Public Health and Environmental Engineering Organisation
- CSTF—City Sanitation Task Force
- CWIS—City Wide Inclusive Sanitation
- CT—Collection Tank
- E. coli—Escherichia coli
- FSS—Faecal Sludge and Septage
- FSSM—Faecal Sludge and Septage Management
- FSSTP—Faecal Sludge and Septage Treatment Plant
- FGD—Focus Group Discussions
- FLT—Fully Lined Tanks
- GOI—Government of India
- HDPE—High:Density Polyethylene
- HH—Households
- IEC—Information, Education and Communication
- KII—Key Informant Interview
- KLD—Kilolitre per Day
- MoHUA—Ministry of Health and Urban Affairs
- MLD—Million Litres per Day
- MSW—Municipal Solid Waste
- MBGL—Metres Below Ground Level
- NPP—Nagar Palika Parishad
- NMCG—National Mission For Clean Ganga
- ODF—Open Defecation Free
- OPEX—Operational Expenditure
- OSS—Onsite Sanitation Systems
- PWD—Public Works Department
- PBIG—Performance Based Incentive Grant
- SBM—Swachh Bharat Mission
- SDG—Sustainable Development Goal
- SDB—Sludge Drying Beds
- SFD—Shit Flow Diagram
- SMCG—State Mission for Clean Ganga
- ST—Septic Tank
- TK—Total Potassium (as K_2O)
- TN—Total Nitrogen
- TOC—Total Organic Carbon
- TS—Total Solids
- TSU—Technical Support Units
- ULB—Urban local body
- UPJN—Uttar Pradesh Jal Nigam
- UASB—Up-flow Anaerobic Sludge Blanket
- UPPCL—Uttar Pradesh Project Corporation Limited

Executive summary

The state of Uttar Pradesh (UP) has made significant progress in creating faecal sludge and septage (FSS) treatment infrastructure in its urban centres. This is a key milestone in addressing the challenge of urban sanitation. The objective now is to ensure that the infrastructure becomes functional and that an enabling state policy, along with city level bylaws, is enacted to support the up-scaling of FSS management in all 763 urban local bodies (ULBs) of the state. This is of paramount importance as untreated septage poses a risk to human health[1], while treated septage can serve as a natural conditioner for soil as it contains valuable nutrients which can be harvested for agriculture.[2]

Uttar Pradesh is the most populous state of India, with nearly 17 per cent of the country's total population. As per the Central Pollution Control Board's (CPCB's) 2020–21 Annual Report, the total wastewater generated in UP's ULBs amounts to 8,263 million litres per day (MLD), out of which only 3,374 MLD is currently being treated at 107 treatment facilities across 31 ULBs.

Bijnor city is the district headquarter of one of the largest districts of Uttar Pradesh (by number of local bodies in it). It is situated 12 km to the west of River Ganga. The city had a population of 93,992 according to the 2011 Census. That has increased approximately to 235,000 in 2022 after the expansion of its boundary in 2020. The city's area was increased after addition of 13 adjacent villages to 11.16 km^2. This is more than three times its area of 3.61 km^2 in 2011.[3] Over 90 per cent of the population in the city is dependent on onsite sanitation systems which are septic tanks, or fully lined tanks.[4]

In 2019, a 24 MLD sewage treatment plant (STP) was commissioned in the city after diverting 17 drains into the sewer network laid in 2016. The city had no infrastructure for treatment of FSS until 2022 and only grey water was being treated in the STP. The National Mission for Clean Ganga funded a 20 KLD co-treatment unit at the site of the 24 MLD STP in Bijnor in 2020 as its first flagship project of this type in Uttar Pradesh. The Centre for Science and Environment (CSE) provided technical assistance in planning, designing and operationalizing this unit, which has been fully operational since June 2022.

UP has followed a standard model of 25 KLD capacity co-treatment units. There is an electrical-mechanical screw press installed for separation of solid and liquid

from the sludge. An operator is often required to monitor and operate the machine. However, the unit in Bijnor uses a simple process of screen chambers, followed by a sludge stabilization tank, solid-liquid separation at sludge drying beds (SDB) and subsequent co-mixing of liquid with sewage in the inlet of the STP. This is followed by its treatment as part of the sewage treatment process at the STP. Co-treatment of septage with sewage has proven to be an efficient use of the existing STP infrastructure.

Bijnor town has put in place a sewerage system that is yet to be connected to the households, hence the co-treatment facility is filling a critical gap. The expanding boundary of the town will always have the potential to cater to this population that are mostly the poor and marginalized.

Potential and limitations of co-treatment systems

For cities that are partially covered with sewerage systems, co-treatment of FSS in existing STPs provides an option for treatment of septage generated in the city.

Expanding cities of India and other countries in the global south are unlikely to attain 100 per cent sewerage network in the coming two or three decades. We cannot therefore wait for sewerage systems to be set up. Sewerage systems are water dependent flow systems requiring large quantities of water as well as electricity and pumping costs when the gravity-based flow system is disrupted. The financial burden of operating and maintaining sewerage based urban sanitation systems is substantial.

The only caution when going for co-treatment of septage with sewage is that the existing sewage treatment systems should be functional and should treat sewage to desired standards. Functionality of STPs in India remains a challenge. If the STP is not functional and does not treat the sewage that it receives, then it cannot be expected to treat septage through co-treatment.

In many cities in India, FSS is directly added without any pre-treatment, either at the inlet of the STP or at the nearest pumping station or manhole of the sewerage network. The considerably higher solids, organic and nutrient load of FSS as compared to sewage, can lead to severe operational problems such as solids deposition, clogging and corrosion of sewerage infrastructure, including STP. This is because the diameter and slope of sewers are designed for the transport of municipal wastewater typically containing 250 to 600 mg TSS/L rather than the 12,000 to 52,500 mg TSS/L present in FSS. Further, the high strength of FSS can have a large impact on the organic, suspended solids and nitrogen loads in the STP

and thus impact its treatment efficiency. The intermittent nature of FSS loading will give rise to high instantaneous loads and thus amplify the problems.[5]

It is also true that combined sewerage-storm water-based systems in most Indian cities, ensure that the strength of the sewage (BOD and COD) coming to the STPs is often less than the designed treatment capacity. Hence there exists a potential to add septage, in appropriate dosage, that can improve the functioning of some STPs. What is therefore required is scientific co-treatment of septage with sewage.

Purpose and aim of the report

The report documents the setting up of the first successfully operating facility for the scientific co-treatment of septage with sewage in Uttar Pradesh, in Bijnor town.

The aim is to describe both the technical and social aspects of septage-sewage co-treatment work, including the important process of bringing together elected representatives, municipal officials, private sector septic tanks desludging operators and citizens of Bijnor in developing and implementing the Faecal Sludge and Septage Management Plan in Bijnor town.

The report highlights the key lessons learnt during the implementation and construction phase of the project:

- Simple but important aspects of designing the infrastructure for co-treatment
- Managing the sludge on arrival at the co-treatment facility, including inlet and outlet connectivity that are important for minimizing risk and spillage
- The importance of and prior readiness of the private sector sludge tanker operators engaged to handle co-treatment desludging
- Need for citizen engagement and a city-level task force to monitor and support this work

Learnings from Bijnor

Long-term systems approach to urban sanitation

Promotion of non-sewered and decentralized sanitation systems requires both policy and program support. The first requirement at the state level is a sanitation strategy and investment plan. This should define the infrastructure and investment plan for urban sanitation in the state for a long-term period of at least 10 to 20 years—that is, how many towns in the state will address their sanitation infrastructure gaps with what types of sanitation systems (sewered and non-sewered sanitation systems)?

Within the larger focus of a circular economy that promotes re-use of treated waste, the focus must be on sustainability of sanitation systems, the operations and maintenance aspects, and equity, inclusion and justice elements of urban sanitation services.

At the city level a City Sanitation Plan (CSP) is needed to define sanitation hotspots, gaps in sanitation and what needs to be done to address them.

Creating a city-level coordination platform

Septage management has long been neglected, given the many stakeholders involved in the sanitations service value chain. The onus of bringing all stakeholders together and address all parts of the sanitation service value chain, requires commitment from the highest levels. With the passage of the National FSSM Policy (2017), state governments are responsible for developing plans and strategies that will enable ULBs to implement septage management solutions.

At the town level, the ULB must focus on all parts of the sanitations service value chain, and take all stakeholders along to address bottlenecks in septage management.

A platform was created in Bijnor town, in the form of a City Sanitation Task Force (CSTF), initially headed by the District Magistrate and later the Town Commissioner/Chairperson. The CSTF provided a receptive body of city officials and elected representatives, to whom the challenges of septage management could be posed. They had the ability to take joint coordinated actions to address these challenges. CSE could present baseline studies of sanitation in Bijnor and Shit Flow Diagrams (SFDs), and put up proposals and suggestions to this group. Democratic city-wide platforms are needed not only for addressing urban sanitation but all other challenges as well. Towns with very large populations and complex urban sanitation requirements may require more than one platform and some additional coordination to achieve an effective city-wide platform.

Understanding scientific co-treatment of septage with sewage

Scientific co-treatment is a conscious procedure of adding FSS to STP modules by understanding the boundaries of treatment in STP. It consists of a detailed study of FSS, sewage and STP modules for compatibility to cater to FSS effluent treatment in STP. Scientific co-treatment is an unconventional method to treat FSS in already existing sewage treatment plants. Contractors experienced in building large sewage treatment plants struggle to execute small sized co-treatment units as they lack the understanding on concepts. In the Bijnor co-treatment project, the contractor was not able to understand the true purpose of the equalization tank and solar roof.

In Bijnor a pre-feasibility study for scientific co-treatment of FSS was done. Quantity, quality and timing of sludge addition to the existing and functional STP needs to be assessed for scientific co-treatment. In Bijnor, this assessment helped in designing modules necessary for co-treatment. The study identified the vast difference in the characteristic/quality of FSS samples collected. An equalization (homogenization tank) of 60 kilolitres was added to the original design.

The final process of scientific co-treatment in Bijnor includes:

- **Screening**: Two screen chambers fitted with bar screen and fine screen are constructed to remove solid wastes from the FSS.
- **Equalization (homogenization) tank:** This tank is used as collection cum equalization tank where FSS collected from different areas of Bijnor (having variable characteristics) is held for a duration of 24 to 72 hours and homogenized FSS is passed to next unit with the help of a control valve.
- **Sludge sump:** Faecal sludge stored in the homogenization tank is passed to the next unit which is sludge sump**. This unit is already there as part of STP unit in a working condition.** Therefore, it helped in cost cutting in co-treatment.
- **Sludge drying beds (SDBs):** The purpose of this module is to separate solid and liquid from the FSS. Sludge drying beds are one of the simplest and oldest techniques for sludge dewatering. They are impermeable beds filled with different layers of gravel and sand. Draining pipes are incorporated at the bottom of the beds. Sludge is applied in layers on the top of the beds. Drying is achieved by evaporation and gravity percolation. The effluent (percolate) is collected in the filtrate sump. **SDBs are already part of the STP unit in working condition.** There were a total of 18 SDBs at the Bijnor STP. Two are being used in the co-treatment process. This also helps in cost-cutting.
- **Solar roof:** To expedite the process of drying of sludge at SDB, solar roofs were installed over two SDBs. These solar roofs were made of polycarbonate sheets which trap solar heat and raise the temperature over beds.
- **Filtrate sump: The effluent from the SDB collects in the filtrate sump of the STP (already existing).** This effluent in the filtrate is further transferred to the inlet of the STP for treatment with incoming wastewater from the city.

Scientific co-treatment helps in careful and conscious addition of FSS in STP inlet or reactor, which is different from the conventional practice of adding FSS directly without any pre-treatment, either at the inlet of the STP or at the nearest pumping station or manhole of the sewerage network.

Strategizing septage treatment: Steps taken

FSSM and wastewater management projects may or may not involve heavy

infrastructure depending upon the local context and priorities. If the baseline study suggests a major dependency on OSS in the city, then ULBs should prioritize actions accordingly. The Bijnor Nagar Palika Parishad (BNPP), with technical support from CSE, concluded that there was potential for co-treatment of 20 kilolitre septage with sewage at the existing STP of Bijnor.

Work on planning for desludging of septic tanks started before the construction of the co-treatment infrastructure at the STP.

Early engagement of the ULB with private desludgers brought a sense of trust between ULB and private players. It helped the BNPP during the trial period and commissioning of co-treatment, as private desludgers were readily available to provide FSS for disposal.

Understanding desludging design aspects: Engaging with desludging tanker operators

Private players play an integral role in any FSSM project. In Bijnor, private desludgers were regularly consulted for various purposes with respect to planning and implementation of the FSSM infrastructure.

One important aspect was matching the height of the screen chamber inlet with outlet of vaccum tanker to ensure minimal spillage and complete decanting of the tanker at the screen chambers of the co-treatment unit. Several existing desludging tankers were invited to measure the height of the outlet of vacuum tankers and the inlet height levels at the co-treatment plant. This is critical to ensure full desludging of the tankers, minimizes risk of spillage of septage, accidents and potential health risk to workers.

The early engagement of the ULB with private desludgers helps in understanding their operational and financial constraints. For example, the sprayer tap at the co-treatment unit were suggested by one of the private desludgers. It currently helps in washing hands after decanting or cleaning any accidental spillage.

Design considerations

a. Institutional and operational

- The actual cost of operation and maintenance of the co-treatment apparatus on the premises of the 24 MLD STP in Bijnor has been proved to be negligible. At present, a single worker is able to manage the operations which involve maintaining the register and cleaning of the premises after decanting on daily basis. It also involves transfer of FS from equalization tanks to SDB

whenever the tank is full. Sometimes, solid sludge accumulates at the bottom of the equalization tank. Support from STP is then taken to safely remove the accumulated sludge for proper cleaning of the tank.

Photograph 1: Accumulated sludge removed

Photograph 2: Removal of accumulated sludge

- Sludge accumulation at the bottom of the equalization tank happens mostly when the equalization tank is not emptied regularly (usually once in a week). Sometimes the worker does not empty the equalization tank.
- In the winter season, it is hard to dry the separated sludge on the sludge drying beds due to high moisture content in the air and foggy mornings.
- It is always better to put removable screens made of stainless steel. It helps in proper cleaning of the screens as well as the chamber.

Photograph 3: Removable stainless steel screens

- ULB should be made responsible for management of co-treatment premises.
- Reuse of treated sludge in commercial crops is desirable. However, in Bijnor it is currently used for gardens in the city. Regular cleaning and dumping of sludge is laborious. The BNPP Staff avoids coming to the STP, which is approximately 10 km away. Hence, a mechanism to create demand and monetary value of the treated sludge must be worked out for better reuse.
- Flexibility is needed for changes during the construction phase (against original design), suiting local conditions. During the entire construction period, maintaining quality standards and addressing emerging issues like groundwater seepage are important. The Detailed Project Report (DPR) of Bijnor co-treatment mentions that the thickness of the reinforced cement concrete (RCC) base for the equalization tank was not sufficient to stop seepage into ground water. The thickness of the RCC base was later increased to eliminate any groundwater seepage. Further, it did not include a detailed design for control valve for transferring FSS from equalization tank to sump well. The control valve was later introduced in the design with proper cover and chamber.

b. How much co-treatment is feasible?

Currently the average incoming faecal sludge at the co-treatment unit is approximately 8 KLD. It is transferred to the SDB every week. It is observed that around 25–30 kl of equalized FS reaches drying beds every week, which generates around 10–12 kl of leachate in the filtrate sump. This filtrate is sent to the inlet of the STP, where it is mixed with incoming municipal sewage. Since it is only done three to four times a month, it has not been seen as disturbing the treatment efficiency of the STP. The CSE lab conducts test in every quarter by taking samples and the results are evidence of the normal functioning of the STP.

Transfer of responsibilities

Frequent changes in the executive/administrative body of the ULB can be a challenge. It creates gaps in the understanding of the city administration on the progress of the project. It also depends on the zeal and priorities of the new administration, to carry forward or to disown the past work. On the other hand, changing administration may do wonders in terms of clearing the files stuck between government departments before. For example, the change of officials in Bijnor in 2022 led to clearing of long pending files of FSSM bylaws, their Gazette notification and the start of construction of a much-delayed DWWTS project. The pro-activeness showed for understanding the gazette process of FSSM bylaws notification increased the pace of the Bijnor FSSM project. An incentive scheme to push private desludgers for maximum decanting at the STP co-treatment facility has been a game changer in Bijnor for increasing the decanting/de-sludging work.

Willingness of different stakeholders to take part in sustainable sanitation

The CSTF in Bijnor consists of different stakeholders coming from several departments and NGOs. CSE-TSU, in their experience with facilitating CSTF meetings, have learnt that the interests and urge of the stakeholders fade when the projects proposed do not attract bulk funds or infrastructure in the city. Willingness of stakeholders for small projects has been low. The idea of heavy infrastructure projects with equally heavy inflow of funds are romanticized by different stakeholders, without understanding their feasibility in the local context.

Safe management at source

Properly designed septic tanks are important for scientific primary and partial digestion of excreta which is further treated in FSTP. During the preparation of SFDs and subsequent discussion with households and masons, it was found that septic tanks are not being designed appropriately in Bijnor. CSE capacitated BNPP officials on ideal designs of containment systems and proposed an onsite training in Bijnor for local masons, civil contractors and labourers on scientific designing of septic tanks and twin pits. The objective was to develop the skills of workers in designing ideal onsite sanitation systems as per Bureau of Indian Standards (BIS) code for safe management of excreta at the containment stage of the sanitation value chain. Further, the training aimed at pushing local masons to promote scientific designing of containments to property owners in the city. The training was conducted as a mix of theory and on-ground practice that helped BNPP create a model of septic tank and twin pits system in the Bijnor NPP garage campus.[6]

Photograph 4: Ideal containment site after the participating masons constructed the OSS in January 2020

Photograph 5: Ideal containment site after renovation to use it as a learning center by BNPP in Dec 2021

Some great feedback was given by the trained masons who made efforts to implement the correct design on field:

1. Until the building bylaws are followed stringently in the city, local masons cannot abide by or commit to constructing scientifically designed septic tanks.
2. Home owners have a tendency to push for constructing bigger sizes (as big as 25 cum) septic tanks, if availability of funds is not an issue.
3. Low-income home owners make small (2.5 to 3.5 cum) rectangular collections tanks (no baffle walls) with outlets in open drains.

About the report

In 2017, Ministry of Housing and Urban Affairs (MoHUA) identified CSE as a partner to technically support 23 flagship towns in achieving open-defecation free (ODF) status and prepare city sanitation plans (CSPs). Being one of those towns, Bijnor approached CSE for support in capacity building and technical guidance to prepare its CSP.

CSE made a Shit Flow Diagram (SFD) of Bijnor city to map the fate of excreta and wastewater in the city. This was baseline research for CSP preparation. The results showed that only 6 per cent of the population's excreta and wastewater was being managed safely. Bijnor NPP, under technical guidance from CSE, constituted a City Sanitation Taskforce for implementation of CSP and FSSM.

In 2019, Bijnor city commissioned its 24 MLD Sewage treatment plant, under State Mission for Clean Ganga funded by National Mission for Clean Ganga (NMCG). However, there were no household connections to the sewerage network and wastewater was intercepted and diverted to the 24 MLD STP. Though municipal sewage was reaching treatment, faecal sludge remained untreated.

In 2019, NMCG guided CSE to explore possible treatment plans for faecal sludge under its technical partnership. CSE came up with a plan to implement 20 KLD co-treatment for core Bijnor city and later construct an FSSTP for the expanded Bijnor area. In line with its vision of pollution abatement in the Ganga, NMCG sanctioned its first co-treatment project in the state. The construction of the project started a year later as the country was fighting the COVID-19 pandemic. Uttar Pradesh Project Corporation Limited (UPPCL) started project construction and commissioned the unit in May 2022. The 20 KLD co-treatment unit was handed over to BNPP in July 2022.

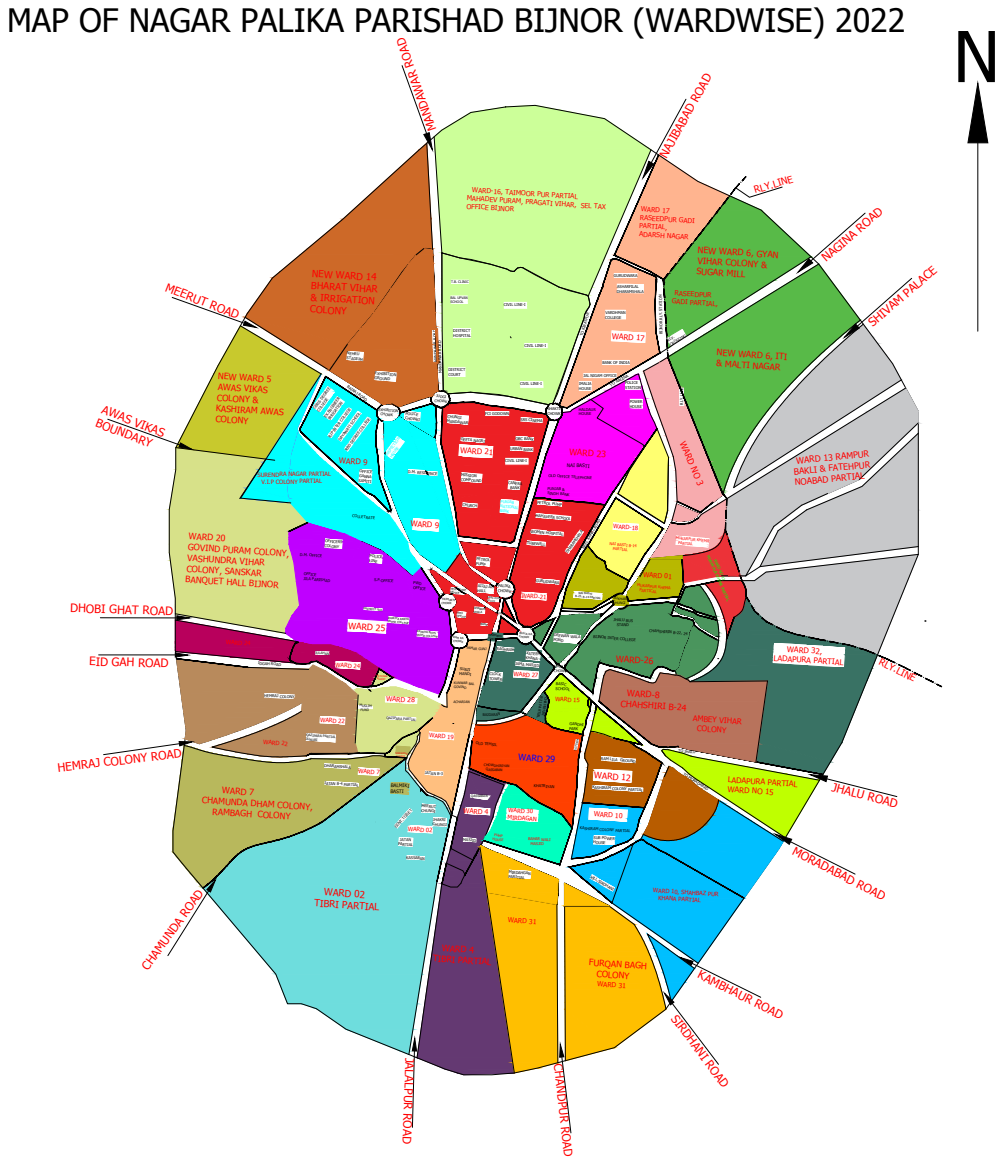
Setting up FSSM and implementation of CSP in Bijnor city was a combined effort of the citizens of Bijnor, BNPP, SMCG, NMCG and UPPCL. The journey has not ended yet, and will continue in the future.

The current report is an effort to document the journey so far, from its beginnings in 2017 till December 2022. The functional co-treatment facility is the first of its type fully funded by NMCG in the country.

1. Introduction to Bijnor

Bijnor city is a small urban region which lies in the upper Indo-Gangetic plains (V), 12 km west of River Ganga. The city is also the district headquarters of Bijnor district in Uttar Pradesh (UP). It is located 460 km from the state capital, Lucknow and 165 km from the national capital, Delhi.

Map 1: Current boundary of Bijnor Nagar Palika Parishad



Source: BNPP, 2021

The city is well connected with other parts of the country via railways and roads. Bijnor railway station (Northern Railway) is located at a distance of 2 km from the city centre (Nagar Palika Parishad, Bijnor Office). National Highway 34 (Gangotri, Uttarakhand–Lakhnadon, MP) connects Meerut and Haridwar to Bijnor. State Highway 12 (Panipat–Khatima), 49 (Moradabad–Dehradun) and 51 (Badaun–Gajraula) connect Bijnor with other major towns.

The current municipal boundary of Bijnor Nagar Palika Parishad (BNPP) encompasses 32 wards spread over an area of 11.61 sq. km. The current boundary of the city is the updated boundary after the city underwent expansion after approval from the centre (Lucknow) in 2020. **The city has recently expanded to include 14 villages (some partially and some fully) in its boundary, which are denoted as Bijnor Expanded Area (BEA).[7] However, the core city is denoted as BNPP boundary and the complete area in the current administration of BNPP is denoted as Bijnor Area (BA) in the current report.**

Table 1: Population of Bijnor city before and after expansion

	Population	Area (sq. km)	Source
Before expansion (census 2011)	93,392	3.65	Census 2011
After expansion (census 2011 based)	171,759	11.61	Census 2011
Estimated actual (2022)	235,000	11.61	BNPP (estimation)

History of Bijnor

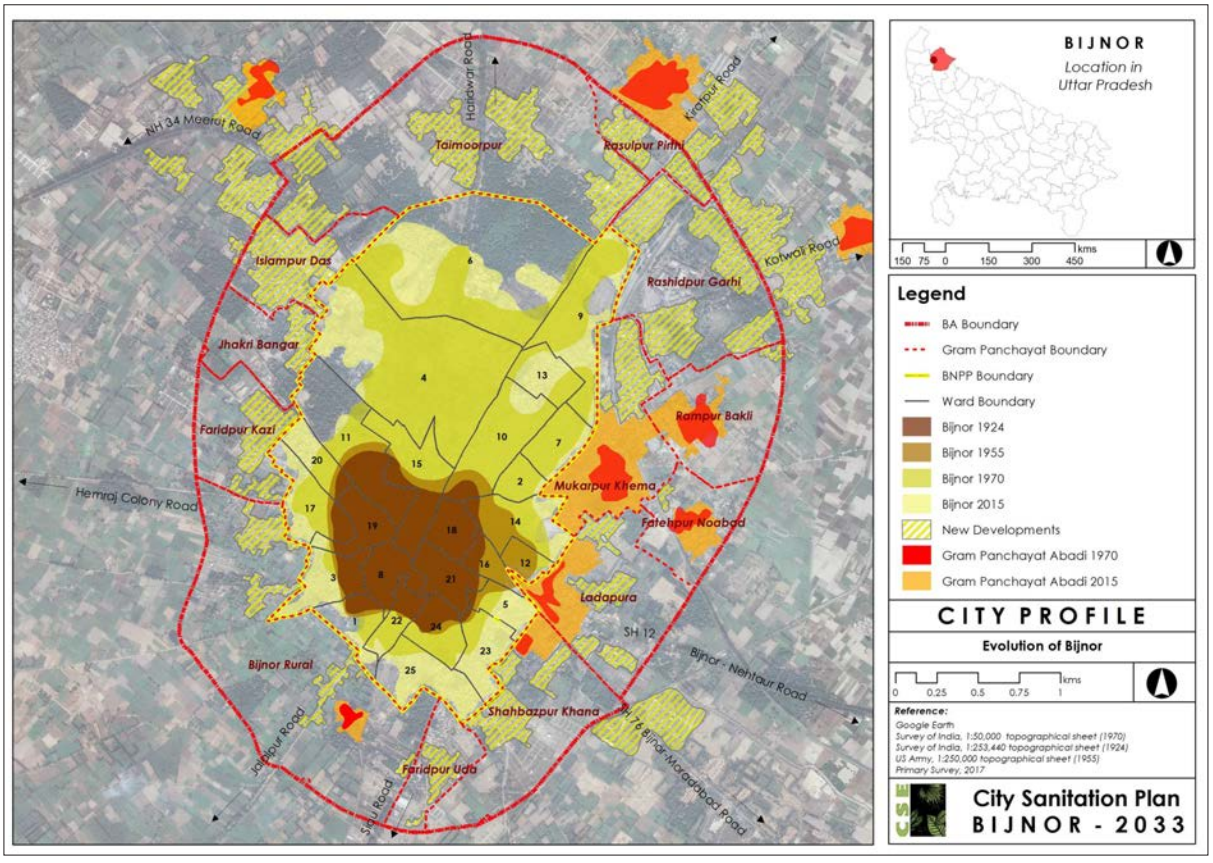
In mythology, Mahabharata mentions Bijnor as the residence of Vidur (currently Vidur Kuti is located 12 km from Bijnor city). The later records are from 16th century when Bijnor was a pargana in Akbar's Empire. In the 17th century, Jats overthrew Muslims and took over control of the town. In 1801, Bijnor was included under the collectorate of Moradabad under the rule of the East India Company. A new district was carved out and called Northern division of Moradabad in 1817 with its headquarters in Nagina. In 1824, the district headquarters was shifted to Bijnor due to the un-healthiness of Nagina and strategically closer location of Bijnor to Meerut Cantonment.[8] Later in 1857, the division was captured by the Nawab of Najibabad. Finally, Bijnor became a municipality in 1866 after being annexed by the British Empire.

Evolution of Bijnor and land-use in Bijnor Area (BA)

The city of Bijnor (wards 8, 18, 19, 21 & 24 which make the old part of city) observed growth towards the east up to 1955. Following this, the city has been recording growth towards the north and northeast continuously. However, in case of BEA, except the south and southwest boundaries of BNPP, all other panchayats have

recorded growth towards BNPP. The exceptional growth has been recorded for Taimoorpur, Mukurpur Khema and Rashidpur Garhi.

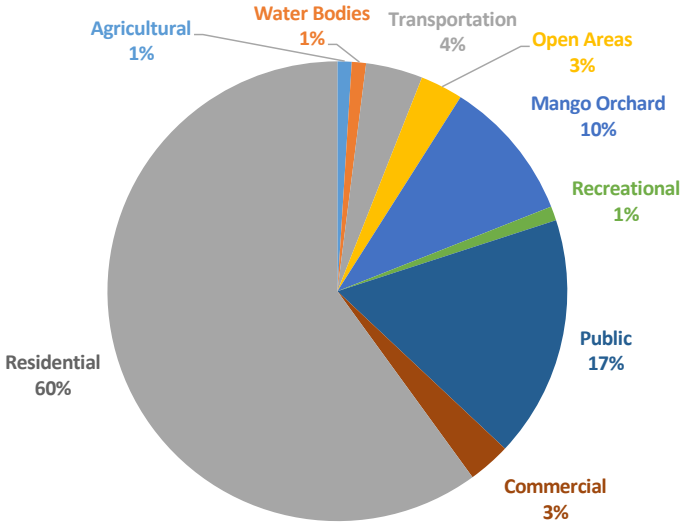
Map 2: BNPP (Bijnor core city) evolution



Source: CSP-Bijnor, 2018

Like any other class II town of India, there is mixed land-use prevailing in BNPP i.e., residential and commercial areas are intertwined. Further, the commercial establishments are mainly located along the major roads in old city (wards 18, 19 and 22) and on road from BNPP office to SRS Mall. The institutions (public/semi-public) are mainly located in wards 4, 6, 9 and 11. There are significant areas within BNPP boundary under mango-farming. In case of BEA, the land use is mainly residential mixed with institutional area.

Graph 1: Land-use distribution in Bijnor Area

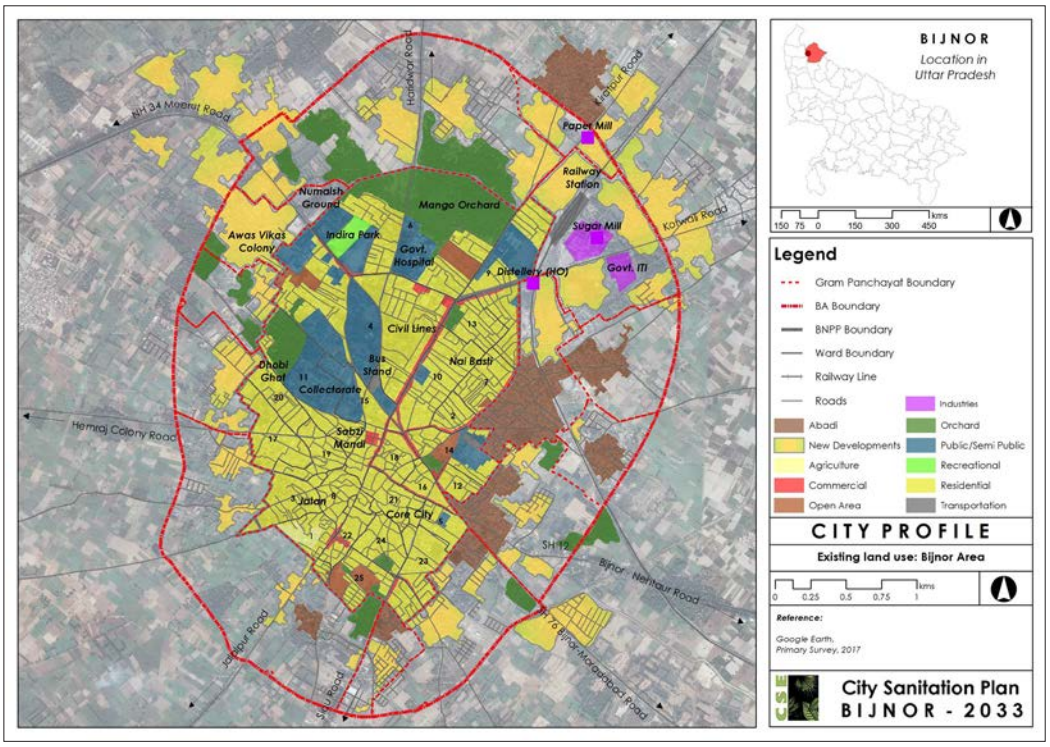


Source: CSP-Bijnor, 2018

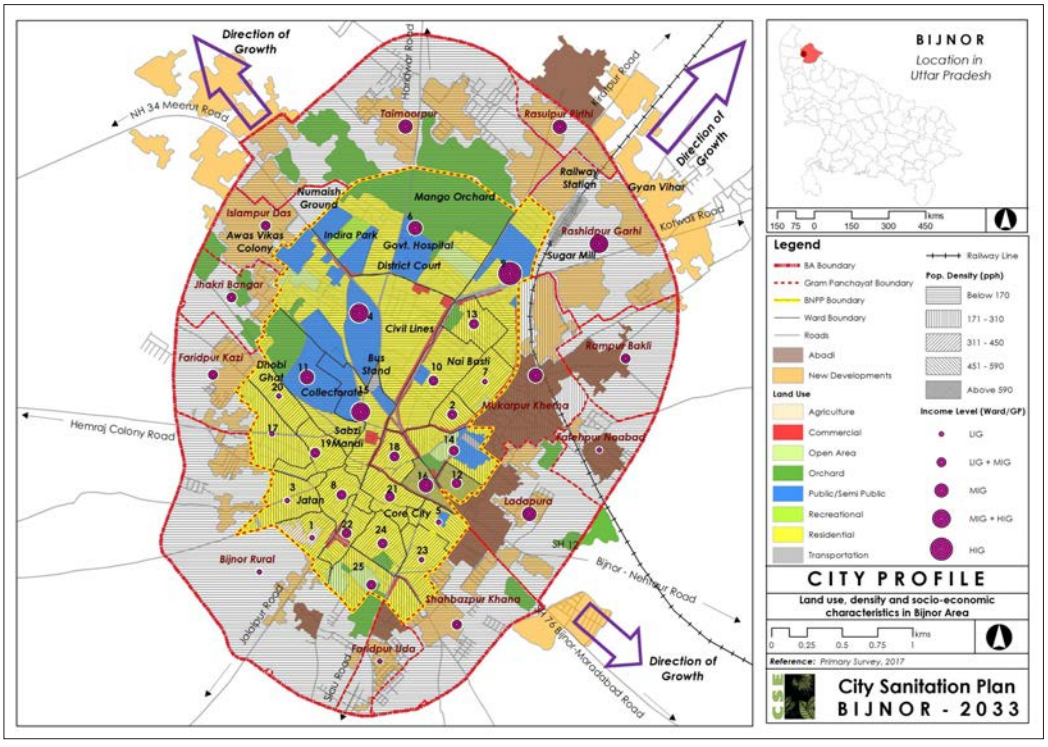
As per the topographical sheet 1924, evolution of the old city is found to be concentrated around wards 18 and 19. All other wards situated around the old city are in the southern part—establishing the core of the city. Sabzi Mandi which is the main vegetable wholesale market of the city is also located in this area. The overall density of this area is high with narrow lanes and cluttered housing with mixed land use. It has been observed that the area comes under relatively low-income group settlement followed by rural setting towards south west of the BEA. On the eastern part of this area, the prevalent settlement is of Abadi area which is located in the low-lying part of the city prone to frequent water logging.

The northern part of the city which lies above Kiratpur road constitutes the civil lines, the low-density administrative area neighbouring mango orchards. The collectorate and other administrative offices are located in the north western part of the city followed by new developments of low-income colonies like Awas Vikas located near Dhobi Ghat. However, open areas in and around Dhobi Ghat are frequently flooded due to incorrect design of the drainage channels. Other open public spaces of this area like Numaish ground and Indra Park are located along the Meerut road. The city is well connected through railway lines with the station located in the eastern part followed by a major sugar mill industry towards the northeast. The future urban growth in terms of development of new colonies, schools and institutions is also proposed towards the north-eastern part of BNPP along Kiratpur and Kotwali roads.

Map 3: Land-use in Bijnor Area



Map 4: Land use, density and socio-economic characteristics

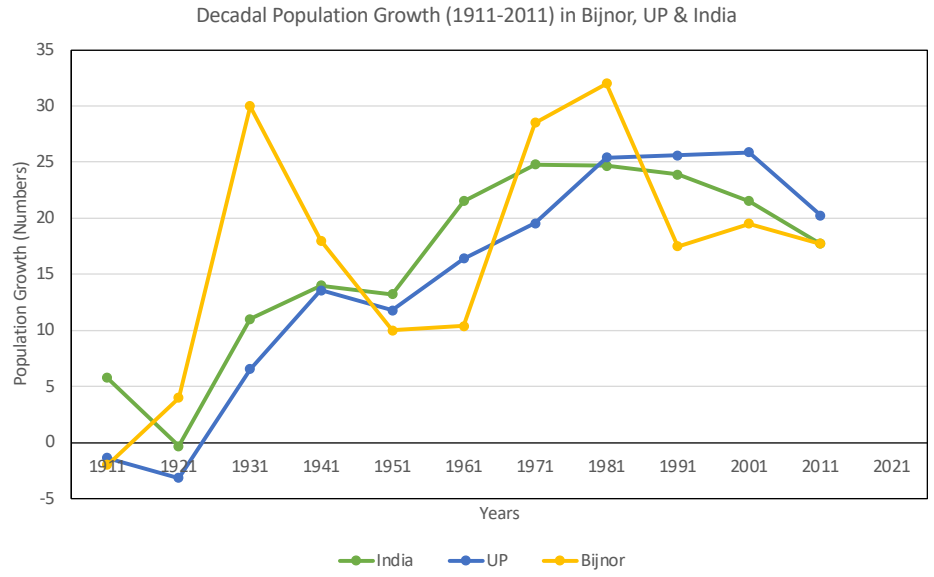


Source: CSP-Bijnor, 2018

Demographics

From 17,583 in 1901, the population in BNPP has grown to 93,297 in 2011 with a total of 17,715 households (HHs). Bijnor witnessed less population growth when compared to UP and India except for occasional surges in 1931, 1971 and 1981, suggesting a natural growth pattern.

Graph 2: Decadal population growth (1911–2011)



Source: Census India

Population density of BNPP is 25,915 persons per sq. km which is very high in comparison to UP and India's population density of 828 and 325 respectively. Wards 4, 6. 9. 10, 11 and 15 have the least population density (3,882–15,993 persons per sq. km.) as the land use in these wards is mainly institutional and open spaces. Wards covering the oldest part of the town (2, 5, 12, 16 and 22) are the most densely populated (44,850–72,794 persons per sq. km.).[9]

Further, in BEA, the population density is low as compared to BNPP except for Mukurpur Khema which is a census town. In recent times, BEA has been witnessing new development in the north (mainly residential plotting), northeast (industrial) and southeast (academic institutes and residential plotting).[10] Also, the southwest does not show any remarkable sign of development and land use primarily remains agricultural. The cumulative population of BEA (covering nearby 14 villages) is 78,367 with 11,853 HHs.[11] Thus, the total population of BA is 1,71,759 residing in 29,568 HHs with a population density of 14,255 people per sq. km, which is still high as compared to that of state and country.

Climate and hydrogeology

According to Indian Council of Agricultural Research's (ICAR), Bijnor is located in hot, sub-humid (dry) northern plains. Located at elevation of 225 metres/738 feet above mean sea level, Bijnor's topography is primarily plain. The overall slope in BNPP is towards Ganga at 0.2 per cent. Bijnor receives an annual average rainfall of 999.4 mm, mainly from southwest monsoon in JJAS (June, July, August and September). Temperature in Bijnor ranges from 5 °C to 46 °C.

Drainage and groundwater

In BNPP, most of the roads are covered with the drainage network and 80 per cent of the drains are covered.[12] The existing drainage network is designed along the roads as per road width and not corresponding to catchment area. As the city largely follows natural topography, the major outfall of drains is in BEA along three radial roads i.e., Hemraj road, Meerut road and Jalalpur road. However, in 2019, after sanctions of the National Green Tribunal (NGT), almost all the major (98 per cent) drains were intercepted and channelled to the 24 MLD STP in Kherki Village. Hence, most of the drains are conveying the storm water from BNPP to STP now. Whereas in BEA, inadequate drainage network leads to water logging on roads and low-lying areas. The groundwater in Bijnor city lies between 5–25 mbgl.

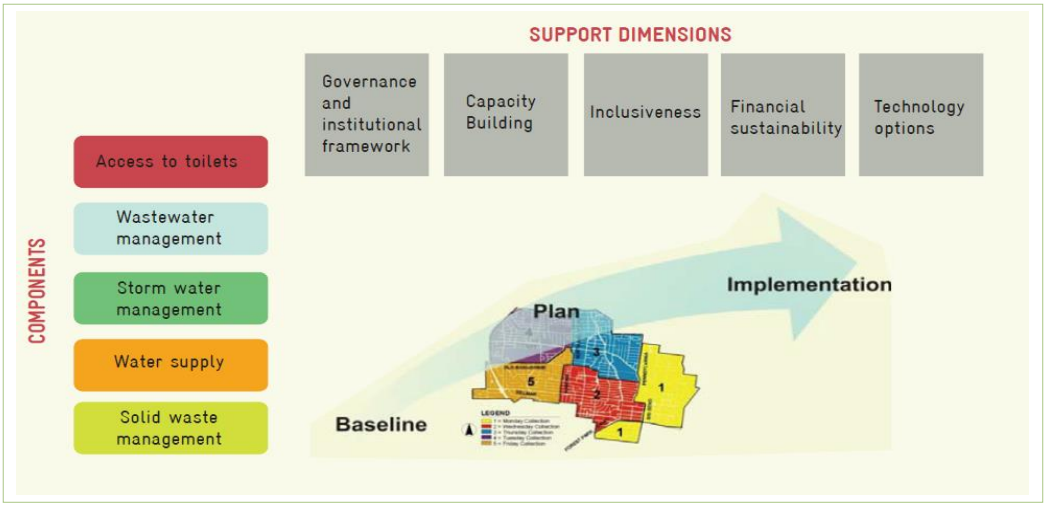
2. Sanitation in Bijnor from 2011–22

The following section captures Bijnor's journey towards achieving Faecal Sludge and Septage Management (FSSM) goals, with technical support from the Centre for Science and Environment (CSE), New Delhi. These goals were laid in the vision of implementation of the City Sanitation Plan, Bijnor, endorsed by CSE in 2018.

CSE, with the support of MoHUA and Ministry of Water Resources for River Development and Ganga Rejuvenation (currently under Ministry of Jal Shakti), has been working on an initiative aimed at capacitating ULBs and other stakeholders to help achieve convergence of national programmes—namely NMCG, AMRUT and SBM—in identified flagship towns/cities by preparing city sanitation plans for effective citywide sanitation including water supply, access to sanitary toilets, storm water management, wastewater and septage management, and solid waste management. MoHUA identified CSE to support a total of 23 towns (including Bijnor) so that they become flagship towns in achieving ODF status and effective faecal sludge management (*see Annexure 2*).

BNPP requested CSE's support to prepare Model CSP for Bijnor city (*see Annexure 3*). In response to this, CSE has extended support to demonstrate the approach, methodology and final outcome of an effective and implementable CSP.

Figure 1: Components of a CSP

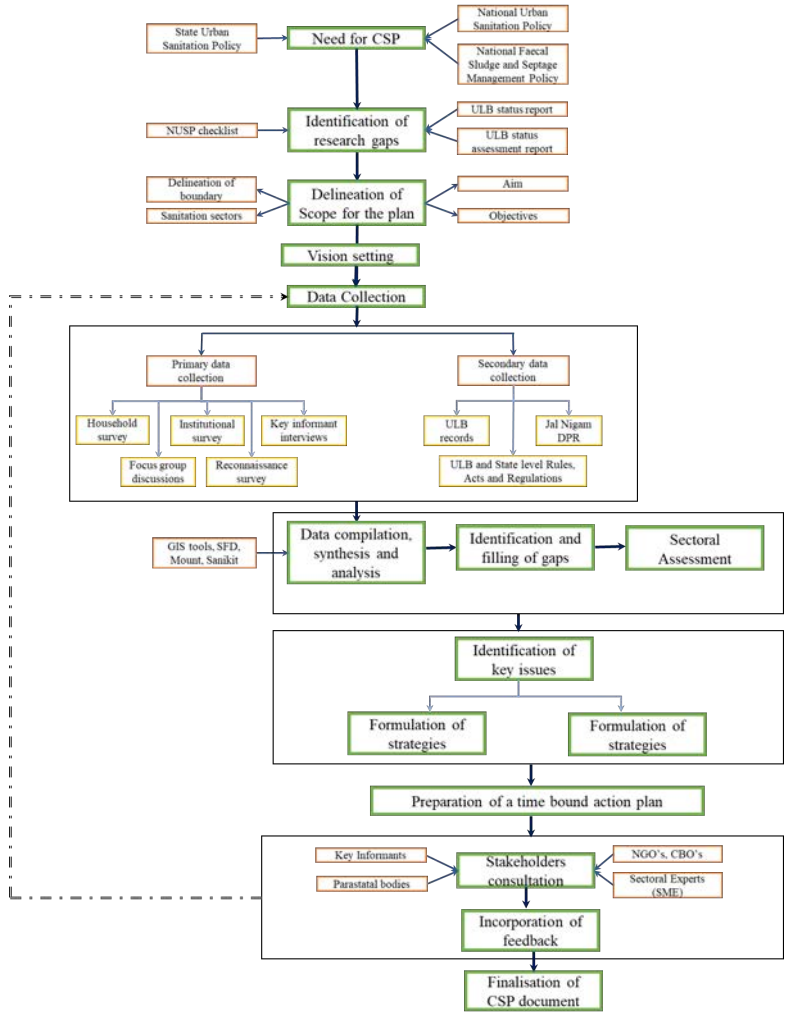


Source: Dirk et.al, Introducing CSP: Practitioners Manual, 2016

Approach and methodology for CSP

- **A systematic and all-inclusive approach** was deployed to prepare the CSP of Bijnor Area. The process involved field surveys (households, institutions, key informant interviews, focussed group discussions).
- **Desk research** (relevant policies, guidelines, ULB records, roles and responsibilities of parastatal bodies, research publications) well supported with the use of advance tools (such as GIS and SFD).
- Capacity building of the staff of BNPP to teach the methodology to prepare CSP

Figure 2: Approach and methodology taken for preparing Bijnor CSP

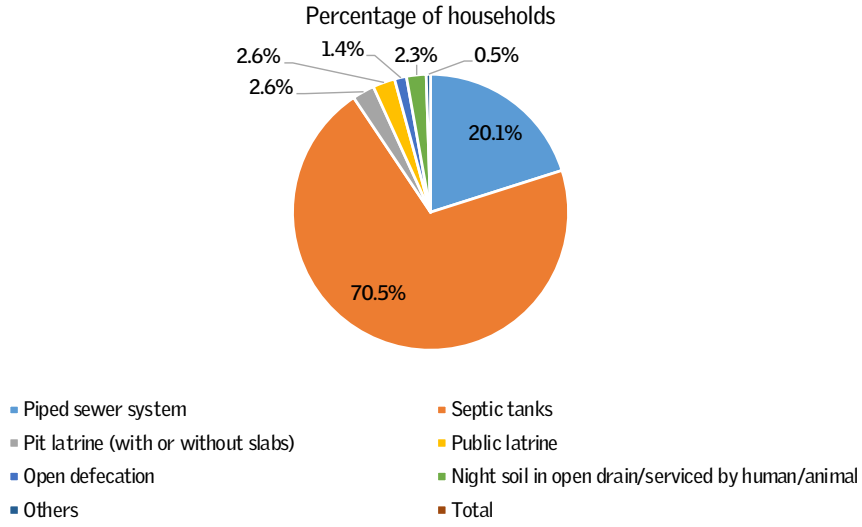


Source: CSE, 2014

Baseline studies: Shit Flow Diagrams

According to the 2011 Census, nearly 20 per cent of the population in Bijnor was connected to piped sewer network whereas approximately 80 per cent of the population was dependent on onsite sanitations systems (OSS) like septic tanks or pits.

Graph 3: Different sanitation systems prevalent in Bijnor

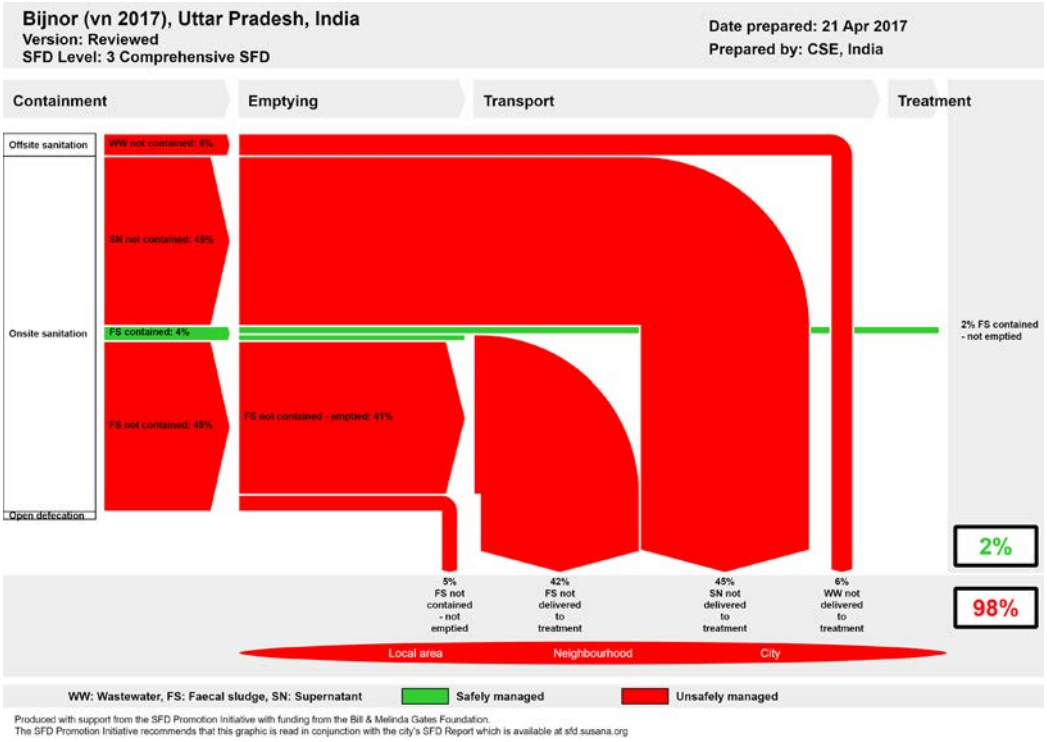


Source: Census, 2011

To understand the sanitation scenario of the city, CSE used the Shit Flow Diagram (SFDs) tool (see *Figure 3: First Shit Flow Diagram of BNPP*).

- In 2017, it was understood from the SFD that nearly 98 per cent of the population inside the BNPP boundary was dependent on OSS. Overall excreta of only 2 per cent of the population was safely managed. This SFD is denoted SFD-1 in the report.
- In 2020, the second SFD of Bijnor city was published (*see Annexure 1*). It showed that 41 per cent of the population's excreta was safely managed. This SFD is denoted as SFD-2 in the report.
- The current SFD of Bijnor core city (excluding expanded area) shows that 75 per cent of excreta and wastewater is managed safely.

Figure 3: First Shit Flow Diagram of BNPP



Source: CSE, 2017

Table 2: Percentages of population using different sanitation systems in Bijnor understood through SFDs

Sanitation and wastewater systems	Census 2011 (%)	SFD: 2017–18 (Initial SFD) (%)	2020 (SFD Lite) (%)	SFD 2022 (Desk-based) (%)
Piped sewer system	20.1	0	0	0
Septic tanks connected soak pit/open drain /open ground or water body	73.1	44	31	34
Fully lined tanks connected to open drain/ ground or water body	NA	46	66	66
Pit latrine (with or without slabs)/ Lined pits with semi permeable walls and open bottoms	2.6	4	0	
Open defecation	1.4		0	0
Night soil in open drain/serviced by human/ animal	2.3	6	3	0
Others	0.5	0	0	0
Wastewater treatment	0	0	80	85
Safely managed	1	2	41	75
Unsafely managed	99	98	59	25

Sanitation and wastewater systems	Census 2011 (%)	SFD: 2017–18 (Initial SFD) (%)	2020 (SFD Lite) (%)	SFD 2022 (Desk-based) (%)
Major factors of change (inside core city)	1. No sewer lines. 2. No covered drains. 3. Septic tanks were not actually septic tanks. 4. No treatment available for wastewater and faecal sludge	1. SBM IHHL increased 2. Sewer lines were complete but no household connections done. 3. STP under-construction, project delayed due to land issues and contractor failures	1. All the major drains of the city were intercepted and diverted to 24 MLD STP by the end of 2019. 2. All households had received toilets and Bijnor became open defecation free. 3. CSE's technical support helped identify insanitary toilets and containments, (like pits) which were then upgraded to tanks.	1. Co-treatment of faecal sludge being practiced. 2. All emptied sludge sent to STP. 3. All the desludgers registered and licenced. 4. Bylaws notified in Gazette

Source: CSE

3. Issues and challenges of sanitation in Bijnor

BNPP administrative boundary issues

Initially in 2017 when CSE started working to prepare the CSP of Bijnor, the Bijnor Nagar Palika Parisad was undergoing expansion of its municipal boundaries. However, due to long governmental and political issues the expansion of administrative boundary of ULB Bijnor was approved at the end of 2020.

Table 3: Issues and challenges faced due to ambiguity around BNPP administrative boundary

Type of issue	Challenges	Appropriate actions
Data collection	- The then boundary of BNPP was not clear, hence data collection from core city and expanded area was difficult. The expansion area was under Gram Panchayat's boundary who were reluctant to provide data or make it easy to conduct household surveys. - It affected any immediate action planning or projection as scepticism around the boundary was conflicting with powers between different institutions. For example: if the boundary had been clear, then CSE had proposed in the CSP the construction of a FSSTP towards the west side of the city.	- CSE took a holistic approach and decided to bring all stakeholders on one platform. - It was done by formation of city sanitation taskforce (CSTF) which was then headed by the District Magistrate (DM) of Bijnor as all governmental lands were under direct jurisdiction of DM (*see Annexure 4*) - CSE started with capacity building of all these stakeholders by means of trainings, exposure visits and so on.
Land availability	- Since BNPP boundary was itself very small (3.61 sq. km then), hence land availability for any treatment infrastructure was an issue. Gram panchayats had conflicts with BNPP as they were reluctant to take the municipal shit (excreta) and wastewater on their lands.	

Inter-governmental cognizance

When CSE initiated the process of making CSP and FSSM plans for Bijnor city in 2017, it was observed that the different government departments lack basic coordination and pace in working.

Table 4: Challenge of coordination between different organizations

Organizations	Challenges
ULB	- ULB was not aware of the projects under UPJN or of the basic data required to describe the then ongoing projects - ULB was itself reluctant or unwilling to coordinate with UPJN - Redundancy of data collection by ULB and UPJN was observed on field
Uttar Pradesh Jal Nigam (UPJN)	- Unaware of requirements of ULB - Minimum consultation with ULB before laying the infrastructure
DM office	- Inter-coordination of ULB, gram panchayat and DM office was missing - Manual scavenging committee never consulted or invited stakeholders (ULB or gram panchayat) in the meetings held in the DM office
Gram panchayat	- Panchayat Pradhan's unwillingness to allow convergence of village into the city, hence reluctance to provide data

Source: CSE, 2022

Creation of city sanitation taskforce—A common platform

Firstly, the CSTF was constituted as a multi-stakeholder platform comprising representatives from different sectors of society, including agencies directly responsible for sanitation (divisions and departments of the ULB, PHED, etc.), or indirectly involved and/or impacted. The taskforce also included eminent persons, practitioners, and representatives of the different stakeholders, NGOs and sanitary workers (*see Annexure 4*).

The terms of reference delineating the roles and responsibilities are:

- Providing overall guidance to the sanitation implementation agency (SIA)
- Approving progress reports provided by the SIA
- Approving of CSP after consultation with citizens
- Regularly supervise progress of CSP preparation
- Issue briefing about the progress to media and state government
- Launching the 100 per cent sanitation coverage campaign in the city
- Generating awareness amongst citizens and stakeholders
- Recommendations to ULB for fixing of responsibilities for city-wide sanitation on a permanent basis

Wastewater and faecal sludge management

When CSE entered Bijnor city, a series of baseline studies were conducted in BNPP and BEA in 2018 and 2019 respectively. CSE preferred to do studies in both as eventually the BEA would come in the BNPP boundary. The following key issues were understood from the baseline studies:

- Inadequate containment of human excreta leads to contamination of water supply and ground water, and attracts the carriers of various diseases, hence posing severe risks to human and animal health.
    - As concluded from primary surveys and FGD with masons, the mechanism for solid-liquid separation in the containment has been locally remodelled. The baffle walls used earlier have been replaced by fixing a 90-degree elbow at the outlet.
    - Lined containment systems in Bijnor area are built according to the availability of space with no adherence to the IS code recommendations.
    - In focus group discussions with masons and primary HH surveys, it was reported that households prefer larger containment systems to minimize O&M cost.
    - About 1 per cent of HHs, which have not constructed any containment system, are discharging black water directly to drains/water bodies in Bijnor area
    - Prescribed standards (BIS, CPHEEO) for the construction of containment systems are not followed and that results in ineffective designs.
    - Absence of municipal level monitoring and evaluation framework to approve the design and construction of containment system.
- Illegal practice of manual scavenging of containment system not only violates the national laws but also exposes the involved population to an inhuman practice.
    - About 19 per cent of emptying is carried out manually, as disclosed during primary surveys and FGDs with manual scavengers. People prefer manual cleaning (even though it is costly) as it offers a "new-looking" and "perfectly cleaned" containment system.
    - Narrow lanes in the city of Bijnor restrict the access of the containment systems to the mechanical emptying trucks, thus resulting in the prevailing practice of manual cleaning.
- Unregulated emptying and transport of FSS exposes the immediate communities like cleaners, proponents, people in the neighbourhood, especially children, to high risk of health hazards.
    - Emptying services rendered by untrained private players.
    - Absence of any municipal level regulatory framework allows unregulated operations by mechanical desludgers.
- Lack of conveyance systems for wastewater results in waterlogged areas and subsequent contamination of surface water, groundwater and agricultural fields.
    - Both grey and black water outlets from households and institutions discharged into storm water drains.

- 24 MLD STP was constructed but was not functional since household sanitation connections were not provided.
- Sewerage coverage was 62 per cent of Bijnor Area.

- Uncontrolled and unscientific disposal of wastewater and raw FSS at numerous points across Bijnor Area.

Key goals and actions suggested by CSE

The following table gives the strategy suggested for the issues related to wastewater and faecal sludge management:

Table 5: Key goals and actions suggested by CSE with implementation status

Sr. no.	Goals	Actions suggested	Implementation status - timeline
1.	Safe containment of all human waste generated in Bijnor Area: 1. Sewer connection to all households 2. Construction and retrofitting of all OSS	Issue government order to ensure sewer connections are provided to all possible households. Formulate an effective financial support mechanism for providing HH connection free or at subsidized rates.	1. Government order issued in 2019. 2. BNPP with technical support from CSE made a proposal in 2022 and submitted in PBIG. 3. All households in Bijnor NPP area (core city) were surveyed in 2019 under SBM with advisory from CSE and retro fitting was done by 2021.
2.	Completely abolish unsafe manual emptying and rehabilitate all manual cleaners: 1. Training of manual cleaners, and promotion of innovative techniques and business models as per NULM provisions	1. Inform and educate manual cleaners about ill-effects and risks involved in their practice. 2. Ensure rigorous trainings for personal safety and encourage innovative. practices suggested in NULM. 3. Regulate and license well-trained cleaners through NPP 4. Make framework for monitoring implementation of the prohibition of manual scavengers from entering tanks.	1. Training of Sanitation workers done on various occasions. 2. BNPP and CSE did rigorous trainings of all the sanitation workers during the pandemic. 3. All desludgers in Bijnor city were licensed in 2020. 4. Monitoring framework is currently a challenge.
3.	Regulated emptying and transport of FSS: 1. Understanding the current situation 2. Ensuring safe and regulated emptying of FSS 3. Scheduled desludging and regulated transportation of FS	1. Mapping of onsite sanitation systems, mechanical emptiers and routes of emptying. 2. Framing of FSSM bylaws and gazette notifications. 3. Licensing of private desludgers; training, development and registration of new desludgers,. 4. Development of revenue-based scheduled desludging model.	1. Mapping of all mechanical emptiers was done by CSE from 2019–21. All unsanitary onsite sanitation systems were changed to either FLT or ST by 2021 under SBM in BNPP core area. 2. CSE helped BNPP frame draft FSSM bylaws in 2019 and they were notified in Gazette of UP in 2022 3. All mechanical private emptiers were registered and licenced by BNPP in 2021 with tech support from CSE. 4. Scheduled desludging could not be done. This is further discussed in Chapter 7.

Sr. no.	Goals	Actions suggested	Implementation status - timeline
4.	Build infrastructure connecting to existing STP and/or DWWTS: 1. Sewer connections to all households. 2. Promote private players to implement projects on a decentralized scale.		Not done
5.	Ensuring treatment and safe disposal/end-use of FSS: 1. Co-treatment at existing STP 2. Construction and implementation of FSTPs at feasible locations 3. Construction and implementation of DWWTS at feasible locations 4. Ensuring safe agriculture application of treated WW and FSS for irrigation and manuring respectively	1. Convincing UPJN for co-treatment at 24 MLD STP. Bylaws framing: a) Prohibition of unscientific and uncontrolled disposal by private emptiers. b) Encouraging mechanical emptiers through incentives to discharge FS at existing STP-co-treatment. 2. Mapping of routes currently followed by private emptiers to know their feasibility and preferences. Prepare DPR for FSTP at feasible location. Construction and commissioning. 3. Prepare DPR of DWWTS at feasible locations for treating effluent of containment systems 4. Exploring opportunities to avail subsidies to market the finished product at a regularized rate making the entire system viable. Standardization and certification of manure manufactured.	1. UPJN gave NOC for co-treatment in 2019 (*see Annexure 8*). a) FSSM bylaws enforced by BNPP in 2022 via gazetted notification. b) BNPP started an incentive-based scheme for private desludgers for maximum decanting at the co- treatment facility. 2. It will be planned in 2024 due to elections 3. Currently a pilot DWWT is under construction in Bijnor on the NPP premises (details in Chapter 7).

Source: Bijnor CSP and CSE-TSU

4. Faecal sludge treatment infrastructure

In February 2019, CSE signed a MoU with BNPP to technically support the city in achieving goals laid in the CSP. According to the MoU, CSE would set up a technical support unit (TSU) in Bijnor to closely work with the ULB in developing necessary knowledge and creating infrastructure for treatment of faecal sludge, wastewater and overall sanitation.

Accordingly, BNPP was bound to give access to necessary technical information required for support in sanitation and wastewater.[13]

Co-treatment of faecal sludge

Co-treatment is the process of combined treatment of FSS and sewage in an STP. For cities that are partially covered with sewerage network, co-treatment of FSS in existing STPs provides a cheaper alternative for treating FSS generated from areas without a sewerage network. 100 per cent coverage of sewerage network in a city is costly and difficult to implement, especially in densely populated areas. Setting up of a dedicated faecal sludge treatment plant (FSTP) is a time-consuming affair due to issues such as land identification, clearances and tendering process. Further, in case of co-treatment, the existing facilities, site infrastructure and manpower of the STP can also be used for co-treatment and thus can eliminate the problem of engaging a new O&M operator and additional cost related to site infrastructure.

In many cities in India, FSS is directly added without any pre-treatment, either at the inlet of the STP or at the nearest pumping station or manhole of the sewerage network. There are learnings from various countries on the detrimental impact of co-treatment of FSS in an STP without any pre-treatment. The considerably higher solids, organic and nutrient load of FSS as compared to sewage, can lead to severe operational problems such as solids deposition, clogging and corrosion of sewerage infrastructure, including the STP. This is because the diameter and slope of sewers are designed for the transport of municipal wastewater typically containing 250 to 600 mg TSS/L rather than the 12,000 to 52,500 mg TSS/L present in FSS. Further, the high strength of FSS can have a large impact on the organic, suspended solids and nitrogen loads on the STP and thus impact its treatment efficiency. The intermittent nature of FSS loading would give rise to high instantaneous loads and thus amplify the problems.[14]

Scientific co-treatment of faecal sludge

Scientific co-treatment process differs from the current practices of directly adding the FSS to the inlets of STPs without any pre-treatment. Most STPs are designed for long-term horizons and have excess capacity available throughout their life cycles. The latest report on National Inventory of STPs in India (June 2020) shows a cumulative average utilization of 75 per cent of current STP capacity across the country. Faecal sludge, though different from sewage in its characteristics, has similar constituents but with higher concentrations. Therefore, with minor additional infrastructure and operational measures, a sewage treatment plant can treat faecal sludge safely. It is clear, however, that faecal sludge from non-sewered areas can be addressed through co-treatment. Following planning and implementation aspects to be researched for scientific co-treatment:

1. Estimating quantity and quality of faecal sludge septage. Understand the non-biodegradable and biodegradable particulate matter in the FSS.
2. Identify a STP/SPS for co-treatment followed by assessment of STP and SPS.
3. Design considerations for co-treatment at STP: Designing the co-treatment module at an STP is usually based on the amount of FSS generation in the city and characteristics of FSS.
4. Determine the co-treatment potential of STP/SPS.
5. Identify the co-treatment infrastructure required and land availability at the STP premises.

Note: It is important to assess the method of co-treating the FS in a STP. It can be either through direct addition in a STP or SPS, or it can be through a solid-liquid separation. The method of addition needs to be assessed.

Co-treatment in Bijnor city

What led to co-treatment?

- As per the vision of the City Sanitation Plan of Bijnor, CSTF members, ULB and other relevant stakeholders agreed to lead the city towards 100 per cent safe management of sewage and septage.
- It was decided in the fourth CSTF meeting held in Urban Local Body Directorate, in February 2019, that CSE will provide the necessary knowledge on treatment infrastructure.
- Based on the preliminary understanding developed after preparation of CSP, CSE suggested to co-treat faecal sludge at 24 MLD STP premises in Bijnor.[15] Following factors lead to decision of co-treatment:

- **Low budget:** The co-treatment module involves minimum capital investment as compared to a faecal sludge treatment plant (FSTP).
- Improved and efficient utilization of existing infrastructure of STP in Bijnor.
- **Uncertainty** around the exact boundary of ULB, due to expansion process
- 24 MLD STP-Sewer lines have been laid but **no household connection has been done**.
- Low O&M cost.

- The Director of ULB Directorate directed CSE to do the necessary study for implementation of co-treatment on Bijnor STP premises.
- BNNP and CSTF members decided to implement co-treatment of faecal sludge and septage at the existing 24 MLD STP at a pilot scale. For this, they requested CSE to do a prefeasibility study and prepare the detailed project report.

Pre-feasibility study for scientific-co-treatment

CSE initiated the pre-feasibility study for implementing a 20 KLD co-treatment plant at the newly commissioned (on 12 December 2019) 24 MLD STP in Bijnor. The following aspects were studied thoroughly by CSE:

- **Characterization of faecal sludge and septage**: CSE collected several FSS samples from different areas of Bijnor with the help of private desludgers during January and February 2019 respectively, following strict process and protocols. The samples were collected at the discharging point of the desludging vehicle. The samples were tested for physio-chemical and microbiological parameters. The information related to the source of the FS was also recorded (*see Annexure 5*).
  - The COD to BOD ratio of faecal sludge of all the samples except one—KCS-B—had >4 value which implied that it is largely non-biodegradable. It consists totally inert material. In case of Bijnor, the COD to BOD ratio is consistently over 10 which means substantial stabilization has already been undertaken in the FSS, and it is not biodegradable. A compatibility study was done to check whether it is possible to discharge the raw faecal sludge at influent or not. See Annexure 8 to find the results.
- **Designing septage treatment solutions for Bijnor:** A baseline study helped in understanding septage generation, collection and conveyance of FSS in the city. That further helped in identifying the capacity of the co-treatment plant as well as potential for setting up a new FSTP.
  - On an average, private vacuum trucks do two trips per day in BNPP limits and one trip per day from the expansion area. The volume of septic tanks ranges from 3,000 litres to 5,000 litres.

- Based on the household survey, we assumed average volume of the tanks being desludged to be 4,000 litres. Therefore, the current demand of the Bijnor area can easily be met by a treatment facility of 12–14 KLD capacity.
- Sooner or later the households in the BNPP limits will get connected to sewerage network but till then the emptied sludge can be safely managed at the STP. The neighbouring villages depend completely on OSS; hence the provision of scheduled desludging would have to be implemented in phases in expansion area. Gradually, FSS generation will decrease from the BNPP area. Simultaneously, the FSS being collected from BEA area will be allowed to discharge at STP.
- Hence, it was proposed that the capacity of this pilot co-treatment facility should be 20 KLD. The proposed plant would make sure that all the emptied sludge brought on demand from both BNPP limits and expansion area gets treated and there will also be spare capacity to take care of demand in near future. This will also help in piloting scheduled desludging in some wards of the city.
- To implement scheduled desludging throughout the city, a faecal sludge treatment plant of 24 KLD capacity could be proposed on the opposite location of the STP so that the distance travelled by each tanker can be reduced.

- **Feasibility of STP:** Sewage tests were conducted to understand the daily BOD, COD and TSS load from domestic sewage at STP. Compatibility of discharging FSS at sludge drying bed of STP was checked to understand if the filtrate (or effluent from SDB) complies with treatment design standards of UASB reactor. The test was positive (it complied)
- **Design period:** The design period of 24 MLD STP in Bijnor is 30 years. The proposed modules in the co-treatment unit would be able to cater to FSS collected from BNPP and BEA for the same period. The quantity of faecal sludge considered for co-treatment was calculated based on the actual demand for faecal sludge from the Bijnor core city and extended area in the coming years. It is forecasted that demand from the sewered city area will decline to zero by 2030 (as household sewer connections will be complete). To implement the scheduled desludging in the expanded city, the municipality would need another FSTP of 24 KLD in opposite direction, which will reduce the distance covered per trip by emptying vehicles significantly.

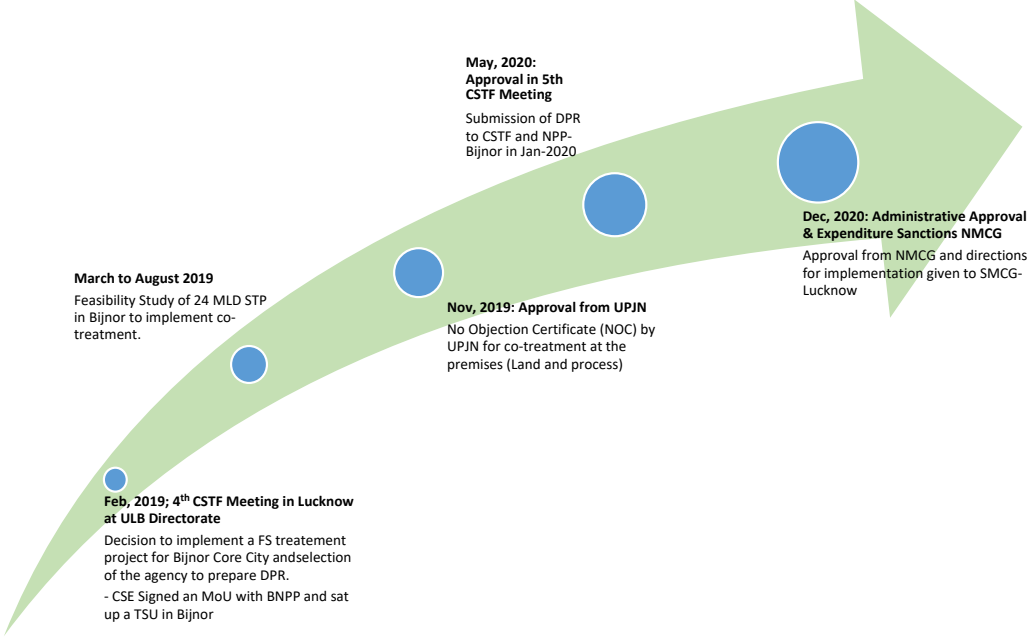
Table 6: Pre-feasibility study and design considerations

Sr. no.	Study type	Annexures/Remarks
1	Sewage test	UPJN were conducted by STP staff under UPJN Bijnor. (Annexure 6)
2	Compatibility of UASB reactor for co-treatment	Annexure 7
3	Physio-chemical and microbiological parameters of FSS from Bijnor	CSE-Lab team (Annexure 5)
4	External expert advisory	Mr. Dorai Narayan, International Consultant
5	To check compatibility (in compliance to design) for discharging at sludge drying bed with preliminary treatment.	Annexure 8
6	Site availability at the premises	Physical visit by CSE team and external expert. (Annexure 9)

Source: DPR-Co-treatment Bijnor, 2019

- UPJN gave No Objection Certificate to BNPP for the pilot co-treatment at STP Bijnor (*see Annexure 10*).
- After prefeasibility study and assessment of proposed sites, an area of 625 sqm was selected for erecting the proposed co-treatment module. The site lies within the STP close to sludge sump unit.
- Detailed Project Report with techno-economic feasibility for using the existing sewage treatment plant at Bijnor for FSS co-treatment module was approved under Namami Gange Mission.[16]

Figure 4: Timeline of events before construction of co-treatment plant



Source: CSE TSU, 2022

Construction of 20 KLD co-treatment unit at 24 MLD STP premises

This section highlights the timeline of the construction of the co-treatment unit, issues and challenges during the construction, and appropriate site specific solutions adopted to complete the project.

Timeline of construction: Bijnor co-treatment

Table 7: Timeline and work progress of co-treatment unit, Bijnor

Timeline	Work progress
Jan 21	• SMCG chose UPPCL as management agency • UPPCL tendered project to third party contractor
May 21	• Due to COVID-19 emergency, the construction was delayed until 25 May 2021. • Excavation was started in May but stopped shortly due to unexpected rains
Jun 21	• Completion of excavation and civil construction started for HT and CC road • Civil construction of HT completed • Construction of CC road completed
Jul 21	• Civil construction of screen chamber completed • Most civil work completed
November 2021: Inspection from SMCG of civil work and solar roof building site for cost revision	
Jan 22	• Revised budget sent to SMCG by UPPCL • Solar roof work started
Mar 22	• Completion of Solar roof • IEC messages and painting work completed
Apr 22	• Testing and trial run protocols shared by CSE to NMCG • Testing and trial started from 15 April 2022
May 22	• Commissioning on May 27
Inspection from NPP Bijnor for handover	
Jul 22	• Handover to ULB after inspection from Jalkal department • First collection of samples for testing at CSE AAETI Lab
September 2022: Inspection visit from NMCG	
The plant was inspected by Mr Dheeraj Joshi, Deputy Secretary, NMCG	

Source: CSE-TSU, 2022

Natural causes and issues

COVID outbreak: The project was approved in December 2020 by NMCG providing administrative approval and expenditure sanctions on the project, and directing SMCG (Program Management Unit) for implementation. SMCG selected state body Uttar Pradesh Project Corporation Limited (UPPCL), as an executing agency, who tendered the project further for on-ground civil work. COVID-19 led to a delay in construction work, which was finally completed only by the end of 2021.

Issues and challenges posed by executing agency and contractor

UPPCL is a Uttar Pradesh government undertaking entrusted with the construction of infrastructure projects.[17] But it had no experience in constructing of a co-treatment project. Since it had experience in small projects and retro-fitting, repairing or renovating treatment plants, it came with its conventional understanding on STPs or WTPs.

- **Inter-departmental coordination:** Frequent changes were noticed in the management or the key contact persons from UPPCL. For example, the person who came for the first site inspection from UPPCL, in February 2021, was different from the person who started the execution work. And the person handling it later was completely different. This resulted in delays and misunderstandings.
- **Increased workload of the technical support unit of CSE:** Due to frequent changes in management of executing agency, CSE-TSU had to put in extra effort to keep the work on track.
- **No site engineer at the site from contractor's end**: Only one experienced mason was responsible to read all the technical drawings and execute the construction. It resulted in mistakes.
- **Oversight from State Management State Mission for Clean Ganga (SMCG)**
  - Inability, to support small projects like co-treatment, focus entirely on big STP projects.
  - Lack of knowledge of officials on what and why of co-treatment systems was made evident.

Challenges during constructions of modules

- **Homogenization Tank (HT) or Equalization Tank (24 May–18 June 2021)**: The excavation work for HT started in end of May. The construction of Homogenization Tank (HT) was started on 4 June and underground structure (including four walls and base) was completed on 18 June.

Table 8: Homogenization tank civil work challenges

Issue or challenge or error	Appropriate solution by CSE
Excavation work	
The work started during monsoon, so groundwater and rain water hindered the process. Since STP Bijnor is close to the Ganga River and local natural water streams, the groundwater levels are high at the site. At the depth of 3 meters (suggested depth in DPR) the groundwater problem occurred.	• CSE-TSU coordinated BNPP and provided government desludging tankers for pumping out the water. • CSE-TSU suggested to overcome the groundwater problem and provide a hard strata, a non-porous base has to be created with an appropriate material and the thickness of RCC must be increased.
Electric pole and underground STP electric line between sump and site for construction of HT. The electric pole was not present during site selection process though and it was constructed after the process by the O&M agency of STP.	• CSE-TSU suggested to increase the distance between sump and HT by 1.5 meters as the on-site solution, as there was no technical disturbance in the process due to the shift.
Civil construction	
• Gas vent was not provided by the contractor. • Two chambers were given on the HT despite three in the DPR.	• CSE-TSU recognized and highlighted the issue and directed the contractor to provide appropriate gas vents with gas pipes. • CSE-TSU insisted that the contractor dig the middle chamber. Additionally, a suggestion was made to put appropriate ladder for the end chambers for going down the HT.

Source: CSE-TSU, 2021

Photograph 6: Excavation for the homogenization tank

Photograph 7: Underground water coming to the surface

Photograph 8: Gas vent provided by the contractor

Photograph 9: Ladder Installed in HT chamber

- **Screen chambers (15 June to 5 July):** As described under the issues and challenges, the contractor was working with no site-specific engineer, and the drawings were read and projected mainly by the mason, which resulted in an error during construction of screen chambers.
  - The shuttering work of the screen chambers was done 90 degrees opposite from the design in the DPR. CSE-TSU recognized the error made during the shattering and notified UPPCL and contractor. The error was rectified later.

Photograph 10: Wrong construction of screen chambers

Photograph 11: Rectified setting of the SC

- **Cement concrete road:** According to the DPR, the CC road to connect the STP internal roads with inlet of screen chambers was proposed to be 25 m. However, due to shifting of the HT by 1.5 meters, the CC road was only 23.5 meters.
  - CSE-TSU intervened and suggested to extend the road towards the other side of the STP road. It served two purposes:
    1. Ease of desludging access: A separate passage to the entry of desludging vehicles for decanting.

2. Operations of STP not disrupted: The O&M agency informed that internal STP connecting roads may be disrupted by hard tyres of the desludging vehicles, hence a separate passage for them would help.

- **Leachate pipe from sludge drying bed to STP Inlet:** It was informed during the construction process that leachate or filtrate of sludge from the SDB was being sent to the aeration chambers. It was done as there were no connecting pipes laid to the inlet of UASB reactor. However, the practice was not ideal. In DPR of co-treatment, the leachate of the filtrate was supposed to be treated starting from the reactor.
    - CSE-TSU intervened with a suggestion to lay a 150 meter connecting pipe from the inlet of the STP to the filtrate of SDB.

Photograph 12: Excavation of trench for laying leachate pipe

Photograph 13: Connection near sewage sump well

Photograph 14: Pipe laid in the trench

Photograph 15: Connection at inlet of STP

- **Control valve chamber:** A control valve chamber was suggested by CSE-TSU for smooth operations. There was no provision recognized by the contracted labourers for transferring the contents of HT to sewage Sump. However, CSE-TSU made a suggestion to connect the HT to the sewage sump through a GI pipe and provide a chamber for controlling the flow to sewage sump.

Photograph 16: Under construction control-valve Chamber

Photograph 17: Completed control valve chamber with cover

Managing changes in budget: Solar roofing

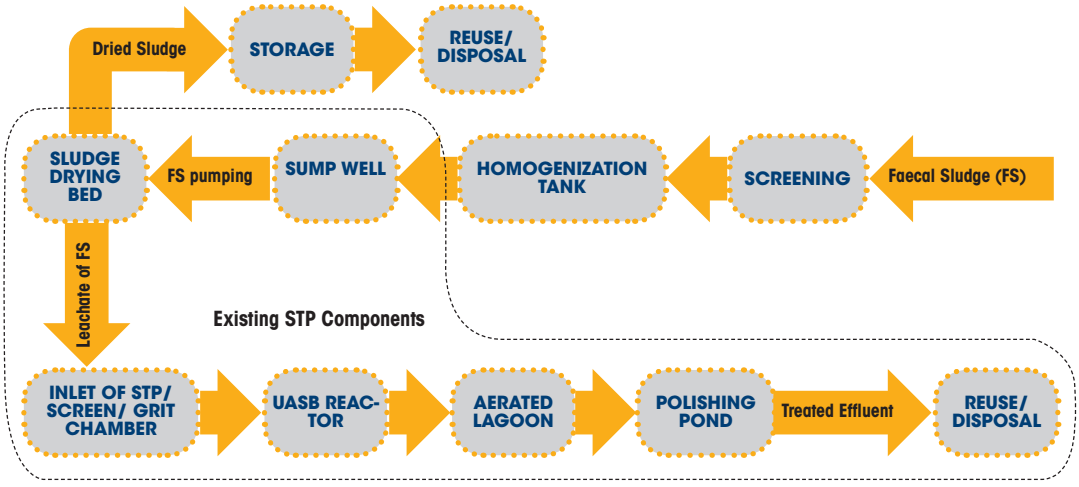
- It was observed that the cost estimates for the fabrication work of solar roofing were not matching the costs estimated in the DPR. This was due to the delay of the construction of the project by 1.5 years and ensuing inflation.
- During the time of the tendering process, the contractor had a very different impression of the solar-roofing. They wrongly understood that the solar panel roof would produce heat for speeding up the drying the solids. Whereas it was only for heat trapping.
- The area where the solar roofing provision was given, the SDB was open from all sides. It was suggested by the contractor to upgrade the steel strength and number of pillars to hold the fabricated sheets as the area experiences frequent high velocity winds. The designed roof specifications may not be able to withstand the winds. Hence, the contractor demanded more funds based on the updated specifications. The process took six months. The work was resumed in January 2022.

Testing protocol submitted by CSE

The implementing agency had no clarity in the testing of the constructed unit. However, CSE on request of NMCG provided an appropriate protocol in March 2022 (*see Annexure 11*).

Snapshot of Bijnor co-treatment

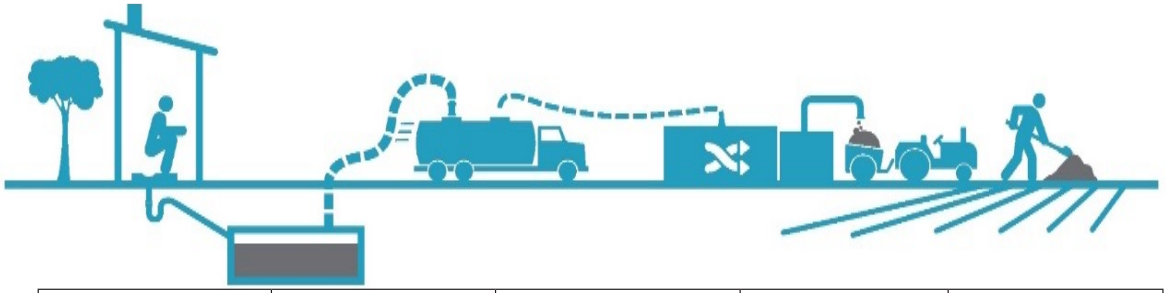
Process



Project highlights

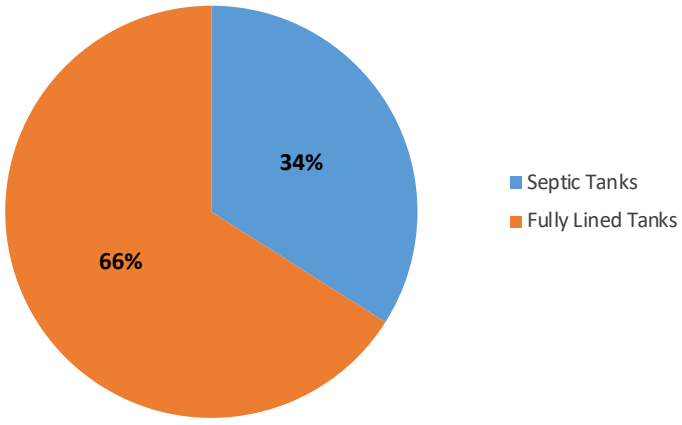
- Capex: Rs 41.42 lakh
- Opex: Rs 1.5 lakhs/annum
- Funding agency: National Mission for Clean Ganga
- Executing agency: Uttar Pradesh Projects Corporation Limited
- Technical support: Centre for Science and Environment
- Duration of construction: 3 months + 1 month trial period
- Geo-coordinates: 29°22′25.2″N 78°06′15.3″E
- Technology: Solid-liquid separation at sludge drying beds followed by liquid treatment at UASB reactor via STP inlet
- Area of co-treatment unit: 225 m^2

FSSM in Bijnor—sanitation value chain



CONTAINMENT	EMPTYING	TRANSPORT	TREATMENT	REUSE/DISPOSAL
– Septic tank: 34% – Fully lined tanks: 66% (*see Graph 4*)	**6-8 KLD (* CSE)** - Emptying from city households - Government buildings - FSS coming from 4 adjacent ULBs	- 1 (Government) Tractor mounted Capacity: 4 kl - 6 private desludgers registered and licensed - Total 9 tractor mounted vacuum tankers	- Faecal sludge Treatment: 1.5 MLD till Dec 22 - Wastewater reaching treatment at STP in Bijnor is 21-22 MLD	Treated Sludge and Water: Sludge used in horticulture or landfilling. Water used for parks by BNPP.

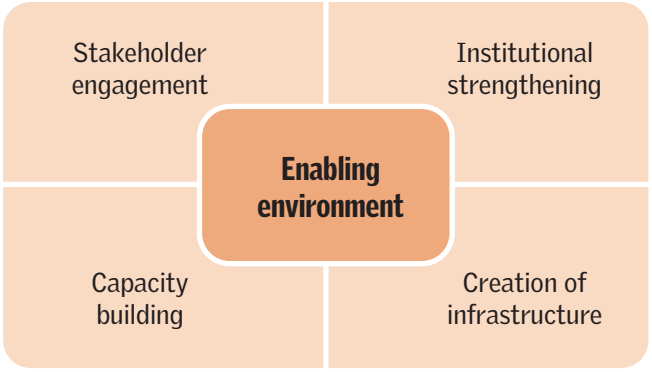
Graph 4: Current containment systems in Bijnor core area



5. Enabling environment for smooth FSSM in Bijnor

Faecal sludge and septage management is a process that involves participation from different stakeholders at various points of the sanitation value chain. BNPP under technical support of CSE, was gifted with such engagements from the beginning of 2017. CSE started its journey in Bijnor with the preparation of the City Sanitation Plan (CSP). Thereafter, CSE has followed a systematic strategy to bring all stakeholders together and develop different fronts of sanitation. It has led to an enabling environment of safe management of excreta and wastewater in Bijnor city.

Figure 5: Components of enabling environment in Bijnor



Source: CSE-TSU

Stakeholder engagement

It was done on two ends:

1. Citizen awareness and engagement
2. Officials like decision makers, planners, implementing agencies and practitioners

Citizen engagement

Table 9: Citizen's engagement done in Bijnor by CSE-TSU

Interval	Activity	Purpose
Aug 2019 to March 2020	• Banner and loud speaker announcement during national Ganga Yatra event	To spread awareness around FSSM, and wrong practices of FSS discharge.
March 2020 to December 2020 (COVID-19 pandemic 1st wave)	• COVID-Awareness week was observed • COVID painting and slogan writing competitions • CSE prepared IEC materials, posters, wall paintings and videos on COVID appropriate behaviour: making masks at home, wearing PPE appropriately, etc. • Orientation training of sanitation workers (public and private) on COVID protocols • Distribution of masks, PPE kits and foot operated hand washing stations	• An appropriately understood strategy to bring awareness around sanitation (FSSM) during the pandemic. • Participation of close to 1,000 school children in painting and 250 persons in slogan competition. • The main purpose was to have continuous engagement in the city. COVID provided a good opportunity to engage with a broader spectrum of people in the city. • Orient common citizens and sanitation workers on practicing COVID appropriate behaviour
January 2021 to Dec 2022	• Open gatherings in parks • Celebration of Ganga Utsav in November 2021 - Poster at Ganga Barrage and signature campaign (Day 1) - Deep Yagya for river Ganga and engagement with local organizations (Day 2) - poem competitions organized in 70 schools in Bijnor with education department • Malasur campaign phase 1 and 2	• Basic knowledge around FSSM • State agenda joined with FSSM was served under the umbrella Ganga Utsav. - Almost 100 officials and political representatives signed the poster for safe management of wastewater and excreta. - Local organizations like AWGP, Mahila Shakti Dal, etc. participated to light *diyas* for River Ganga pollution abatement - 300 students from 70 schools of Bijnor district participated in the poem competition

Photo gallery: IEC activities in Bijnor

Engagement with other governmental departments and stakeholders

Table 10: Engagements done with stakeholders and departments in the government

Department	Engagement
State Mission for Clean Ganga	Bijnor co-treatment being the first project to be built in the entire country with NMCG funding, the project is of immense importance to all the stakeholders. SMCG, the state interface of the NMCG, facilitates the implementation of the entire programme.
UPJN	• 24 MLD STP, where the 20 KLD co-treatment unit is constructed, is monitored by UPJN. Hence, they are an important stakeholder. • CSE organized an exposure visit for UPJN officials to Malaysia, Bangladesh, and other parts of the country to understand the issues and challenges related to FSSM. • UPJN officials participated in various training programmes organized by CSE

Department	Engagement
Jalkal	• Jalkal department is an important stakeholder in the Bijnor programme and supported in organizing various events for awareness generation like world water day and world toilet day. Jalkal officials actively participates in the Bijnor level programmes. • Jalkal engineers participated in various trainings organized by CSE. • Jalkal engineers accompanied and consulted during the testing and handover of co-treatment unit as eventually the co-treatment has to be maintained by them under BNPP.
UPPCL	• Uttar Pradesh Project Corporation Limited (UPPCL) is the executive agency for implementing the co-treatment unit. • They were constantly engaged and pushed during construction of 20 KLD co-treatment unit.
BNPP	• The most crucial stakeholder for the successful implementation of the Bijnor programme, including land selection, awareness generation, providing desludging services, implementation of bylaws, etc. • CSE provided technical support to constitute a sanitation cell for regular monitoring of the FSSM related issues. • City Sanitation Task Force has been constituted in Bijnor NPP and, till date, nine CSTF meetings have been held for the implementation of FSSM in Bijnor smoothly.
Private desludgers	• Private desludgers' identification, registration and licensing have been observed as the backbone for sustainability in FSSM. • CSE-TSU keeps a constant regular interaction with them to understand their issues and challenges. It also urges BNPP for regular engagement with them. • Capacity building of Bijnor private desludgers has been done in Lucknow and Ghaziabad.
Other institutions	BBC media action helped CSE in the implementation of the MalAsur campaign including development of IEC materials

Source: CSE-TSU, 2022

Institutional strengthening

Constitution and functioning of City Sanitation Task Force

The City Sanitation Task Force (CSTF) of Bijnor was constituted on 2 December 2016. The purpose behind the constitution of CSTF was to bring the stakeholders involved in the sanitation of Bijnor city on one platform. This platform was used as a base to formulate, regulate and disseminate the information related to sanitation challenges in the city. CSE, being the facilitator, helped CSTF in providing the necessary knowledge and advisory for taking informed decisions on critical issues like, which technology to select for treatment, priority actions and planning. By 31 March 2018, three CSTF meetings had been conducted. CSE deployed a systematic approach comprising classroom training and field exposure visits to capacitate the CSTF members on effective city-wide sanitation and CSP preparation. In the later years, CSTF started regular meetings on quarterly basis. Overall nine CSTF meetings were conducted in Bijnor, the last being on 2 December 2021. In these meetings, regular updates on the construction and progress of FSSM work in the

city were given to CSTF members by CSE-TSU and BNPP officials. CSTF, also came forward to discuss the challenges posed by the COVID-19 pandemic in 2020 to 2021. They helped in regulating the information necessary around COVID-19 and disseminating plans of awareness and aids provided by BNPP and CSE jointly.

Sanitation cell

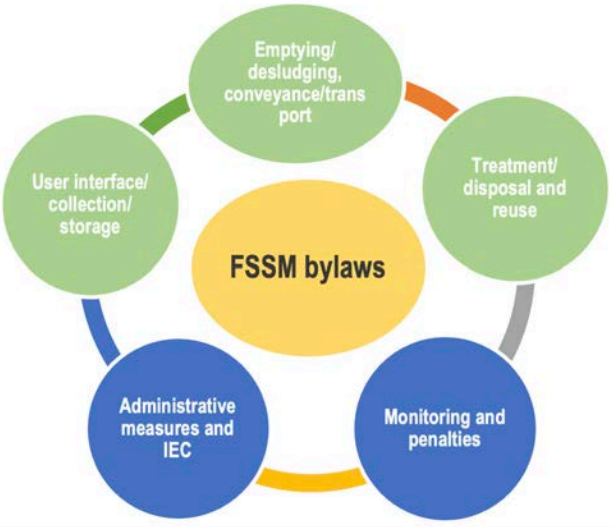
In January 2022, BNPP constituted a dedicated cell of five members, with technical support from CSE, to address all the issues and challenges regarding sanitation and especially related to FSSM. Bijnor NPP allotted and publicized a dedicated phone number for citizens to register any complaint or grievance related to sanitation or request for desludging. The sanitation cell submits a monthly report to the executive officer on the number of complaints received, how many of them have been resolved, associated issues and number of desludging requests received vis-à-vis serviced (*see Annexure 12*).

FSSM bylaws formation and gazette notification

CSE prepared draft bylaws on faecal sludge and septage management for Bijnor in 2019.

- CSE-TSU presented that draft in the BNPP council board meeting in February 2021. It was passed by the board.
- A revised newspaper notification was given in May 2022 after which bylaws were sent for Gazette notification.
- Gazette Notification of Bijnor FSSM bylaws came on 25 June 2022 (*see Annexure 15*). Following components were taken into account for laying the Bijnor FSSM bylaws:

Figure 6: FSSM bylaws components



Creating infrastructure

See Chapter 4.

Capacity building

Pre-CSP

Table 11: Capacitating CSTF members on citywide sanitation and CSP preparation

Sr. no.	Training	Venue and date	Agenda
1	Sensitization workshop on citywide sanitation	New Delhi, 18–19 July 2016	Sensitize and promote knowledge of decision makers (municipal functionaries, State Mission Director-SBM, State PMG-Namami Gange, on mapping septage and sewage flow using Shit Flow Diagrams.
2	1st handholding training on preparation of city sanitation plan	Patna, 20–22 Sept 2016	CSTF constitution, preparation of status report, training on know-how of Rapid Assessment Tool
3	2nd handholding training on preparation of city sanitation plan	Lucknow, 5–7 Dec 2016	Carrying out demand and supply analysis; preparation of status assessment report; identification of city specific key issues
4	3rd handholding training on preparation of city sanitation plan	New Delhi, 4–6 Sept 2017	Review of key issues; formulation of sectoral strategies and preparation of action plan; hands-on training of GIS tools for CSP preparation
5	Technical training on planning and designing decentralized wastewater and faecal sludge treatment system	New Delhi, 10–13 Oct, 2017	Planning, designing and implementing the decentralized wastewater treatment and septage treatment plants
6	National field exposure visit	Bangalore, Chennai, Pondicherry, 8–11 Dec 2016	Field visits to implement Best Management Practices (BMPs) in the areas of faecal sludge management and decentralized wastewater treatment
7	International field exposure visit	Kuala Lumpur and Malacca, Malaysia 6–11 Aug 2017	Demonstration of international BMPs in faecal sludge management and wastewater management in wetlands

Post-CSP

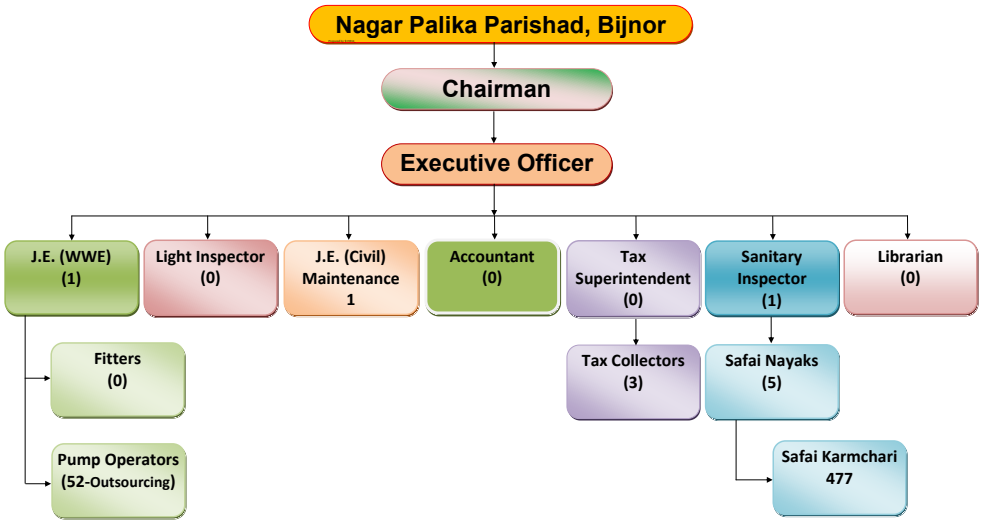
Table 12: Capacity building initiatives taken post-CSP

Sr. no.	Capacity building initiative	Venue/Date	Description
1	Desludgers training-1	Lucknow, 15–19 Oct 2019	Five private desludging operators and two government desludging workers along with SFI and sanitation supervisor participated
2	International training and exposure visit for faecal sludge and septage management in Bangladesh	Dhaka, Feb 2020	The training was a part of CSE's initiative for capacity building of state and city officials from Uttar Pradesh and National Mission for Clean Ganga. The event included two days of classroom training and an exposure visit to a FSSTP.
3	Masons training at BNPP	NPP, Bijnor 19–22 Jan 2022	CSE conducted training on construction of OSS for local masons. Four days of training provided to 25 masons to bring improvement in the design and infrastructure of septic tanks.
4	Training and exposure visit for planning and implementation of faecal sludge and septage management	December 2018	The training was organized in Lucknow for two days. Executive Officer Bijnor, as a member of CSTF, participated in the training.
5	Desludgers training-2	Ghaziabad, 21–25 April 2022	Seven operators from Bijnor city participated in the training

6. Future sanitation challenges and way forward

The section will describe the current sanitation scenario and future tentative action points for transitioning to City Wide Inclusive Sanitation (CWIS).

Figure 7: Organogram Nagar Palika Parishad, Bijnor



Source: NPP, Bijnor

The current population under city administration is estimated to by 235,000 residing in 32 wards (25 old-core city + 11 expansion area). The administrative body is currently working under-staffed with extensive burden on the sanitation department to give appropriate services in all wards. Though the city has undergone expansion and started administration over area more than three times the previous area, there have not been any new recruitments done for proper management. That has resulted in unequal services based on living standards and income levels of the locals.

Current sanitation status

As described earlier, Bijnor city underwent expansion in 2021. The city administrative body has started providing services like **solid waste collection, roads and drain cleaning, and putting dustbins at public places in the expansion**

area. In the core city (BNPP), all the wards are given listed sanitation services under normal duties of ULBs. There is a separate Sewage Treatment Plant based on Up Flow Anaerobic Sludge Blanket (USAB) technology commissioned in 2019. The table below gives specifics of the sewerage network in Bijnor city.

Table 13: Timeline of Bijnor Sewerage Project and specifics

Sr. no.	Bijnor Sewage treatment details	Data
1	Bijnor sewer lines construction start date	27.12.2010
2	Bijnor sewer lines construction completion date	31.3.2016
3	Bijnor sewer line length	88.72 km
4	Installed capacity of the treatment plant	24 MLD
4	24 MLD STP construction start date	01.01.2015
5	24 MLD STP construction end date	30.06.2019
6	24 MLD STP commissioning date	21.12.2019
7	Bijnor STP current O&M funding agency	SMCG-ULB Directorate

The gravity-based sewerage network is dependent on one main pumping station (MPS-1) present at the premises of the STP. Households in Bijnor Area do not have sewer connections. However, around 98 per cent of the core city`s wastewater and 30 per cent of the expansion area's wastewater reaches the plant through 17 tapped drains in the city.[18] The detailed location of the tapped drains is given in Annexure 13. Since only grey water is tapped through drains, the black water remains a challenge. Hence, the safe treatment of black water is based solely on the frequency or practice of emptying of containments in households of Bijnor. It further directly depends on the emptied faecal sludge reaching to the treatment apparatus, which is the 20 KLD co-treatment in Bijnor. The ULB has recently completed the formation and gazette notification of FSSM bylaws in Bijnor city, which provides the necessary legal framework for smooth functioning of FSSM in the city. However, implementation of bylaws is currently a challenge in the city as the administrative body is under-staffed.

Table 14: Current sanitation Staff in NPP, Bijnor

	Ideal positions	Male (Filled)	Female (Filled)	Total
Permanent govt	115	36	13	49
Contract govt	65	32	11	43
Outsourcing	-	237	154	391
Total				477

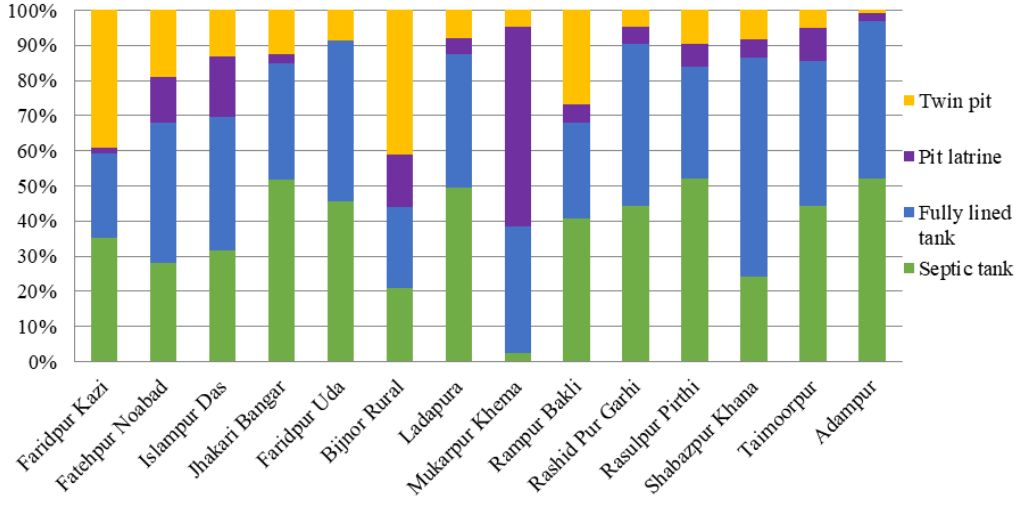
Source: NPP, Bijnor

Currently, the ULB is preparing an action plan to meet the gaps in sanitation services. However, the ULB must take a holistic approach to provide equal services in all the areas of the city. The following section describes the areas that require specific approaches based on the challenges posed.

Bijnor Expansion Area and related challenges

In BEA, which is mostly rural, 32 per cent of the HHs with toilets resort to septic tanks, 38 per cent to fully lined tanks, 19 per cent of the HHs are dependent on pit latrines while 11 per cent are dependent on twin pits.[19] Overall, the minimum size of containments observed was 0.8 cubic metres and maximum size of containments observed was 11.8 cubic metres, whereas average size of containments observed was 5.8 cubic meters.

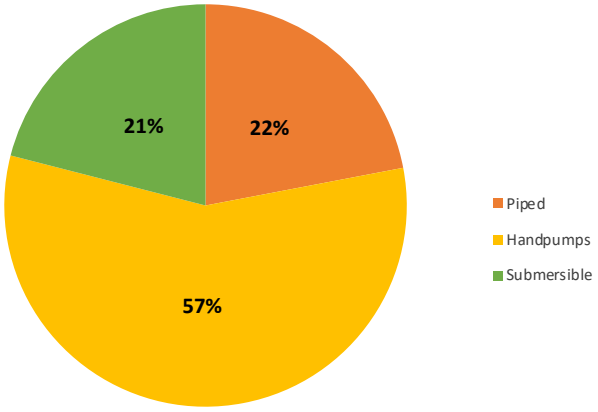
Graph 5: BEA village-wise containments



Source: CSE Primary Survey, 2018

In BEA, users entirely depend upon hand pumps (private as well as installed by the gram panchayat), and borewells to meet their domestic and cattle rearing needs, except in Ladapura and Rashidpur Garhi where piped water supply is available to 90 per cent of the population. At present there is inadequate infrastructure for efficient water supply provision in BEA. Overall, 57 per cent of the population depends on hand pumps (private or public), 21 per cent on private submersible pumps and 22 per cent on piped water supply (see *Graph 6: Source-wise dependency in BEA*). There is lack of awareness about sustainable utilization of water. Hence, there are frequent incidences of unregulated use of submersible pumps.

Graph 6: Source-wise dependency in BEA



In BEA, Awas Vikas and Ladapura areas are completely covered by the sewer network. The remaining areas have open drains which are not adequately built, due to which spillage of wastewater and mixing with the nearby environment is frequently observed. Open drains are also not present in every region of BEA and wastewater generated ends in open areas, low lying lands or farmlands. The estimated wastewater generation from BEA is approximately 6 MLD out of which only 3–4 MLD (from Awas Vikas, Ladapura and Timarpur) reaches treatment from tapped drains into sewers. Currently the 24 MLD STP in Bijnor is receiving an average of 21–22 MLD of wastewater. Hence, the available balance is approximately 1.5 to 2.5 MLD. Therefore, the administrative body has to plan for wastewater treatment to cater to demand from BEA.

Photograph 18: Low-lying areas where wastewater gets collected from open drains in BEA

In addition, piped water supply currently only caters to 25 per cent of the water needs in BEA.[20] As per the rural water connection mission, all the households in BEA will be connected with water supply in the coming future. Hence it would add to the current wastewater generation in BEA. To sum up, the following issues and challenges are understood as demanding action immediately:

- Needs assessment of public sanitation is required in BEA.
- Construction and retrofitting of OSS as per IS codes recommendations. Ensuring enforcement of building bylaws in BEA and inspection of containment systems during construction to ensure that there are no deviations from the approved designs and the quality of the construction materials being used confirms to the specifications as per Indian Standard Codes.
- Mapping of all existing OSS should be conducted and those found faulty, should be targeted for retrofitting. Further, an effective financial support mechanism should be formulated for retrofitting of faulty containments.
- Regular emptying and transport of FSS. Understanding current situation by mapping accessibility to OSS (road leading to the building + access within the house). Mapping of the existing routes taken by the operators to have better picture about their economic feasibility and preferences. IEC of residents and emptiers for scheduled desludging is required.

Community and public toilets

Table 15: List of community and public toilets given by Bijnor NPP

सार्वजनिक शौचालयों की सूची

क्र0 सं0	वार्ड नं0	वार्ड का नाम	शौचालय का प्रकार	सीट संख्या	खुलने का समय	लैंडमार्क	केयर टेकर का नाम
1	4	सिविल लाईन प्रथम आंशिक	सार्वजनिक	4	5 AM to 11 PM	प्रदर्शनी चौक, पुलिस चौकी के पास	सुभाष
2	4	सिविल लाईन प्रथम आंशिक	सार्वजनिक	4	5 AM to 11 PM	जिलाधिकारी कार्यालय	प्रमोद
3	4	सिविल लाईन प्रथम आंशिक	सार्वजनिक	10	5 AM to 11 PM	रोडवेज	लोकेश
4	4	पामरगंज	सार्वजनिक	3	5 AM to 11 PM	सब्जी मण्डी	ज्ञान
5	15	मौ0 कुवँर बाल गोविन्द आंशिक	सार्वजनिक	3	5 AM to 11 PM	महिला थाने के अन्दर	–
6	6	सिविल लाईन द्वितीय	सार्वजनिक	5	5 AM to 11 PM	तहसील के अन्दर	नफीस
7	20	सिविल लाईन द्वितीय	सार्वजनिक	6	5 AM to 11 PM	तहसील के बाहर	संगीता
8	4	सिविल लाईन–द्वितीय	सार्वजनिक	4	5 AM to 11 PM	कलक्ट्रेट निर्वाचन कार्यालय	प्रमोद
9	6	सिविल लाईन द्वितीय	सार्वजनिक	10	5 AM to 11 PM	सरकारी अस्पताल के अन्दर	प्रमोद
10	6	जजी कैम्पस	सार्वजनिक (पिंक शौचालय)	5	5 AM to 11 PM	जजी कैम्पस के अन्दर	–
11	4	नगर पालिका पार्क	सार्वजनिक (पिंक शौचालय)	2	5 AM to 11 PM	नगर पालिका पार्क	सोनू
योग				67			

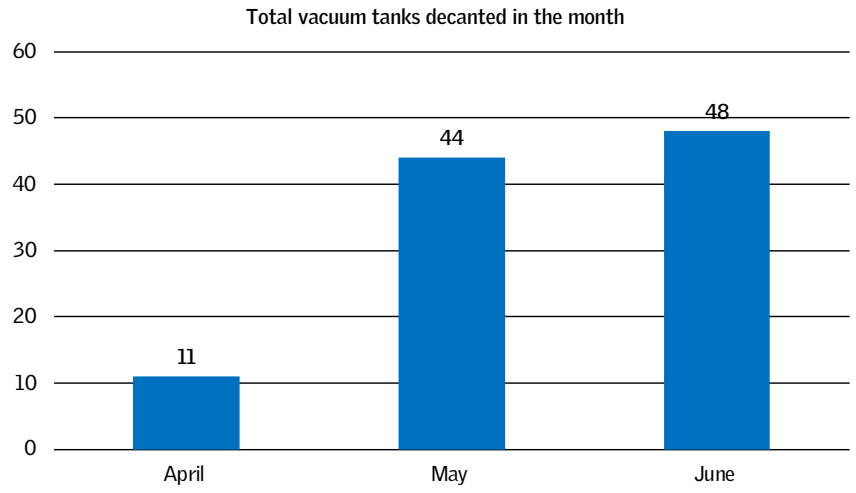
Currently, public and community toilets in Bijnor NPP area are operated by BNPP. A big challenge is posed by behavioural issues in maintaining the hygiene and cleanliness of their premises. The sanitation department of BNPP had installed MHM disposal machines, touch-free hand sanitizer dispensers, etc., which have been vandalized by anonymous people. It has been observed as a regular phenomenon in case of public toilets and community toilets. In many cases, the taps have been found broken or stolen. Regular maintenance funds are therefore required for smooth functioning of CTs and PTs in the city. Bijnor NPP has also taken stringent monitoring steps like putting CCTVs and guards but miscreants have either stolen the CCTVs or fought with the guards.

Sustaining the functioning of co-treatment

Desludging operations and trends

In the initial period of commissioning of the co-treatment unit, the decanting trend observed was lower. Private desludgers were trying to escape from discharging FSS at the co-treatment facility to save fuel costs. However, Bijnor NPP came with an incentive scheme in May 2022, to recognize and push the sincere private desludgers. According to the scheme, the Bijnor NPP gave cash rewards to the operators who discharged highest amount of FSS at the co-treatment unit every three months. The first awards were given in July 2022 (*see Annexure 14*). A good increase in frequency of desludging was observed after that consecutively till September 2022. However, after that the scheme was not continued due to financial issues in BNPP. Currently, a great effort is required by the sanitation cell in Bijnor to maintain regular discharging of FSS at co-treatment. Sometimes, the demand of desludging is very low from the city due to unknown reasons and sometimes the desludgers are engaged in side activities like using the vacuum tank in private mills for emptying their factory ponds. All of this hinders the frequency of discharging FSS at the co-treatment unit.

Graph 7: Decanting trend after incentive scheme in Bijnor



Operations and maintenance of the co-treatment unit

The current co-treatment unit in Bijnor city requires very little maintenance. Currently, it is done by Bijnor NPP. Ideally it should have been included under the regular operation and maintenance of STP but as the current O&M agency of STP has already been given the tender till 2024, it became difficult to alter the agreement. Currently, the O&M requires maintaining of records of discharging at co-treatment units and cleaning of the modules regularly. It also involves regular transfer equalized FSS to the SDB and cleaning SDB. It is managed by one labourer deployed by BNPP at the co-treatment premises. A separate fund might be required to manage O&M of the co-treatment unit by Bijnor NPP.

Strengthening institutional and regulatory framework

Regularizing functioning of CSTF and sanitation cell

Bijnor has set up its monitoring mechanism by constituting and regularizing CSTF and City Sanitation Cell. It has additionally provisioned one helpline number for citizen communication. All the steps already taken require to be maintained with regularity. Apart from that, Bijnor NPP should maintain an online dashboard to showcase sincerity in FSSM operations in the city. The dashboard would further help the ULB in better monitoring of desludging services and all other activities under FSSM on a real-time basis.

Strengthening desludging services

The current desludging services are broadly based on private service providers. As the city has expanded, the Bijnor NPP must develop plans for implementation of FSSM bylaws citywide. Currently, the ULB has done a gazette notification of Bijnor bylaws for FSSM. The enforcement of bylaws in regular practice would require careful monitoring from Bijnor NPP's end. Posing fines and penalties on desludgers may create a gap between private desludgers and ULB officials. Hence, ULB may have to find a middle way which would include dedicated efforts from the sanitation cell of Bijnor to sensitize and recognize desludgers. To strengthen desludging services, the ULB has to win the trust of private players and work as a partner to sustain the services.

Welfare of sanitation workers of Bijnor NPP

Currently, Bijnor NPP has 477 sanitation workers (391 outsourced and 92 permanent or contractual). There is no visible discrimination between male and female candidates in terms of daily wage and work load. However, there is payment and privilege difference between private and government employees. Bijnor NPP must ensure the following services to sanitation workers:

- Training of sanitation workers on health and safety on a regular basis
- Provision of rest area with facilities like toilets and washrooms with proper cleaning materials
- Insurance and regular health check-ups
- Linking private desludging operators to all possible government schemes for welfare of sanitation workers run by the government
- Provision of safety kits and equipment for sanitation workers

Gender inclusion in sanitation strategies

Currently, in the experience of CSE-TSU, a low participation of local women is observed in overall sanitation work of Bijnor city. Bijnor municipality or its sanitation wing does not have any women members at management and supervisory levels. However, a great number of women sanitation workers are present to do works like cleaning of roads and parks in the department.

Capacity building and citizen engagement

The following training programmes could be organized:

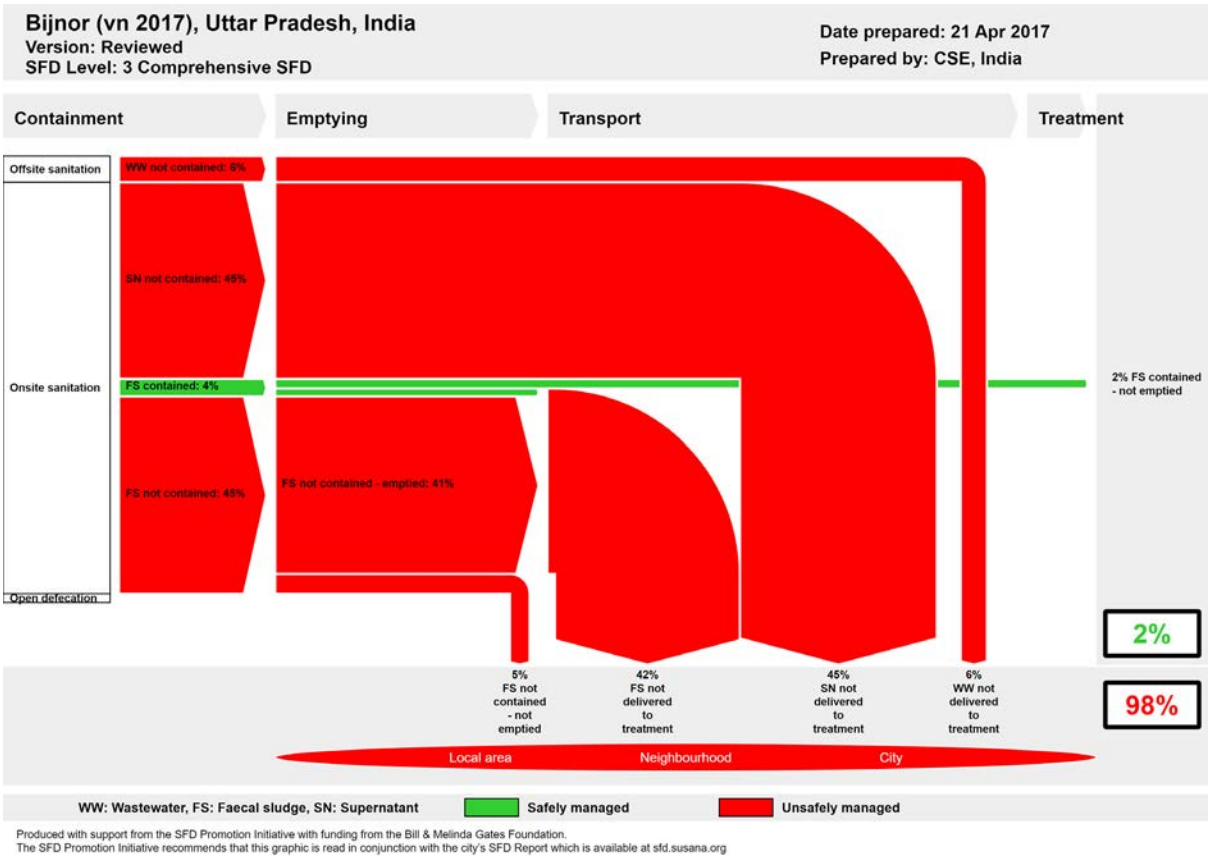
Table 16: Recommended areas of capacity building for Bijnor city officials

Participants	Training topic
Trainings	
Executive Officer	Overall management of co-treatment and desludging operations; Reuse of treated wastewater and bio-solids; financial sustainability of FSSM projects; planning of FSSTP; CWIS planning
Sanitary and Food Inspector	Reuse of treated wastewater and bio-solids; health and safety of sanitation workers; various govt schemes available; O&M of plant; O&M of vehicle; CWIS planning
UPJN engineers	Reuse of treated wastewater and bio-solids; O&M of plant; health and safety of sanitation workers; CWIS concepts
Driver and helper of desludging Vehicle (govt/private)	O&M of vehicles; health and safety of sanitation workers
Sanitation workers	Health and safety of sanitation workers; Reuse of treated wastewater and bio-solids; various govt. schemes
Masons	Design and construction of septic tank
IEC activities	
Citizens	Overall cleanliness; proper designing and construction of new toilet and retrofitting of existing toilets; regular desludging of septic tank

Annexures

Annexure 1: Shit Flow Diagrams of Bijnor

Figure 8: First SFD Bijnor Nagar Palika Parishad (BNPP)



Produced with support from the SFD Promotion Initiative with funding from the Bill & Melinda Gates Foundation.
The SFD Promotion Initiative recommends that this graphic is read in conjunction with the city's SFD Report which is available at sfd.susana.org

Figure 9: SFD Bijnor Expanded Area-2017

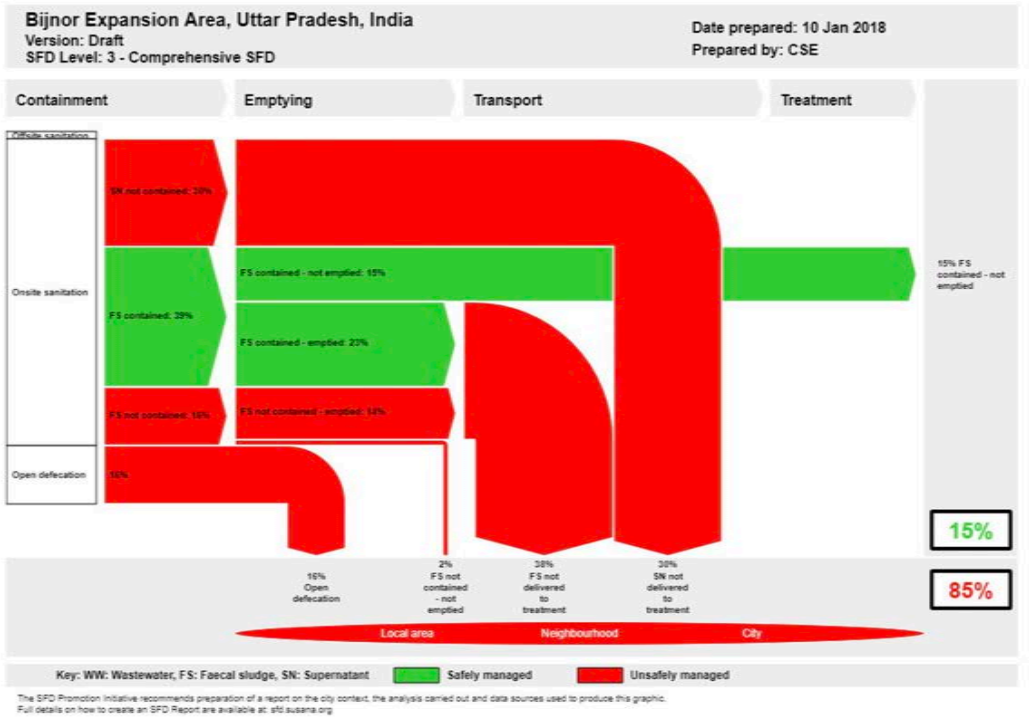


Figure 10: Bijnor SFD in 2020 after commissioning of 24 MLD STP

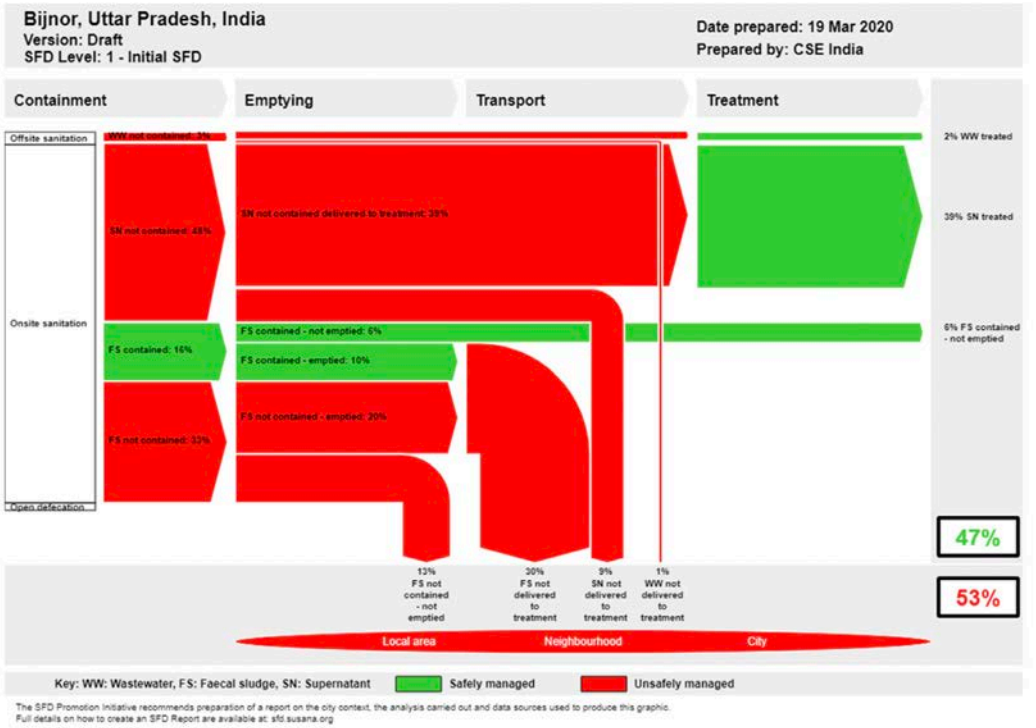
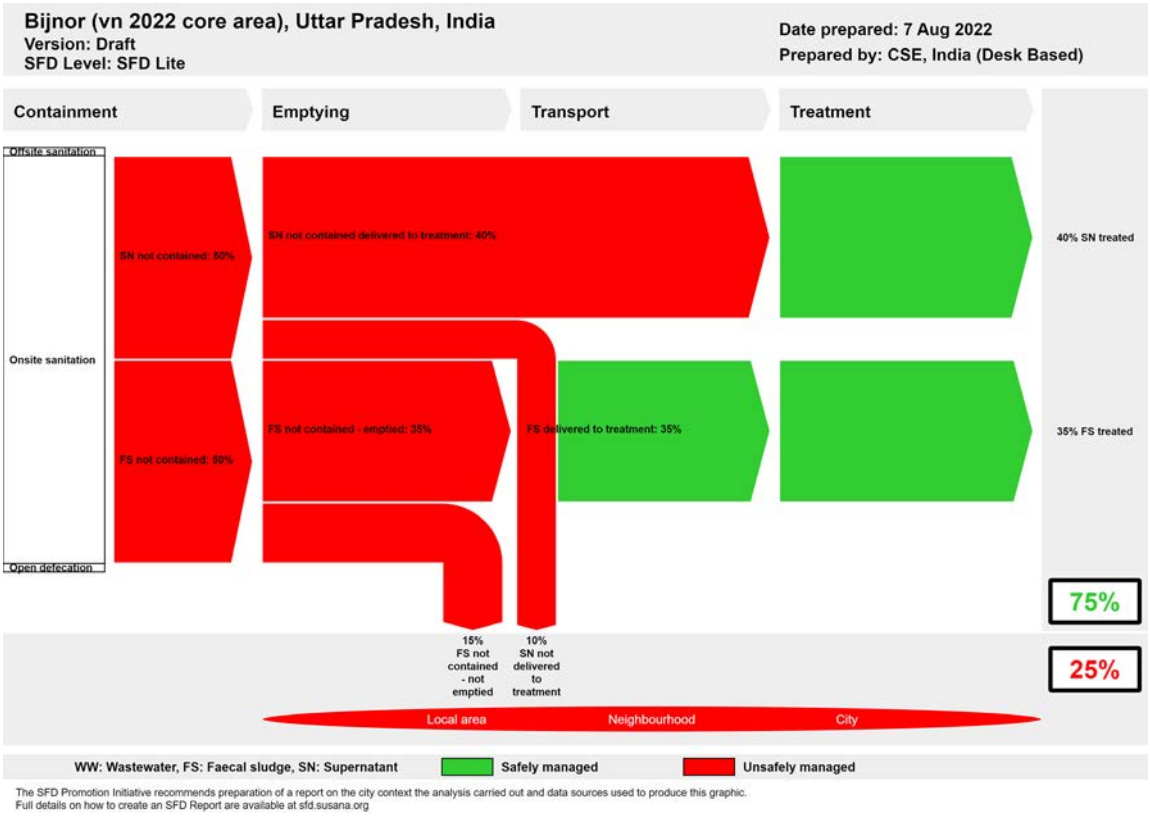


Figure 11: Bijnor desk-based SFD-2022 for core area



The SFD Promotion Initiative recommends preparation of a report on the city context the analysis carried out and data sources used to produce this graphic.
Full details on how to create an SFD Report are available at sfd.susana.org

Annexure 2: SBM's letter on ODF and effective faecal sludge management

PRAVEEN PRAKASH, IAS
Joint Secretary & Mission Director (SBM)
GOVERNMENT OF INDIA
MINISTRY OF URBAN DEVELOPMENT

प्रवीण प्रकाश, आई.ए.एस.
संयुक्त सचिव एवं मिशन निदेशक (एस.बी.एम.)
भारत सरकार
शहरी विकास मंत्रालय

सत्यमेव जयते

D.O No. MD-SBM/AA/62/2016

30th May, 2016

Sub: Support to Towns for achieving ODF status and for effective Fecal Sludge Management (FSM) - Reg.

Respected Sir,

As you are aware, one of the key objectives of Swachh Bharat Mission (Urban) is to help all 4041 cities/towns achieve 100% Open Defecation Free (ODF) status by 2nd October 2019.

2. As we move towards 100% coverage of toilets, we need to look ahead at managing the large volume of fecal sludge from the growing number of septic tanks and single pit latrines. Proper fecal sludge management (FSM) that maximizes safety and sustainability is essential and we need to develop a model that will cater to the country's future needs. Fecal sludge comprises partially stabilized excreta and slurry from improved single pit latrines, septic tanks, as well as latrines based on other improved and unimproved technologies. Unless managed appropriately, this fecal sludge poses a huge risk to public health and the environment.

3. At present about 64 million Indian households must be supported with safe FSM services. Safe disposal of fecal sludge means ensuring safety while handling/emptying the sludge from septic tanks/pits and the proper transport and disposal of the removed sludge. The demand and supply services for FSM need to be assessed, along with the associated safety issues. Local bodies, both rural and urban, state governments, and the central government have a stake in ensuring that the fecal sludge is disposed of properly, in a manner that does not cause any health or environmental hazards.

4. In this regard, MoUD has decided to extend extensive handholding support to 29 cities/towns so that they can become flagship towns for Fecal Sludge Management in India. For the same, two agencies, **Centre for Science & Environment (CSE, a leading non-profit working on environmental issues in India)** and the **National Institute for Urban Affairs (NIUA, a Government of India entity)**, working on urban transformation efforts) will provide active handholding to the below selected cities:

Sl. No	State	Towns/Cities	Assigned Agency
1	Andhra Pradesh	Proddatur, Dist. Kadapa	NIUA
2	Andhra Pradesh	Gudur, Dist Nellore	NIUA
3	Andhra Pradesh	Srikakulam, Dist Srikakulam	CSE
4	Uttarakhand	Rishikesh, Dist Dehradun	CSE
5	Uttar Pradesh	Unnao, Dist Unnao	NIUA
6	Uttar Pradesh	Ghazipur, Dist Ghazipur	NIUA
7	Uttar Pradesh	Chunar, Dist Mirzapur	CSE
8	Uttar Pradesh	Ramnagar, Dist Varanasi	CSE
9	Uttar Pradesh	Ganga Ghat, Dist Unnao	CSE
10	Uttar Pradesh	Bijnore, Dist Bijnore	CSE
11	Uttar Pradesh	Agra, Dist Agra	
12	Bihar	Bhagalpur, Dist Bhagalpur	NIUA
13	Bihar	Hajipur, Dist Vaishali	NIUA

Office: 140-C, Nirman Bhawan, New Delhi-110011 ♦ Mob: 9013133636, Phone: 011-23062309, Fax: 23062477
praveenprakashud@gmail.com, praveen.prakash71@nic.in

Annexure 3: BNPP letter requesting CSE for technical support in making Model CSP

कार्यालय नगर पालिका परिषद, बिजनौर

संख्या : 237 / न0पा0प0रि0 दिनांक : 29-6-17

प्रेषक:
अधिशासी अधिकारी,
नगर पालिका परिषद, बिजनौर।

सेवा में,
डा0 सुरेश कुमार रोहिल्ला
प्रोग्राम निदेशक, वॉटर प्रोग्राम
सेन्टर फॉर साईंस एण्ड एन्वारन्मेंट ,
नई दिल्ली–110062

विषय: बिजनौर नगर पालिका क्षेत्र में Model City Sanitation Plan Preparation and Pilot Faecal Sludge Treatment Plant (FSTP) एवं City Level FSSM (Faecal Sludge and Septage Management) Guideline के निर्माण में निःशुल्क तकनीकी सहयोग प्रदान करने के सम्बन्ध में।

महोदय,

उपरोक्त विषय के सम्बन्ध में सर्वप्रथम नगर पालिका परिषद, बिजनौर सी0एस0ई0 द्वारा वॉटर एवं वेस्ट मैनेजमेंट के लिये पालिका बिजनौर को चयनित करने तथा अपनी निःशुल्क सेवाएं प्रदान के साथ–साथ अनथक प्रयासों के लिए धन्यवाद करती है। उक्त के सम्बन्ध में आपको अवगत कराना है कि बिजनौर नगर पालिका के द्वारा द्वितीय शहरी स्वच्छता कार्यबल की बैठक दिनांक 08–03–2017 को माननीय अध्यक्ष महोदय, नगर पालिका परिषद बिजनौर की अध्यक्षता में आहूत की गयी तथा उसमें सदस्यगण अधि ाशासी अधिकारी न0पा0परि0बिजनौर, अधिशासी अभियन्ता (लो.नि.वि.), श्री राजरत्न सरदार सीएसई प्रतिनिधि ा, प्रधानाचार्य आरजेपी इण्टर कॉलेज, स्वास्थ्य निरीक्षक न0पा0परि0बि0, अवर अभियन्ता(जल) न0पा0परि0बि0, कर–निर्धारण अधिकारी न0पा0परि0बि0, डा0 श्रीमति संध्या रस्तौगी एन0जी0ओ0 बिजनौर, श्री वसीम अख्तर डिजिटल मीडिया बिजनौर एवं श्री कैलाश सारस्वत (सी0एण्ड डी0एस0) परियोजना प्रबंधक बिजनौर आदि उपस्थित रहे। अ

अध्यक्ष महोदय तथा सदस्यों की उपस्थित में शहरी स्वच्छता को गंभीरता से लेते हुए वार्तालाप किया गया कि तत्काल समस्त स्वच्छता संबंधी कदम जल्द से जल्द उठाये जाये तथा निम्न बिन्दुओं पर भी विचार विमर्श किया गया:–

1 – गत् बैठक दिनांक 26–11–2016 का अनुमोदन।
2 – स्टेटस रिपोर्ट।
3 – सी0एस0ई0 प्रतिनिधि के द्वारा एस0एफ0डी0 पर प्रस्तुतिकरण।
4 – एफ0एस0एम0 तकनीकी पर विचार।

महोदय उक्त के संबंध में आगामी बैठक माह जून, 2017 के अंतिम सप्ताह में आहूत की जाने की संभावना है, जिसमें जिलाधिकारी महोदय मुख्य अतिथि होगे।

अतः महोदय से अनुरोध है कि Pilot FSTP के Site Indentification, Desiging, Sustainable and Affordable Technology Selection including identification of technology provider for pilot project, preparation of DPR and City Level FSSM Guideline निःशुल्य तकनीकी सहयोग प्रदान करने की कृपा की जाये।

भवदीय

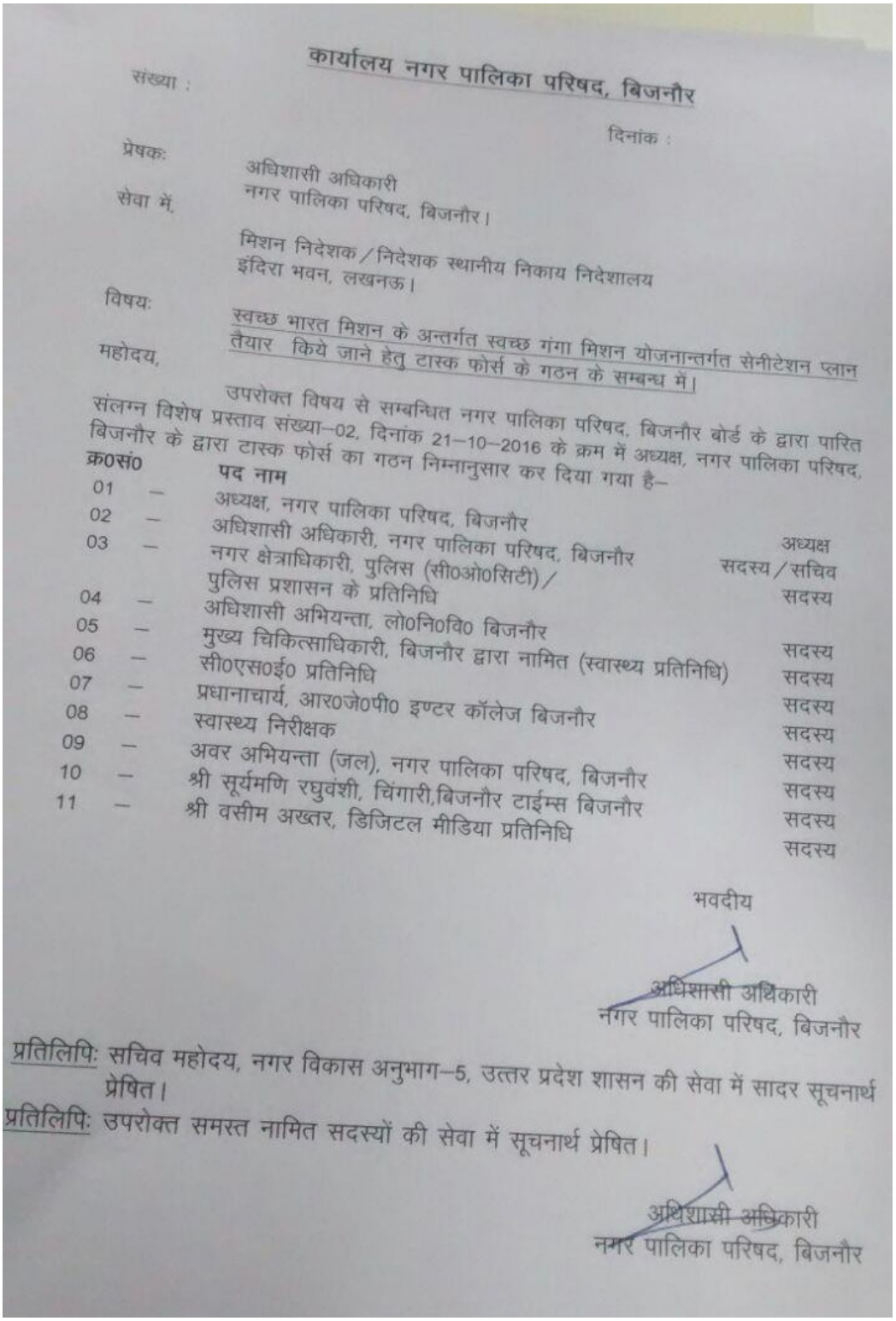
अधिशासी अधिकारी
नगर पालिका परिषद, बिजनौर

wwe/241

प्रतिलिपि: अध्यक्ष महोदय की सेवा में सादर सूचनार्थ प्रेषित।

अधिशासी अधिकारी
नगर पालिका परिषद, बिजनौर

Annexure 4: Constitution of CSTF Bijnor



कार्यालय नगर पालिका परिषद, बिजनौर

संख्या :

दिनांक :

प्रेषक:

अधिशासी अधिकारी
नगर पालिका परिषद, बिजनौर।

सेवा में,

मिशन निदेशक/निदेशक स्थानीय निकाय निदेशालय
इंदिरा भवन, लखनऊ।

विषय:

स्वच्छ भारत मिशन के अन्तर्गत स्वच्छ गंगा मिशन योजनान्तर्गत सेनीटेशन प्लान तैयार किये जाने हेतु टास्क फोर्स के गठन के सम्बन्ध में।

महोदय,

उपरोक्त विषय से सम्बन्धित नगर पालिका परिषद, बिजनौर बोर्ड के द्वारा पारित संलग्न विशेष प्रस्ताव संख्या–02, दिनांक 21–10–2016 के क्रम में अध्यक्ष, नगर पालिका परिषद, बिजनौर के द्वारा टास्क फोर्स का गठन निम्नानुसार कर दिया गया है–

क्र0सं0		पद नाम	
01	–	अध्यक्ष, नगर पालिका परिषद, बिजनौर	अध्यक्ष
02	–	अधिशासी अधिकारी, नगर पालिका परिषद, बिजनौर	सदस्य/सचिव
03	–	नगर क्षेत्राधिकारी, पुलिस (सी0ओ0सिटी)/ पुलिस प्रशासन के प्रतिनिधि	सदस्य
04	–	अधिशासी अभियन्ता, लो0नि0वि0 बिजनौर	सदस्य
05	–	मुख्य चिकित्साधिकारी, बिजनौर द्वारा नामित (स्वास्थ्य प्रतिनिधि)	सदस्य
06	–	सी0एस0ई0 प्रतिनिधि	सदस्य
07	–	प्रधानाचार्य, आर0जे0पी0 इण्टर कॉलेज बिजनौर	सदस्य
08	–	स्वास्थ्य निरीक्षक	सदस्य
09	–	अवर अभियन्ता (जल), नगर पालिका परिषद, बिजनौर	सदस्य
10	–	श्री सूर्यमणि रघुवंशी, चिंगारी,बिजनौर टाईम्स बिजनौर	सदस्य
11	–	श्री वसीम अख्तर, डिजिटल मीडिया प्रतिनिधि	सदस्य

भवदीय

अधिशासी अधिकारी
नगर पालिका परिषद, बिजनौर

प्रतिलिपि: सचिव महोदय, नगर विकास अनुभाग–5, उत्तर प्रदेश शासन की सेवा में सादर सूचनार्थ प्रेषित।

प्रतिलिपि: उपरोक्त समस्त नामित सदस्यों की सेवा में सूचनार्थ प्रेषित।

अधिशासी अधिकारी
नगर पालिका परिषद, बिजनौर

Annexure 5: FSS characteristics of Bijnor

FSS characteristics

SL no.	Sample location	TSS	COD	BOD	TKN	COD/BOD
1	HCT -B	50328	32600	4280	851	7.62
2	RCR_B	25360	20550	1380	862	14.89
3	HMK-B	118648	120100	5430	3080	22.12
4	HWV-B	31398	35900	4630	10133	7.75
5	JLP-B	34388	26900	2420	806	11.12
6	KCS-B	1278	1040	870	126	1.20
7	HFU-B	42264	45550	1640	1428	27.77
8	CTR-B	2638	6200	630	210	9.84
9	DHR-B	9766	16200	1258	571	12.88
10	DMR-B	79622	71950	3850	2329	18.69
11	AVI-B	41424	49300	3010	1584	16.38
12	**COM-B (Composite Sample)**	**27594**	**37900**	**2690**	**1282**	**14.09**
Average		38725.67	38682.5	2674	1938.5	13.70
For design consideration		**40000**	**45000**	**3500**	**1500**	**12.86**

*<2: readily biodegradable effluent;
2 <COD / BOD <4: moderately biodegradable effluent;
COD / BOD> 4: hardly biodegradable effluent.

Results of Physico-chemical and microbiological parameters in faecal sludge samples

Environment Monitoring Laboratory
A unit of Centre for Science and Environment
Anil Agarwal Environment Training Institute
Nimli, District Alwar, Rajasthan-301019
TEST REPORT FORM

EML Form No.: 4

Date: Mar 2nd, 2019
Report ID –EML/TRF/046

CSE Team Participating	Water Team & FSM Lab
Sample Identity	Sludge Samples from Bijnor, UP
Number of samples	11 (From Bijnor) + 1 (Composite sample prepared in Lab)
Samples collected/delivered by	Self-Collected
Date of sample submission at AAETI	Feb 8th, 2019

Result of Physico-chemical and Microbiological parameters in Fecal Sludge samples

S No	Sample Location	pH ± Error % (95% C.I.)	Moisture Content %	TS ± Error % (95% C.I.) (ppm)	COD ± Error % (95% C.I.) (ppm)	BOD_5 (5 days at 20°C) (ppm)	TKN ± Error % (95% C.I.) (ppm)	Ammoniacal N ± Error % (95% C.I.) (ppm)	Total Phosphate ± Error % (95% C.I.) (ppm)	Fecal coliform (MPN/100 ml)	Calorific Value (cal/g)
1.	HCT-B	6.5 ± 0.2%	98.1	50,328 ± 0.8%	32,600 ± 0.5%	4,280	851.2± 2.4%	164.6 ± 0.5%	166.0 ± 2.8%	1.2×10^7	3424.0
2.	RCR-B	7.2 ± 0.2%	99.2	25,360 ± 0.8%	20,550 ± 0.5%	1,380	862.4± 2.4%	236.3 ± 0.5%	221.0 ± 2.8%	5.6×10^5	3950.5
3	HMK-B	6.5 ± 0.2%	84.3	118,648 ± 0.8%	120,100 ± 0.5%	5,430	3080.0±2.4%	116.5 ± 0.5%	656.0 ± 2.8%	1.5×10^6	2768.6
4	HWV-B	7.3 ± 0.2%	96.7	31,398 ± 0.8%	35,900 ± 0.5%	4,630	1013.6±2.4%	136.6 ± 0.5%	262.0 ± 2.8%	2.3×10^5	3534.0
5	JLP-B	7.5 ± 0.2%	93.0	34,388 ± 0.8%	26,900 ± 0.5%	2,420	806.4 ± 2.4%	177.0 ± 0.5%	238.5 ± 2.8%	1.5×10^5	2696.1
6	KCS-B	7.2 ± 0.2%	99.4	1,278 ± 3.1%	1,040 ± 1.7%	870	126.0 ± 2.4%	67.2 ± 0.5%	24.5 ± 2.8%	9.2×10^4	2276.7
7	HFU-B	6.8 ± 0.2%	94.2	42,264 ± 0.8%	45,550 ± 0.5%	1,640	1428.0±2.4%	227.4 ± 0.5%	458.0 ± 2.8%	2.3×10^5	3264.9
8	CTR-B	6.9 ± 0.2%	99.2	2,638 ± 3.1%	6,200 ± 0.5%	630	210.0 ± 2.4%	82.9 ± 0.5%	56.5 ± 2.8%	4.3×10^5	2813.5
9	DHR-B	7.4 ± 0.2%	98.9	9,766 ± 0.8%	16,200 ± 0.5%	1258	571.2± 2.4%	168.0 ± 0.5%	131.0 ± 2.8%	2.3×10^5	3643.6
10	DMR-B	7.8 ± 0.2%	93.4	79,622 ± 0.8%	71,950 ± 0.5%	3850	2329.6±2.4%	169.1 ± 0.5%	738.0 ± 2.8%	1.1×10^7	2364.1
11	AVI-B	7.5 ± 0.2%	96.4	41,424 ± 0.8%	49,300 ± 0.5%	3010	1584.8±2.4%	278.9 ± 0.5%	333.0 ± 2.8%	1.2×10^7	2815.7

% Error added for certain parameters where error quantification has been done

AAETI

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S No	Sample Location	pH ± Error % (95% C.I.)	Moisture Content %	TS ± Error % (95% C.I.) (ppm)	COD ± Error % (95% C.I.) (ppm)	BOD_3 (3 days at 20°C) (ppm)	TKN ± Error % (95% C.I.) (ppm)	Ammoniacal N ± Error % (95% C.I.) (ppm)	Total Phosphate ± Error % (95% C.I.) (ppm)	Fecal coliform (MPN/100 ml)	Calorific Value (cal/g)
1.	COM-B	7.2 ± 0.2%	98.1	27,594 ± 0.8%	37,900 ± 0.5%	2,690	1282.4± 2.4%	178.1 ± 0.5%	335.0 ± 2.8%	4.3×10^3	Not Available

Sample Collection Points and Dates

S No	Code	Place	Date of Collection
1.	HCT-B	Hotel Chetali, Taimoorpur	Feb 05, 2019
2.	RCR-B	Household, Railway Colony, Rashidpur Garhi	Feb 05, 2019
3	HMK-B	Household, Mukarpur Khema	Feb 05, 2019
4	HWV-B	Household Ward No.1, Valmik iBasti	Feb 06, 2019
5	JLP-B	Household, Ladapura Village, Jyothi Nagar	Feb 06, 2019
6	KCS-B	Krishna College, Shahbazpur Khana	Feb 06, 2019
7	HFU-B	Household, Faridpur Uda	Feb 06, 2019
8	CTR-B	Community Toilet, Ravidas Nagar	Feb 06, 2019
9	DHR-B	District Hospital, Rambagh	Feb 07, 2019
10	DMR-B	District Magistrate Residence, Sadar Bazar	Feb 07, 2019
11	AVI-B	Household, Aawas Vikas Colony, Islampur Das	Feb 07, 2019

Dr. Vinod Vijayan
Sr. Research Scientist

Dr. Mrinal Mallik
Head, EML

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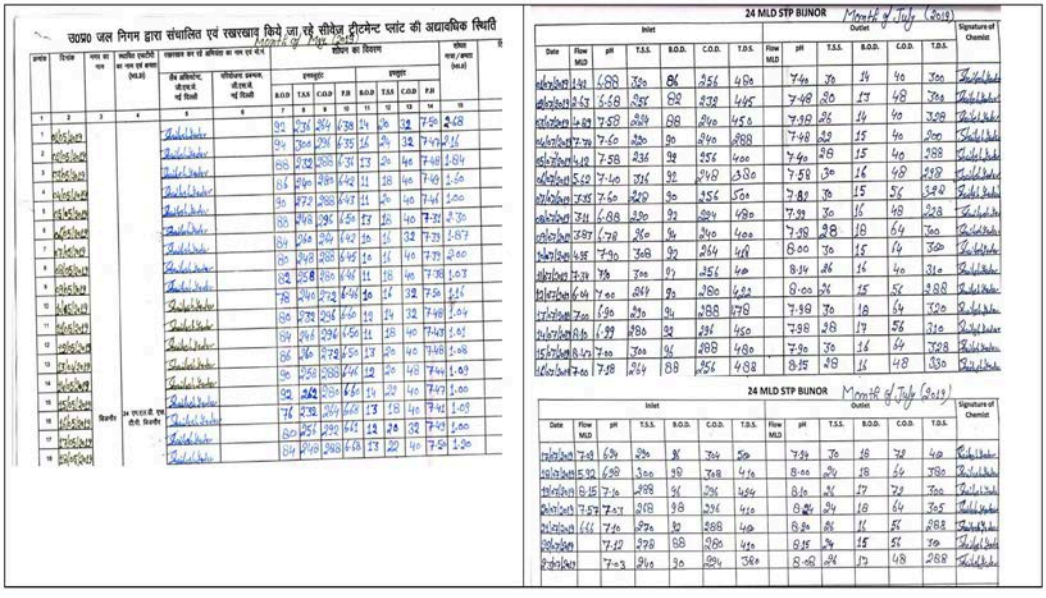
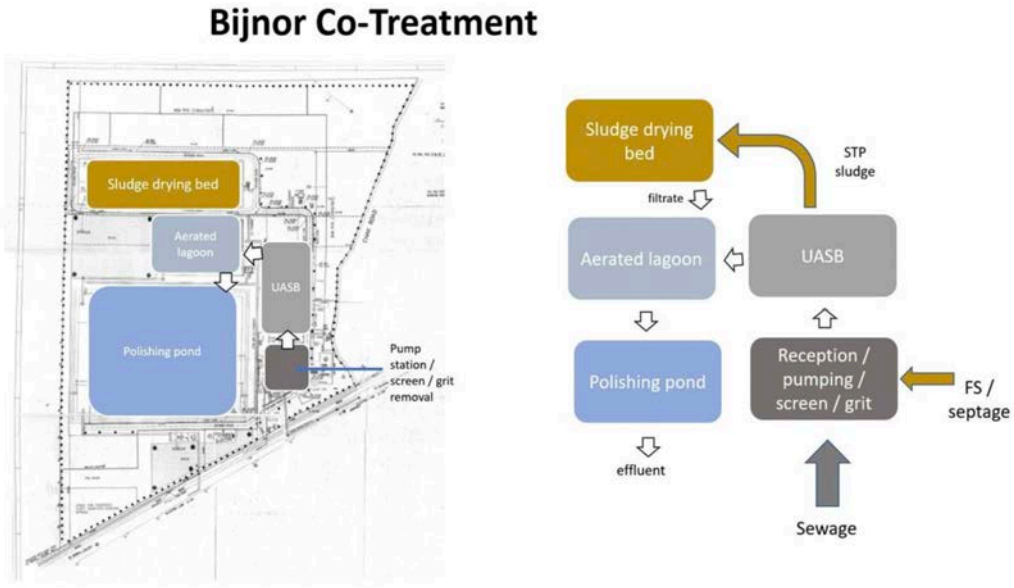
Annexure 6: Sewage tests



Annexure 7: Compatibility of UASB reactor



Sludge thickness	BOD removal	COD removal	TSS removal
<20%	0%	0%	0%
20-30%	20%	20%	20%
30-50%	50%	50%	50%
50-80%	65%	65%	65%
80-90%	50%	50%	40%
>90%	20%	20%	10%

Sludge Thickness and Corresponding Removal Efficiency

Annexure 8: To check compatibility (in compliance with design) for discharging at sludge drying bed with preliminary treatment

		Formula used for calculation (=)	Value /calculation	Designed limit	OK/Not Ok
Sewage (Se)	Flow (MLD)		10		
	BOD (mg/l)		250		
	COD (mg/l)		450		
	TSS (mg/l)		500		
	TDS (mg/l)		450		
	Volume of the UASB reactor (m^3)		9140		
Faecal Sludge (FSS)	Flow (KLD)		10		
	BOD (mg/l)		3500		
	COD (mg/l)		45000		
	TSS (mg/l)		40000		
	TKN		1500		
Sewage load (in KG)	BOD	*(Se flow x Se BOD)*	2500		
	COD	*(Se flow x Se COD)*	4500		
	TSS	*(Se flow x Se TSS)*	5000		
Compliance Check based on current flow of sewage with designed parameters* (*higher side values)	COD Loading rate kg/m3	COD loading (kg)/Total Volume of reactor (m^3)	0.49	1.15 - 1.45	Not ok
	HRT (hrs)	Total Volume of reactor (m^3)/ (Sewage flow (m^3/hr)	21.91	8 - 12	Not ok
	Up-flow velocity (avg.) (m/hr)	Sewage flow (m^3/hr)/ Area of the reactor (m^2)	0.23	0.5 – 0.6	Not ok
	Sludge thickness (% of sludge zone)	(Sewage COD x COD removal efficiency x Total bacterial yield x degradation of organic compound) + (Sewage TSS x TSS reduction in reactor x Volatile TSS*[8]) (%solids x sludge retention time) / (Surface area of the reactor x Depth of sludge zone)	33%	@ 65% removal efficiency (% of sludge zone: 50% - 80%)	Not ok
	Sludge drying bed area required (m^2)	Sewage COD x COD removal efficiency x Total bacterial yield x degradation of organic compound) + (Sewage TSS x TSS reduction in reactor x Volatile TSS*[9]) (%solids x Drying cycle)/Depth of sludge application	2743	<6584 sq.m	OK (Around 8 beds would be required for sewage sludge)
	BOD, COD, TSS % removal	See table 1 and percentage of sludge zone	50%		Not ok
Faecal sludge on the Sludge drying bed	Flow (m^3/hr)	416.7 (10KLD)			
	BOD (mg/l)	3500			
	COD (mg/l)	45000			
	TSS (mg/l)	40000			
Filtrate	Volume (m^3)	Sludge volume applied x TSS x %Solid removal/ expected concentration of solids in thickened sludge (assumed 200000 mg/l)	8.10		
	BOD	BOD - %removal x BOD	700		
	COD	COD - %removal x COD	2250		
	TSS	TSS - %removal x TSS	2469		
Aerated lagoons	Oxygen requirement	If effluent BOD with FSS is >designed effluent then = (BOD incoming – designed BOD)/ (Sewage flow + Sludge Flow) x 1.5 Kg O_2 required/Kg BOD removed	79	<77 kg	OK, as the concentration of Sewage BOD (i.e. 250 mg/l) is taken as compared to 120 mg/l (actual). Sewage BOD till ~200 mg/l can be handled

					without extra aeration.
Polishing pond	Retention time	Volume of the Pond/(Sewage flow + Sludge flow	58	>24 hrs.	OK
	TSS in effluent	90% removal efficiency for 24 hrs. retention time	25	<30 mg/l	OK
	BOD in effluent	80% removal efficiency for 24 hrs. retention time	25	<20 mg/l	OK, as the concentration of BOD (i.e. 250 mg/l) is taken as compared to 120 mg/l . BOD till ~200 mg/l can be handled without extra aeration.
	COD in effluent	90% removal efficiency for 24 hrs. retention time	23	<100 mg/l	OK

Annexure 9: Photograph of site inspection

Annexure 10: No Objection Certificate

E-mail: cegangaupjn@yahoo.in

उत्तर प्रदेश जल निगम

प्रधान कार्यालय 6, राणा प्रताप मार्ग, लखनऊ 226001

संख्या– 1020 /022-505/2019, दिनांक – 29.11.2019

To,
Mr. Rahul Mankotia
Programme Manager ,
Programme Support Unit ,Water Programme
Centre for Science and Environment ,New Delhi

Subject : Regarding NOC for Co-treatment of Faecal Sludge at STP in Bijnor

Dear Sir,

This is in reference to your letter no - CSE/DoUD/2019-10-24, Dated : 24th October 2019 regarding NOC for co-treatment of Faecal Sludge at 24 MLD capacity STP, Bijnor addressed to Managing Director, U.P. Jal Nigam.

In this regard, UP Jal Nigam has **No Objection** on the proposal of CSE for proposing and implementing FSS co-treatment at Sewage Treatment Plant at Bijnor, subject to the condition that CSE will submit a detailed technical proposal to the Chief Engineer (Moradabad), U.P.Jal Nigam, Moradabad for approval, before implementing at site.

This is being issued after the approval of competent authority.

Thanking you

With Regards

29.11.19

(Ajaya Rastogi)
Chief Engineer (Ganga)

Copy to following for information and necessary action :-

1. Managing Director , UP Jal Nigam Lucknow
2. Director , Local Bodies Directorate, Lucknow
3. Additional Project Director, State Mission for Clean Ganga UP
4. Shri Ramakant Pandey (IAS), District Magistrate, Bijnor
5. Shri A. K Rai, Chief Engineer, Moradabad Zone, UP Jal Nigam,Moradabad
6. Shri Durgeswar Tripathi, Executive Officer, Bijnor
7. Shri K. B. Jain, Executive Engineer, U. P. Jal Nigam ,Bijnor
8. Shri Javed Ansari, Technical Advisor, State Mission for Clean Ganga UP
9. Dr.Suresh Kumar Rohilla, Senior Director , Water Programme , CSE, New Delhi

Chief Engineer (Ganga)

Letter no 25.11.2019

Annexure 11: Protocol for testing and trial of co-treatment

Co-treatment of faecal sludge (20 KLD Capacity) at 24 MLD STP in Bijnor

"Trial Run/Commissioning Protocols"

The 20 KLD capacity co-treatment facility in Bijnor is ready to be commissioned but prior to the commissioning, it requires to undergo some checks and tests as detailed below:

- **Leakage Test:** The tank will be filled up to effective depth with either fresh water or treated sewage from STP which will be left for 24 hours then dropdown in water level will be noted after the duration of 24 hours. If the dropdown in water level is noted around 5-15 mm, it will be ok but if it is more then it will be considered as leakage.
- **Slope Test:** This test will help checking whether the slope provided is correct or not for the ease of flow.
- **Check for Alignment and Pipe Fittings:** This test will ensure proper arrangements of all the inlet and outlet pipes.

Protocol for trial run and commissioning

1. **Trial Run:** The co-treatment unit will undergo a 1 month trial run which will be closely monitored by Centre for Science and Environment (Knowledge Partner) and UP Jal Nigam (as discussed during NMCG review meeting-16/03/2022). The trial run would basically test the performance of the screen chambers, and homogenization tank. The trial would be done according to following protocol:
   - 1.1. **Screen Chamber:** How effectively screens are able to stop the non-degradable materials (like polythene, condoms, sanitary pads, wafer packets etc) to reach the next unit.
   - 1.2. **Homogenization cum stabilization tank:** In case of homogenization tanks the testing would be observed whether liquid FS is going to the next unit completely or not? In the first phase when 8-12 KLD FS will be received at the decanting station, it will be collected in HT for 6 days and then all the FS from the tank will be transferred to Sludge Drying Beds (SDB) through sludge sump well. Observation would be whether any sludge accumulated or left behind or not?
   - 1.3. **Sludge Sump:** The observation would be made on time taken by the pump to discharge the stored sludge from sludge sump well to Sludge drying beds (ideally 5 hours for 60KLD). Any shortfalls will be noted.
2. **General Instructions during trial run/commissioning:**
   - 2.1. Entrance:
     - 2.1.1. The tractor mounted desludging vacuum tractor must enter from the main gate of STP.
     - 2.1.2. The desludging operator must give all the details mentioned in "Form 3 of Bijnor Bye-laws for FSSM" (like address from FS is received, How old FS is?; Type of containment emptied etc.)
     - 2.1.3. Maintain a log for each trip coming to the facility.
     - 2.1.4. The operator must wear all the necessary PPEs (masks, gloves, helmet and suit,etc.) while decanting the FS at screens.
     - 2.1.5. The Desludging operator must watch out for any spillage on the RCC road near the chambers. If any accidental spillage is there the operator must clean it through sprayer of the water tap beside.

Annexure 12: Sanitation Cell Bijnor

Letter for Sanitation Cell

कार्यालय – नगर पालिका परिषद, बिजनौर (जनपद बिजनौर)

संख्या :121 /न0पा0परि0बि0/2021–22, दिनांक : 02-2-22

कार्यालय ज्ञाप

जैसाकि आप समस्त विदित ही है कि नगर बिजनौर में स्थायी FSSM कार्यान्वयन के लिए सेंटर फॉर साईंस एवं एनवायरनमेंट नगर पालिका परिषद, बिजनौर में समर्थन कर रहा है। इसी संदर्भ में बिजनौर में मल कीचड़ से सुरक्षित निपटान हेतु को–ट्रीटमेंट व्यवस्था का कार्य 24 MLD STP स्थल पर प्रगति पर है। जो माह फरवरी, 2022 में प्रारम्भ किया जायेगा, जिसके पूर्व ट्रीटमेंट स्थल पर निरंतर सेप्टिक टैंक से निकले हुए मल की मांग रहेगी।

इस क्रम में शहर में FSSM गतिविधियों में तेज़ी लाने के लिए हम बिजनौर में उत्तर प्रदेश सेप्टेज मैनेजमेंट पालिसी 2019 में दिए गए सेप्टेज प्रबंधन के संचालन हेतु नागर निकायों के अन्तर्गत सेप्टेज मैनेजमेंट सेल (स्वच्छता प्रकोष्ट) जैसे एक समर्पित प्रकोष्ट का गठन करने की आवश्यकता होगी। यह स्वच्छता प्रकोष्ट स्वच्छता सर्वेक्षण–2022 में पालिका को महत्वपूर्ण अंक दिलाने व रैंकिंग बढ़ाने में भी कारगर रहेगा, जिसका वर्णन स्वच्छ सर्वेक्षण टूलकिट 2022 के कॉलम 3.6 में दिया गया है। यही नहीं ये प्रकोष्ट शहर में उचित सेप्टिक टैंक डिजाईन को बढ़ावा देने एवं उचित सेप्टिक टैंक के निर्माण, खाली करने/अनुसूचित निकासी और ट्रीटमेंट के लिए मल कीचड़ के सुरक्षित परिवाहन जैसे स्वच्छता मुद्दों, खाली संबंधित सभी मुद्दों एवं चुनौतियों को देखेंगा। उक्त से सम्बन्धित सदस्य व उनको दी गयी जिम्मेदारी हेतु विवरण निम्नवत है –

क्र0सं0	नाम	पद	संस्था	संपर्क सूत्र
1.	श्री विकास कुमार	अधिशासी अधिकारी/प्रकोष्ट अध्यक्ष	न0पा0परि0बिजनौर	8189078116
2.	श्री गोविन्द कुमार	सफाई एवं खाद्य निरीक्षक/प्रकोष्ट प्रबन्धक	" "	7983963260
3.	संबंधित वार्ड के सफाई नायक	क्षेत्राधिकारी	" "	01342260073
4.	श्री संदीप कुमार	कॉल प्रबंधन सहायक	" "	8868881809
5.	श्री हर्ष यादव	तकनीकि सलाहकार	सी0एस0ई0	8709638775

स्वच्छता सेवाओं के लिए संपर्क सूत्र : 1800–180–5062

भूमिका एवं जिम्मेदारी

प्रकोष्ट अध्यक्ष : स्वच्छता प्रकोष्ट द्वारा प्रदान की जाने वाली स्वच्छता सेवाओं की कार्य कुशलता को संबोधिता एवं ट्रैक किए गये सभी मुद्दों के कार्य और प्रलेखन की निगरानी।

प्रकोष्ट प्रबंधक : जनता द्वारा स्वच्छता सेवा की मांग के सम्बन्ध में सभी कॉल्स में भाग लेने और इसी संदर्भ में मासिक रिपोर्ट बनाने हेतु एक समर्पित व्यक्ति।

क्षेत्राधिकारी : एक समर्पित व्यक्ति जो जमीन पर मुद्दों का निरीक्षण एवं समाधान करेगा।

कॉल प्रबंधन सहायक : को–ट्रीटमेंट प्रभारी एवं स्वच्छता प्रोकोष्ट में कॉल प्रबंधन में सहायक – को–ट्रीटमेंट पर मल कीचड़ को सुरक्षित रूप में खाली करना और निपटाना सुनिश्चित करेंगे और यह भी सुनिश्चित करेंगे की सभी कर्मचारी को डी–स्लजिंग गतिविधिओं के दौरान पी0पी0 ई0 किट्स पहने रहें।

तकनीकि सलाहकार : बिजनौर FSSM कार्यान्वयन और स्वच्छता प्रकोष्ट उपयोग में चुनौतियों के लिए तकनीकि सहायता देंगे।

02/02/022

अधिशासी अधिकारी,
नगर पालिका परिषद, बिजनौर

प्रतिलिपि निम्नलिखित को सूचनार्थ प्रेषित :–

1– अध्यक्ष महोदया, न0पा0परि0 बिजनौर।
2– प्रभारी अधिकारी स्थानीय निकाय बिजनौर।
3– समस्त सम्बंधित को अनुपालनार्थ।

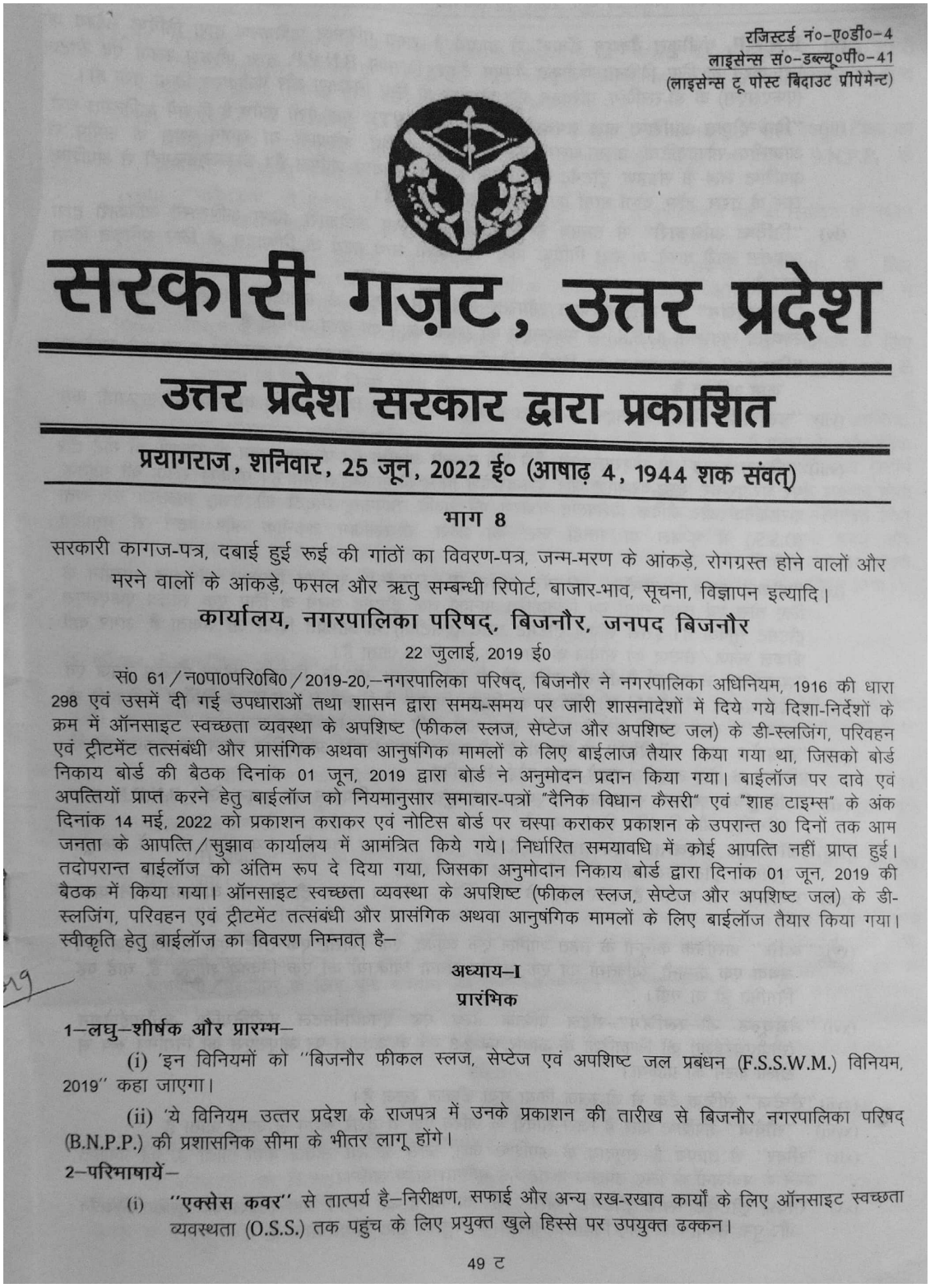
अधिशासी अधिकारी,
नगर पालिका परिषद, बिजनौर

Annexure 13: List of intercepted drains in Bijnor city

	Location
1	STP Taping
2	Chamunda Mandir
3	Tevri village
4	Chandpur Chungi
5	Ramleela Ground
6	Ladapura Village
7	PWD Colony
8	Police Station
9	Vardhman College
10	Police Line
11	Shanti Nagar
12	Aawas Vikas
13	Eid Gha
14	Machli Bazar1st
15	Machli Bazar2nd
16	Near UPJN Office
17	Near Polytechnic College

Annexure 14: Rewards ceremony for private desludgers

Annexure 15: FSSM Bylaws Gazette Notification



रजिस्टर्ड नं०-ए०डी०-4
लाइसेन्स सं०-डब्ल्यू०पी०-41
(लाइसेन्स टू पोस्ट बिदाउट प्रीपेमेन्ट)

सरकारी गज़ट, उत्तर प्रदेश

उत्तर प्रदेश सरकार द्वारा प्रकाशित

प्रयागराज, शनिवार, 25 जून, 2022 ई० (आषाढ़ 4, 1944 शक संवत्)

भाग 8

सरकारी कागज-पत्र, दबाई हुई रूई की गांठों का विवरण-पत्र, जन्म-मरण के आंकड़े, रोगग्रस्त होने वालों और मरने वालों के आंकड़े, फसल और ऋतु सम्बन्धी रिपोर्ट, बाजार-भाव, सूचना, विज्ञापन इत्यादि।

कार्यालय, नगरपालिका परिषद्, बिजनौर, जनपद बिजनौर

22 जुलाई, 2019 ई0

सं0 61/न0पा0परि0बि0/2019-20,—नगरपालिका परिषद्, बिजनौर ने नगरपालिका अधिनियम, 1916 की धारा 298 एवं उसमें दी गई उपधाराओं तथा शासन द्वारा समय-समय पर जारी शासनादेशों में दिये गये दिशा-निर्देशों के क्रम में ऑनसाइट स्वच्छता व्यवस्था के अपशिष्ट (फीकल स्लज, सेप्टेज और अपशिष्ट जल) के डी-स्लजिंग, परिवहन एवं ट्रीटमेंट तत्संबंधी और प्रासंगिक अथवा आनुषंगिक मामलों के लिए बाईलाज तैयार किया गया था, जिसको बोर्ड निकाय बोर्ड की बैठक दिनांक 01 जून, 2019 द्वारा बोर्ड ने अनुमोदन प्रदान किया गया। बाईलॉज पर दावे एवं अपत्तियों प्राप्त करने हेतु बाईलॉज को नियमानुसार समाचार-पत्रों "दैनिक विधान कैसरी" एवं "शाह टाइम्स" के अंक दिनांक 14 मई, 2022 को प्रकाशन कराकर एवं नोटिस बोर्ड पर चस्पा कराकर प्रकाशन के उपरान्त 30 दिनों तक आम जनता के आपत्ति/सुझाव कार्यालय में आमंत्रित किये गये। निर्धारित समयावधि में कोई आपत्ति नहीं प्राप्त हुई। तदोपरान्त बाईलॉज को अंतिम रूप दे दिया गया, जिसका अनुमोदान निकाय बोर्ड द्वारा दिनांक 01 जून, 2019 की बैठक में किया गया। ऑनसाइट स्वच्छता व्यवस्था के अपशिष्ट (फीकल स्लज, सेप्टेज और अपशिष्ट जल) के डी-स्लजिंग, परिवहन एवं ट्रीटमेंट तत्संबंधी और प्रासंगिक अथवा आनुषंगिक मामलों के लिए बाईलॉज तैयार किया गया। स्वीकृति हेतु बाईलॉज का विवरण निम्नवत् है—

अध्याय—I

प्रारंभिक

1—लघु—शीर्षक और प्रारम्भ—

(i) 'इन विनियमों को "बिजनौर फीकल स्लज, सेप्टेज एवं अपशिष्ट जल प्रबंधन (F.S.S.W.M.) विनियम, 2019" कहा जाएगा।

(ii) 'ये विनियम उत्तर प्रदेश के राजपत्र में उनके प्रकाशन की तारीख से बिजनौर नगरपालिका परिषद् (B.N.P.P.) की प्रशासनिक सीमा के भीतर लागू होंगे।

2—परिभाषायें—

(i) **"एक्सेस कवर"** से तात्पर्य है—निरीक्षण, सफाई और अन्य रख-रखाव कार्यों के लिए ऑनसाइट स्वच्छता व्यवस्थता (O.S.S.) तक पहुंच के लिए प्रयुक्त खुले हिस्से पर उपयुक्त ढक्कन।

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Annexure 16: Bijnor co-treatment setup

Notes and references

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13 https://www.cseindia.org/cse-bnpp-memorandum-of-understanding-9637

14 Mainstreaming Co-treatment of Faecal Sludge and Septage (FSS) in STPs in Uttar Pradesh-Report CSE https://www.cseindia.org/mainstreaming-co-treatment-of-faecal-sludge-septage-fss-in-stps-in-uttar-pradesh-9658

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16 https://www.cseindia.org/detailed-project-report-on-co-treatment-of-faecal-sludge-at-bijnor-sewage-treatment-plant-10299

17 https://www.upprojects.upsdc.gov.in/Home/ProfileofCorporations

18 KII- Information revealed in discussion with JalKal Department Nagar Palika Parishad, Bijnor

19 CSE 2018 primary survey data analysis.

20 Key Informant Interview with Jalkal engineer, Bijnor NPP.

The Centre for Science and Environment (CSE) worked closely with the National Mission for Clean Ganga (NMCG), State Mission for Clean Ganga-Uttar Pradesh (SMCG-UP), Department of Urban Development (DoUD), UP Jal Nigam (UPJN), Bijnor Nagar Palika Parishad (BNPP), the contractors, local community and other stakeholders to design, develop and operationalize the 20 kilolitre per day (KLD) co-treatment unit at the site of the 24 million litres per day (MLD) sewage treatment plant (STP) in Bijnor town.

This report presents the learnings from challenges faced during the construction of the co-treatment unit, measures taken to overcome these challenges, and the way forward. It provides a valuable case study in the construction and operationalization of a sustainable co-treatment unit at an existing STP and various aspects of implementing context-specific faecal sludge and septage management (FSSM) projects in small- and medium-sized cities of India.

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