DECODING DESLUDGING CHALLENGES IN TOWNS OF UTTAR PRADESH

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Maps in this report are indicative and not to scale.

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Contents

LIST OF TABLES

LIST OF MAPS

LIST OF FIGURES

Executive summary

All faecal sludge treatment plants in Uttar Pradesh, barring one, are functional. Many of the plants are, however, not getting enough sludge, making them underutilized. Some plants, in contrast, have shown good numbers with regard to vacuum tankers emptying sludge at the faecal sludge treatment plant (FSTP).

Why are desludging numbers different for different towns?

In order to find the answer, the Centre for Science and Environment (CSE) undertook a study in four towns to have a deeper understanding of desludging at the town level. The study focused mainly on identifying the factors impacting desludging in the towns, with special focus on the nature of containments and related elements. The study also sought to enhance understanding of desludging from the perspective of different stakeholders and ultimately critique on treatment plants' utilization based on actual numbers and theoretical potential.

The selected towns, each with a 32-kilolitre-per-day (KLD) FSTP, were topographically similar. On the basis of secondary data, two towns, Raebareli and Sitapur, however, had low numbers of desludging and subsequent decanting reported at the treatment plant, and the remaining two towns, Shikohabad and Gonda, reported contrasting good numbers.

Operational challenges, which include monitoring mechanism and protocols by the urban local body as well as formalization of private operators into the government system were not studied deeply in this study.

Key takeaways

All four towns have factors of varying influence—that is, the nature of containment, i.e. size, type or absence of such containments in the households—on desludging numbers. The reason for low desludging numbers in Raebareli and Sitapur is the negative impact of these factors and absence of any positive influence/support to offset them.

In Shikohabad, on the other hand, the factors have a lower negative influence and there are positive supporting factors such as treatment plant location and distance from all parts of the town as well as free desludging service provided by the municipality. It is further aided by increase in levelling of road in some wards,

creating the urge to empty containment systems. This need is short-lived but has resulted in an artificial surge in desludging numbers, which will also be temporary.

In Gonda, the only positive influences that result in better desludging numbers are better administration and hold on private operators than the other studied towns.

Also, it was observed that although the septic tanks in all towns had length and width as per IS code 2470-1, the households had twice or thrice the minimum recommended depth. This resulted in lower desludging frequency.

Apart from the aforementioned factors, others factors such as affordability, tolerance to smell and odour, and narrow lanes resulting in delayed desludging, pose challenges or barriers to desludging. However, in the larger context of the overall desludging scenario in the town, their significance is limited.

From the study, it can be concluded that physical aspects of containment structure have a significant impact, i.e. overall lower desludging numbers than anticipated, in a town. There is, however, still scope for an increased number of vacuum tankers decanting sludge at the treatment plant. This is possible only through better enforcement and monitoring by the urban local body which can restrict indiscriminate dumping of sludge. Further, sustained awareness-generation campaigns, user-friendly and prompt service delivery and equitable and uniform desludging rates all across will aid in enhancing the overall numbers of desludging.

Recommendations

It is crucial to ensure that whatever sludge is emptied in the town reaches the treatment plant as indiscriminate dumping results in contamination of groundwater and poses significant threat to humans and environment in general.

While physical aspects such as the nature of containments and planning of settlements in towns play an important role in affecting desludging numbers, it is essential that the major focus should be on operational-level challenges pertaining to desludging and the number of desludging vehicles decanting sludge at the treatment plant. These include formalizing of private players involved in the desludging business, better monitoring by the local body, and strict enforcement of fines and penalties for indiscriminate dumping of sludge. This is due to the fact that treatment plants are now functional and the impact of containment-related retrofitting and modifications will take time to reflect on ground. In this regard, the role of municipality in terms of monitoring and enforcement become vital.

The study also points that although physical challenges related to containments affect the number of desludgings, the related effect on treatment plant utilization can be reduced if proper monitoring of indiscriminate dumping of sludge from the actual desludgings happening in the town is seriously taken up by the municipality. The case of Gonda is a good example where there are containment-level challenges, but the municipality's consistent efforts have resulted in better capacity utilization of the treatment plant than in Raebareli and Sitapur.

1. Better monitoring mechanism

Proactive monitoring of private operators by the municipality is the first step in ensuring that all sludge that is emptied reaches the treatment plant. Fines and penalties for indiscriminate dumping should be levied by the municipality. This could be enforced through FSSM byelaws. In addition, formalizing private desludging operators and making them a part of the government system as an extended arm of the municipality should be prioritized.

2. Targeted capacity—building and awareness programmes

All the operators, including government and private, should have targeted capacity-building programmes and be regularly trained with regard to safe desludging practices and fines and penalties related to indiscriminate dumping of sludge. Wards could be identified where containment systems are septic tanks and fully lined tanks are in majority, and targeted programmes and campaigns to raise awareness about desludging could be introduced.

3. Developing and implementing scheduled institutional desludging plan

In order to ensure that a minimum quantity of sludge reaches the treatment plant, the municipality can develop and implement scheduled institutional desludging plan. In simple terms, it is mandatory cleaning of septic tanks of all government owned or managed establishments. A guideline[1] for improving treatment plant utilization through scheduled institutional desludging was issued by the UP state government.

4. Future containments as per IS code

For all the future construction, ensure households have septic tanks as per IS 2470. This could be done at the time of approval of the plan/map at the municipality level. This would result in higher desludging intervals and better supernatant quality.

5. Realistic sizing of treatment plant

Many of the treatment plants in Uttar Pradesh are still not functioning at the optimum capacities. As in April 2025, 15 FSTPs out of 36 and three out of 19 co-treatment plants were running at 20 per cent or below capacity.

Theoretically, for quantification of faecal sludge in a town is done using three methods, i.e. population method, volume of onsite sanitation systems (OSS) method, and sludge transportation method. Each one has some cons. Based on the study and experience from the field, an improvised approach for quantification of faecal sludge for realistic sizing of the treatment plant is put forward. This way the designed plants would be closer to the actual desludgings in a town.

The improvised approach is based on modifying the existing method. Until now, the formula used was very straightforward, i.e., population of town dependent on containments, i.e., mainly septic tanks and pits, is multiplied by respective sludge generation rates as mentioned by CPHEEO.

Under this improvised approach, the containments are further filtered. The containments are classified into septic tanks, fully lined tanks and semi-lined tanks. In addition, households discharging directly into open drains and households connected with sewers are also taken into account.

The basic principle applied here in calculating the capacity of a treatment plant is the consideration of households that have containments with the probability of emptying them on more regular basis like septic tanks and fully lined tanks and leaving the households connected with sewer. While the households with semi-lined containments or directly discharging into open drains are considered at a lower value than the original number and this is due to a two-sided rationale, i.e., one, the desludging frequencies of semi-lined containments are much lower than that of septic tanks or fully lined tanks and, two, an expectation that households directly discharging into open drains will get proper containments at some point of time during design period of the treatment plant. To get to the lower value, the original number of households with such arrangements could be multiplied by a maximum value of one-third. The value thus obtained approximately accounts for the number of semi-lined containments that would get emptied in the same time.

The number of households thus obtained could be multiplied by the septage generation rate (120 litres/capita/year [l/c/y]) for septic tanks and fully lined tanks and sludge generation rate for semi lined tanks (76 l/c/y) to arrive at the capacity of treatment plant.

The improvised method holds good for the towns selected for this study. This approach could be used to check if capacity estimations using other methods are correct or need any correction.

Background

As per the latest UP Jal Nigam data (2024), there are 133 STPs In Uttar Pradesh. More than 700 urban local bodies (ULBs) out of 762, however, are still heavily reliant on on-site sanitation systems. This implies that faecal sludge generation and its storage in some quantum or form happens on-site. As of April 2025, for treating the sludge generated from these systems, 55 towns have either FSTPs or co-treatment facilities currently operating at various capacities.

A major challenge for a municipality is to ensure the emptied sludge safely reaches the treatment facility. As the septic tank cleaning market in most of the cities is heavily dominated by private players who are difficult to regulate, the gravity of this challenge rises tremendously.

While there has been significant improvement in the establishment and operationalization of FSTPs in UP in the last two years, the status of FSTPs capacity utilization as on April 2025 is as follows:

- 15 out of 36 FSTP towns have less than 20 per cent capacity utilization.
- Three out of 19 towns with co-treatment have less than 20 per cent capacity utilization.

What is the cause of this low capacity utilization? The primary and secondary factors responsible for this needs to be explored. As many of the FSSM projects in India are not being able to operate at optimum capacity, fingers are being raised at the investments made and FSSM as an alternative solution for tackling sanitation management. The future of faecal sludge management (FSM) work in India depends on finding answers to this question.

CSE undertook a study in order to get the answers and enhance the understanding of 'desludging' and its associated attributes while assessing its role in improving utilization of treatment plants. Addressing concerns around plant utilization in UP is crucial as many of them are running way below capacity and poses questions marks over initial planning on 'one-size-fits-all' approach. This way, study findings are expected to lead to a realistic sizing of FSTPs in the future.

Objective

The following are the objectives of the study:

1. To identify various contributors affecting desludging and quantify the gravity of each in a town;
2. To understand 'end-to-end' desludging in a town from the perspective of different stakeholders;
3. To critique utilization of treatment plants based on a town's potential and actual desludgings.

Methodology

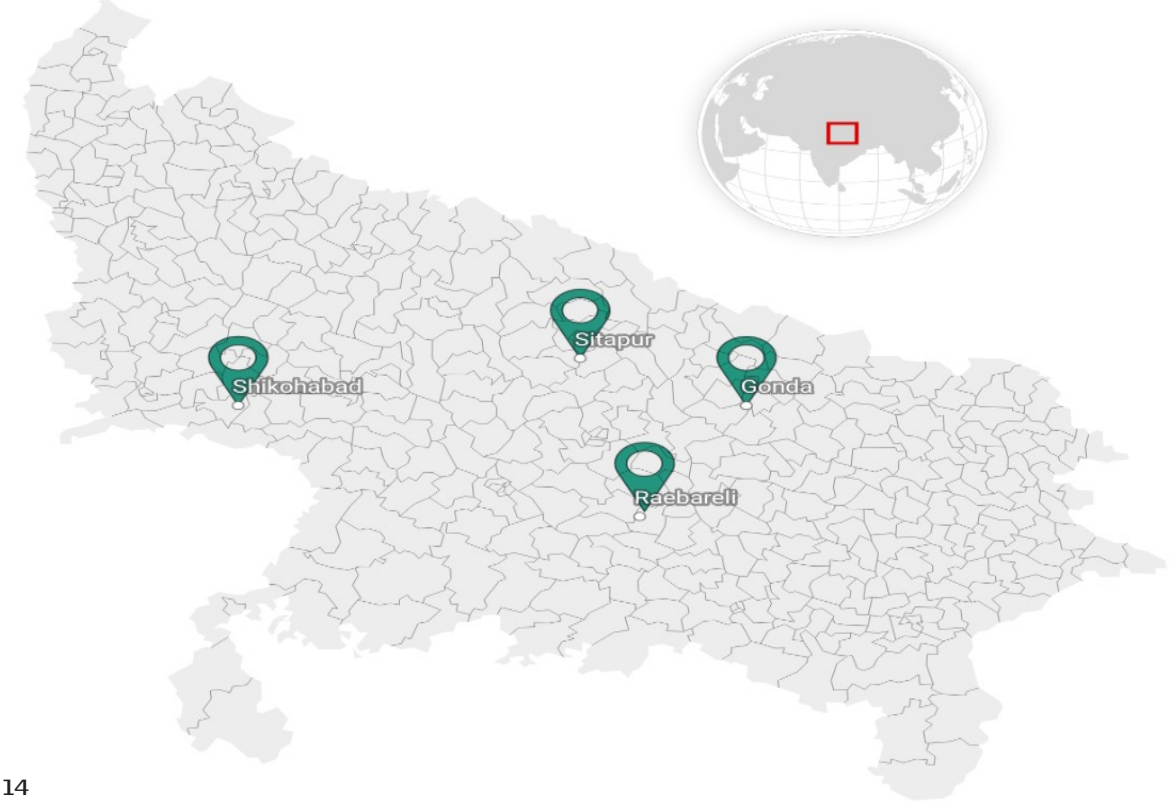
1. Preparation of concept note

A concept note was prepared before undergoing field surveys and data collection. The note was needed to understand the requirements of the study and freeze the scope, sharpen the objectives, define limitations of the study and postulate hypothesis for test.

Selection of towns for the study

The study focused on data collection through field visits in four medium-populated towns. Two towns where the treatment plant is reporting a smaller number of vacuum tankers than required at the treatment plant are **Raebareli and Sitapur**. While the other two towns, **Shikohabad** and **Gonda** selected as reported number of tankers reaching the treatment plant are on the higher side (between five and eight per day). This way the study tried to understand the two ends of the spectrum of desludging. The towns so selected also helped in understanding whether towns have low desludging due to physical aspects majorly or there is a gap in actual desludgings and reported numbers at treatment plant due to operational

Map 1: Map of Uttar Pradesh with locations of selected cities for study



challenges also. This selection is also influenced by already available data collected during earlier engagements with the towns, responsiveness of officials and also logistical considerations.

2. Collection of data from previous visits and secondary sources

Data such as number of households, population, sewer connections and low-income settlement areas were collected from previous visits to these towns. This was done under CSE's initiative to support these towns for operationalizing FSSM projects in Uttar Pradesh. Other than this, census data as a secondary source was also referred to during desk research.

3. Development of questionnaire for data collection from field

Questionnaire for each stakeholder, including private operators, municipality officials and households, were developed using earlier insights and experience. Each questionnaire gathered information on desludging from different perspectives. Templates of random household survey, government official, private operator questionnaire are attached at the end of the report (see *Annexures 1, 2 and 3*)

4. Field visit and data collection plan

As this was more of a qualitative study based on intensive interviews of households, a higher sample size and questionnaire-based data collection was avoided in favour of a small sample size representing different strata and settlements in a town.

Field surveys in the selected cities were conducted for a duration of two to three days and questionnaires were run with the relevant stakeholders—including households, vacuum-tanker operators, masons, ward councilors, sanitation supervisors and government officials—to collect the necessary information.

The process followed for field survey is as follows:

i. Discussion with government official and understanding of the various areas of the town using a ward-wise map of the ULB;

ii. Based on the information and discussion with officials, wards were demarcated on the map on the basis of the following:
    a. Area/households connected with sewer, if available;
    b. Area/households with narrow lanes (3–5 feet wide);
    c. Households in peri-urban area or informal settlements;

d. Households in the core city area or old residents of the unplanned inner core of the city; and
e. Households in the remaining areas or new planned settlements if any.

iii. Plan for household-level survey in the wards that are of different nature as mentioned above, leaving similar wards. This was done to reduce the effort and time of the researcher on the field.

iv. A random household survey protocol was later followed to have an understanding of the town's desludging scenario. The maximum or minimum number of households to be surveyed was not fixed prior and was left to the judgement of the surveyor on the field.

v. Based on the data and information collected from the household surveys and interviews with relevant stakeholders, preliminary-level data analysis in terms of physical aspects of containments was done in percentage terms.

5. Data analysis and interpretation

All the data collected from the field was then be collated, analysed and interpreted with regard to the following:

i. Containment size: Whether the town has enough large-sized containments resulting in low desludgings;

ii. Containment type: Whether the town has containment types that require low desludging frequency;

iii. Households in narrow lanes: The following needs to be ascertained: Is desludging is actually affected? Is manual desludging prevalent in such areas? What is the contribution of narrow lanes as a factor in overall contributors affecting desludging?

iv. Indiscriminate dumping: Identify indiscriminate dumping hotspots and their distances from nearby households and desludging areas.

Based on the findings and key takeaways, recommendations were put forward such that the treatment plants get more sludge, and increase in overall desludgings happen while restricting indiscriminate dumping of sludge in the open.

Data collection

The following stakeholders were interviewed during field visits to all four towns:

Table 1: Information about stakeholders interviewed in each town

Stakeholder	Raebareli	Sitapur	Shikohabad	Gonda	Total
Households	85	90	102	117	394
Vacuum-tanker operators	3	-	2	2	7
Masons	4	04	5	2	15
Ward councilors	8	08	6	8	30
Sanitation supervisors	9	08	4	4	25
Government officials	2	02	3	2	9
Total	111	112	122	135	480

The total number of stakeholders interviewed in all four towns is 480 (see *Table 1: Information about stakeholders interviewed in each town*). City-wise data collection information is as follows:

Raebareli

Raebareli is the only town where there is a sewage treatment pPlant (STP), and some of the area has sewer coverage. The STP, with a designed capacity of 18 MLD, is fully functional and currently receives an average of 4–5 MLD of wastewater. The town also has a 32-KLD faecal sludge treatment plant (FSTP) built out of AMRUT funding and currently operated by a four-membered women self-help group (SHG) engaged under the Central government's AMRUT MITRA initiative. The FSTP is severely underutilized and receives an average of two to three tankers of sludge on a daily basis, which adds up to less than 40 per cent monthly capacity utilization.

A total of 85 households in 15 wards were surveyed on the basis of a household-level questionnaire. The interviewers met and understood the sanitation scenario of their wards from eight ward councilors and nine sanitation supervisors. Apart from this, three private vacuum-tanker operators and four masons and one Junior Engineer and one Assistant Engineer were also interviewed (see *Table 2: General information on Raebareli town*).

Table 2: General information on Raebareli town

Population (current)	239,145
Households	46,580
Sewer connections	6,981
Area (km^2)	50.12
Number of wards	34

Source: NPP, Raebareli

Sitapur

Sitapur has minimal sewer coverage in the Awas Vikas ward but there is no STP for wastewater treatment. The town, like Raebareli, has a 32-KLD faecal sludge treatment plant (FSTP) built out of AMRUT funding and currently operated by a four-membered women self-help group (SHG) engaged under the Central government's AMRUT MITRA initiative. The FSTP is severely underutilized, and functions at a meagre 5 per cent monthly capacity utilization.

A total of 90 households in 14 wards were surveyed based on a household-level questionnaire. The interviewer met and understood the sanitation scenario of their wards from eight ward councilors and eight sanitation supervisors. Four masons were also interviewed (see *Table 3: General information on Sitapur town*).

Table 3: General information on Sitapur town

Population (2011)	177,234
Households	25,261
Sewer connections	505
Area (km^2)	56
Number of wards	30

Source: NPP, Sitapur

Shikohabad

This is the smallest city out of all in terms of area. The town, like Sitapur, has a 32-KLD faecal sludge treatment plant (FSTP) built out of AMRUT funding and currently operated by a contractor hired by the ULB using its own funds. The FSTP is currently running at above 50 per cent capacity and on good days gets a maximum of eight tankers of faecal sludge.

A total of 102 households in 12 wards were surveyed on the basis of a household-level questionnaire. The interviewer met and understood the sanitation scenario of their wards from six ward councilors and four sanitation supervisors. Apart

from the FSTP operator and driver, five masons and two private operators were also interviewed (see *Table 4: General information on Shikohabad town*).

Table 4: General information on Shikohabad town

Population (2011)	107,300
Households	23,655
Sewer connections	Nil
Area (km^2)	8.48
Number of wards	25

Source: NPP, Shikohabad

Gonda

The town, like all previous towns, has a 32-KLD faecal sludge treatment plant (FSTP) built out of AMRUT funding and currently operated by the ULB on its own. The FSTP is currently running at above 60 per cent capacity, and on good days gets a maximum of five to seven tankers of faecal sludge.

A total of 117 households in 16 wards were surveyed on the basis of a household-level questionnaire. The interviewer met and understood the sanitation scenario of their wards from eight ward councilors and four sanitation supervisors. Two masons and two private operators were also interviewed (see *Table 5: General information on Gonda town*).

Table 5: General information on Gonda town

Population (current)	146,276
Households	21,105
Sewer connections	Nil
Area (km^2)	42.6
Number of wards	27

Source: NPP, Gonda

Data analysis

The data collected from the field visits was analysed to enhance our understanding of various factors that affect desludging. It is worth mentioning that the data collected from various sources have different weightages or percentages attached in all towns in order to arrive at an overall numerical data representation. This is due to the fact that data collected from stakeholders/sources had varying level of confidence or credibility associated with each one. For example, data collected for sewer connections from a government source was given 100 per cent credibility and was used as it is in the calculations, while data for percentage of septic tanks given by a mason was verified with different masons before accepting the data. If different masons provided different percentage, a mean value of all the values was considered.

As this exercise was very much observation based, the final weightage was decided by the person who was responsible for conducting the field visits. However, to keep minimum discrepancy in weightage, all the town visits were conducted by the same person. Town-wise data analysis, the related inferences along with some peculiar observations are as follows.

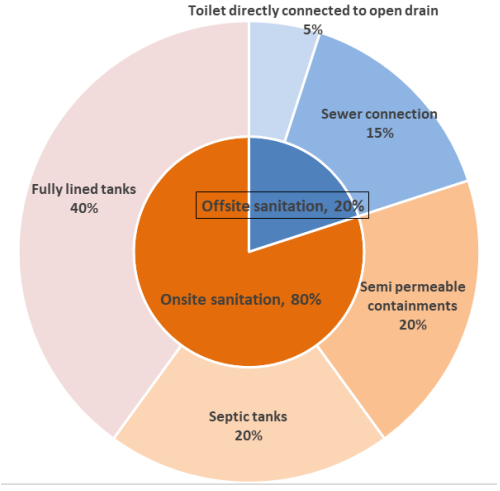
Status of sanitation systems of the towns

Knowing the sanitation systems in a town helps in understanding the desludging trends and in quantification of actual possible desludgings.

Raebareli

From the pie chart (Figure 1), it can be concluded that in Raebareli, every fifth house has a septic tank, leaving others houses with systems requiring less frequent to no desludging scenario (see *Figure 1: Status of sanitation systems in Raebareli*). The calculations shown in the pie chart are based on the data collected from household surveys, interviews and focused group discussions with different stakeholders. The values are representative in nature and true values of the towns might deviate from these.

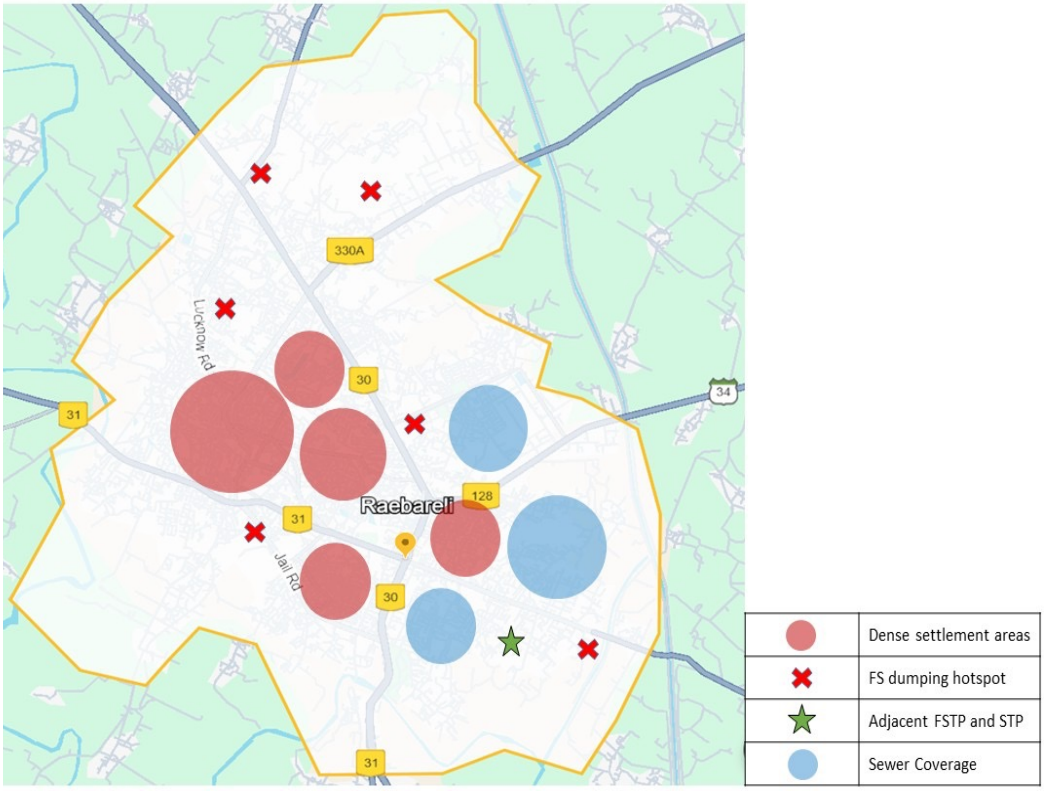
Figure 1: Status of sanitation systems in Raebareli



Identifying old dense settlement areas is essential for understanding overall desludging as these largely have old containment structures that are semi-lined and require less frequent desludging. In addition, these areas also have narrow lanes that makes desludging difficult. Further, households in these areas have toilets that directly discharge into open drains.

Demarcating these areas on the map makes analysis easier. Map 2 highlights such areas along with areas with sewers, FSTPs, STP location (both adjacent to each other) and indiscriminate faecal sludge dumping hotspots. The identified hotspots are places that are convenient for private operators to dump the faecal sludge without fear of getting penalized for it. Open fields of Ratapur, Tripula and outer areas along Lucknow–Raebareli highway are examples.

Map 2: Map of Raebareli with different areas highlighted (based on field visits and interviews)



Factors impacting desludging

On the basis of Map 2, the data was collected, analysed and interpreted. The factors that impact desludging numbers adversely in the town in descending order of gravity are:

1. **Containment size:** Around 40 per cent of the households have fully lined tanks. Their average size is 1.4 times[2] bigger than that of average-sized septic tanks in the city. Out of this, one-quarter of the tanks are large-sized,[3] thus requiring desludging at lower intervals. It was observed that newer households, particularly from middle-income groups, preferred fully lined tanks in place of septic tanks as these can be constructed at half the cost of a septic tank. These are prevalent in peri-urban and newer settlement areas.

2. **Containment type:** 20 per cent of the households have containment structures that have semi-lined walls (honeycombed). As per the survey results, these don't have a specific size and varied as per the requirements of the households. It was revealed that these containment structures are emptied in not less than 15 years of intervals. A typical honeycombed structure as per local masons costs one-quarter that of a septic tank. All such households are located in the red marked category on the map i.e. old town and dense populated.

3. **Increased sewer network:** As per municipal records and field observation, 15 per cent of the households are now connected with sewers (area highlighted in blue). This number is increasing gradually and consistently. Thus, households with any type of on-site containment—which previously would have required desludging—no longer require this service after being connected with a sewer. Based on the interviews with the private operators, a reduction of 40 per cent in their business from the town was observed. Over the years, they have increased catering to desludging demands from nearby rural areas and smaller towns to sustain and continue their livelihood.

4. **Households directly discharging into open drains:** 5 per cent of the households still lack any type of containment structure. This could be for two reasons: one, the households have limited area, particularly in dense and narrow lane areas and, two, the financial condition of households does not allow them to opt for a containment structure. This is out of fear for money needed, initially for its construction and then for getting it emptied once it gets full.

Households discharging domestic wastewater into an open drain

Apart from these, there are other factors considered as barriers to desludging in the town. These, however, are of negligible order from whole town's perspective.

1. Areas with narrow lanes: About 10 per cent of the households are in areas where road width is 3–5 feet. While approachability for desludging vehicles is a question in such areas, most of the houses have none to low desludging requirements.

2. Affordability: Affordability is an issue for the poorest or the poor, forcing them to practice open defecation. This segment includes daily wage workers, slum dwellers and labourers who earn less than Rs 10,000/month. These numbers are approximately 1 per cent of the total population.[4]

Areas with narrow lanes have prominent semi-lined systems and toilets discharging directly into open drains

An abandoned toilet that was constructed by a household under SBM due to fear of the containment being emptied

3. Tolerance to smell: Based on the field observations, it was found that people delay getting desludging services until it is unavoidable. This delay stretches from a timeframe of a few days to one to two months at a stretch. This delay is insignificant with regard to frequency of desludging, which is undertaken every few years.

Stakeholders' perspective

From the household survey, the key takeaway related to desludging was that the frequency of desludging for septic tanks was three to five years and for fully lined tanks five to 10 years, while for semi-lined tanks it shoots up to more than 15 years. Households prefer to call private operators over government ones as they provide timely services and pay up without much bargain. Also, none of the households enquire where the sludge is finally taken once it leaves their premises.

Due to ever-increasing sewer coverage in the town, the private operators are getting more calls for desludging from nearby towns and villages than from Raebareli. The business from the town over the last three to four years has plummeted by 40 per cent. Out of the three operators, only one decants the sludge at the treatment plant regularly. This is also due to the fact that the treatment plant is within his operating area.

Interview with private operators in Raebareli

Interaction with masons revealed that newer households prefer to construct fully lined tanks more as they are cheaper by almost 50 per cent in comparison to septic tanks. Semi-lined containments are still in numbers in older/densely populated areas.

Ward councilors and sanitation supervisors had excellent knowledge about the wards. They provided numbers of households with different type of containments with great accuracy, which helped in estimating the overall sanitation scenario of the town. They also detailed and facilitated physical verification of households, including outliers such as those with no toilets.

Interaction with government officials helped in concluding that the municipality is not putting in enough concentrated efforts to improve treatment plant utilization. Proper monitoring of indiscriminate dumping of sludge by private operators is restricting increased sludge load at FSTP.

Utilization of treatment plant

Interviews with private operators and field observations indicated that two to three tankers were reaching the plant per day, i.e. for 8–10 kilolitres per day (KLD) of sludge, but the actual numbers jump to five to six per day, i.e. 15–18 KLD of sludge. It is clear that proper monitoring is an issue. Even so, the plant would still remain underutilized even if the numbers jumped to the later figure. We need to find out if there is a gap between actual desludgings and theoretical potential which could indicate to us the maximum capacity utilization of the treatment plant. We are leaving aside unlined/semi-lined containment systems and off-site sanitation for the sake of calculation as they require no or less frequent desludging.

Theoretically, 10 containments could be desludged each day in Raebareli. Based on the average containment size, leaving 25 mm (as per IS code) as seeding material at the time of desludging, the plant could easily run at full capacity. However, this number is greater than the number of actual desludgings reported. This discrepancy could be due to recently constructed houses that are still to be emptied. The number is also affected by the household size—the actual number of persons residing are less than the average household size considered.

As per IS code 2740 (Part 1), 1985, septic tanks should be emptied once every two to three years. As per the IS code, the minimum depth of a septic tank should be 1 m (or 3.2 feet) and the prescribed emptying frequency corresponds to it. Also, the code suggests emptying the tank once the depth of scum and the sludge exceed half the depth of the tank. But, the takeaway from the field is that while the length-

Table 6: Calculations for estimation of theoretical desludging potential of Raebareli

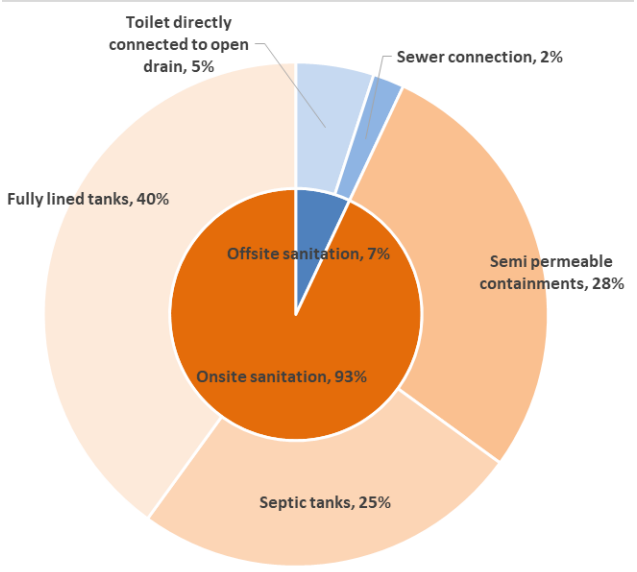
Number of septic tanks	9,316
Household size	5.1
Average size of tank	4,077 litres
Septage generation (litres/capita/year)	120 (as per IS Code)
Average desludging frequency of a unit (years)	4,077/120*5.1 = 6.6
Septic tanks to be desludged/day (A)	9,316/6.6*300 = 5
Number of fully lined tanks	18,632
Number of large-sized tanks	4,658
Number to be considered	13,974
Average size of the tank	5,946 litres
Septage generation (litres/capita/year)	120 (as per IS Code)
Average desludging frequency of a unit (years)	5,946/120*5.1 = 9.7
Septic tanks to be desludged/day (B)	13,974/9.7*300 = 5
Total containments to be desludged/day	A+B = 10

to-width ratio and measurement corresponds to the standards, the depth largely observed is more than twice the standard. Also, desludging is only undertaken once the tank is full and there is backflow. This results in reduced desludging frequency.

Sitapur

The FSTP in Sitapur is located on the outskirts of the urban municipality boundary in the south-western direction. The location itself restricts sludge transportation from other end of the town.

Figure 2: Status of sanitation systems in Sitapur



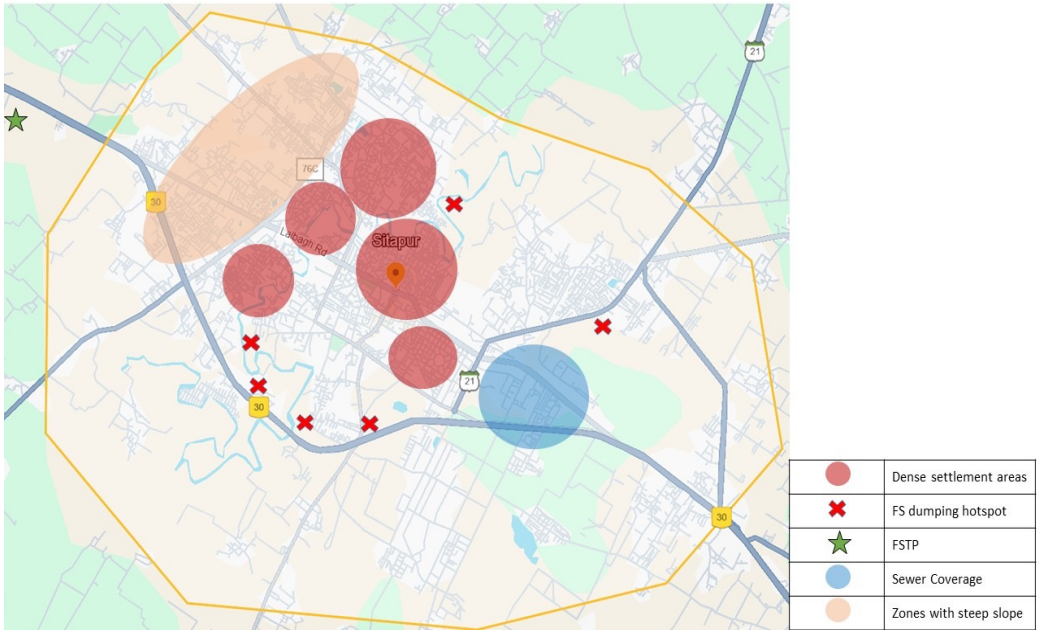
In Sitapur, every fourth household has a septic tank. While 40 per cent of the households are dependent on fully lined tanks, one-fourth of these are in the wards along the water stream where the strata is highly undulated. Wards like

Lonianpurwa, Ucha Tila and Kot have roads at a steep slope, which restricts the commuting of desludging vehicles to these wards. From field observation and interviews, it was deduced that Sitapur has a more concentrated population as compared to Raebareli. In densely populated areas, 33 per cent of households[5] are either dependent on semi-permeable containment structures or the toilets are directly connected with open drains.

Fully lined tanks and septic tanks are more observed in prosperous or peri-urban areas. Apart from this, only 2 per cent of the households have sewer connections in Awas Vikas ward.

Map 3 highlights densely populated areas, along with areas with sewers, FSTPs and indiscriminate faecal sludge dumping hotspots. Only one private operator has been identified to be operating in Sitapur. Dumping hotspots are open areas, the waterbody, and areas along the national highway. Areas such as Ahata Kaptan, Khubpur and Lachimanpur that are along NH 30 are examples.

Map 3: Map of Sitapur with different areas highlighted



Note: The map is based on field visits and interviews

Factors impacting desludging

The data was analysed and interpreted on the basis of Map 5 and the data collected. The following factors impact desludging numbers in the town in descending order of gravity:

1. **Containment type:** 28 per cent of the households have containment structures that have semi-lined walls (honeycombed). As per the survey results, these don't have any specific size and varied as per the requirements of the households. It was revealed that these get emptied in not less than 15 years. All such households are located in the red-marked category on the map, i.e. in the old town and densely populated. It was observed during field visits that in narrow lane areas such containments were shared between two to three families and were constructed in the middle of narrow lanes.

Containment shared by two families

2. **Containment size:** Around 40 per cent of the households have fully lined tanks. Their average size is twice[6] that of average-sized septic tanks in the city. Out of this, one-fourth of the tanks are large sized,[7] thus, requiring desludging at lower intervals. It was observed that newer households, particularly from the middle-income group, preferred fully lined tanks in place of septic tanks as these can be constructed at half the cost of a septic tank. These are prevalent in peri-urban and newer settlement areas. Apart from this, another one-fourth of the households with lined tanks are located in areas where there is a steep slope, restricting emptying by desludging vehicles.

3. **Households directly discharging into open drains:** 5 per cent of the households still lack any type of containment structure. This is for two reasons: one, household have limited areas, particularly in dense and narrow lane areas and, two, the financial condition of households does not allow them to opt for a containment structure. This is out of fear for money required initially for its construction and then for getting it emptied once it gets full.

Apart from these, other factors considered as barriers to desludging are present in the town. However, these are of negligible order from whole town's perspective.

A toilet constructed on the first floor of a house due to a space constraint

1. Narrow lane areas: About 20 per cent of the households are in areas where road width is 3–5 feet. While approachability for desludging vehicles is a question in such areas, the majority of the houses have none to little desludging requirement.

2. Affordability: Affordability is an issue for the poorest or the poor, forcing them to practice open defecation. This segment includes daily wage workers, slum dwellers and labourers who earn less than Rs 10,000/month. These sections comprise approximately 1 per cent of the total population.

3. Tolerance to smell: Based on the field observations, it was found that people delay getting desludging services until it's unavoidable. The delay stretches from a timeframe of a few days to one to two months at a stretch, which is insignificant with regard to desludging frequency as it is generally undertaken every few years.

4. Sewer network: While 2 per cent of the households are connected with sewers, it is only limited to one ward in the town. Also, there is no information of any expansion of the network or any STP in future.

Stakeholders' perspective

There was no takeaway related to desludging from the household survey as only three out of 90 surveyed households reported that they had availed of desludging services. This was due to people shifting their residence in the last two to three years or recently retrofitting or constructing containment systems. Households in old town areas did not report any desludging for more than 15 years. Previously, the municipality was the sole service provider as their rates were very low (Rs 500), leaving no room for profit for any private player business. Now, however, as the municipality has increased the rates, people prefer to call a private operator, who comes from the nearby town Lakhimpur.

The desludgings done by municipality are taken to the treatment plant. The numbers, however, are very low.

Interview with a mason in Sitapur

Interaction with masons revealed that newer households prefer to construct fully lined tanks as they are cheaper by almost 50 per cent in comparison to septic tanks. There are still semi-lined containments in large numbers in older and/or densely populated areas.

Ward councilors and sanitation supervisors had excellent knowledge about the wards. They provided numbers of households with different type of containments with great accuracy, which helped in estimating the overall sanitation scenario of the town. They also detailed and facilitated physical verification of households, including of outliers such as those with no toilets.

Interaction with government officials helped to conclude that the municipality is not putting in enough concentrated efforts to improve treatment plant utilization.

Utilization of treatment plants

The reported number of tankers reaching the plant are one every two or three days, i.e. for 3–4 KLD sludge. During the field survey also, very few households reported availing desludging services in the past. The presence of only one private operator also suggests that desludging is not prevalent in considerable numbers in the city. We need to find out if there is a gap between actual desludgings and theoretical potential, which could indicate to us the maximum capacity utilization of the treatment plant. We are keeping aside unlined/semi-lined containment systems and off-site sanitation for the sake of calculation as they require no or less frequent desludging.

Theoretically, seven containments should require desludging each day in Sitapur. Based on the average containment size, leaving 25 mm (as per IS code) as seeding material at the time of desludging, the plant could easily run at 90 per cent capacity. However, this number is greater than the number of actual desludgings reported. This discrepancy could be due to number of reasons, including underreporting of actual desludging numbers and/or abundance of recently constructed households that are still to be emptied. The number is also affected by the household size and

Table 7: Calculations for estimation of theoretical desludging potential of Sitapur

Number of septic tanks	6,315
Household size	7.02
Average size of tank	3,567 litres
Septage generation (litres/capita/year)	120 (as per IS code)
Average desludging frequency of a unit (years)	3,567/120*7.02 = 4.2
Septic tanks to be desludged/day (A)	6,315/4.2*300 = 5
Number of fully lined tanks	10,104
Number of large-sized tanks	2,526
Number of tanks with restricted access by slope	2,526
Number to be considered	5,052
Average size of the tank	7,135 litres
Septage generation (litres/capita/year)	120 (as per IS code)
Average desludging frequency of a unit (years)	7,135/120*7.02 = 8.4
Septic tanks to be desludged/day (B)	5,052/8.4*300 = 2
Total containments to be desludged/day	A+B = 7

Source: CSE

by whether the actual number of persons residing is less than the average household size considered.

As per IS code 2740 (Part 1), 1985, septic tanks should be emptied once every two to three years. As per the IS code, the minimum depth of a septic tank should be 1 m (or 3.2 feet) and the prescribed emptying frequency corresponding to it. Also, the code suggests emptying the tank once the depth of scum and the sludge exceeds half the depth of the tank. But, the takeaway from the field is that while the length-to-width ratio and measurement corresponds to the standards, the depth mainly observed is more than double the standard. Also, desludging is only undertaken once the tank is full and backflow happens. This results in reduced desludging frequency.

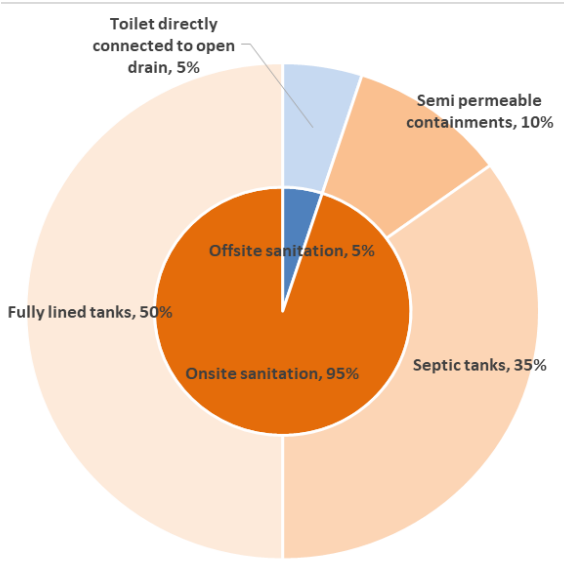
Shikohabad

Shikohabad is a small densely populated town, 21 km from district headquarter Firozabad. Most of its population lives in the southern end of the town area. NH 19 divides the town essentially into the old town and the new settlement areas.

In Shikohabad, analysis revealed that every third household has a septic tank. While 50 per cent of the households are dependent on fully lined tanks, one-eighth of these are large-sized tanks. These lined tanks are also the largest in all four towns.

Twenty per cent of the area is densely populated, with narrow lanes that are comparatively cleaner than other visited towns. While in Raebareli and Sitapur, such areas largely had semi-lined toilets discharging directly into open drains, this was not the case in Shikohabad. Only 15 per cent of households had this system. A considerable number of lined tanks were also seen in these areas.

Figure 3: Status of sanitation systems in Shikohabad

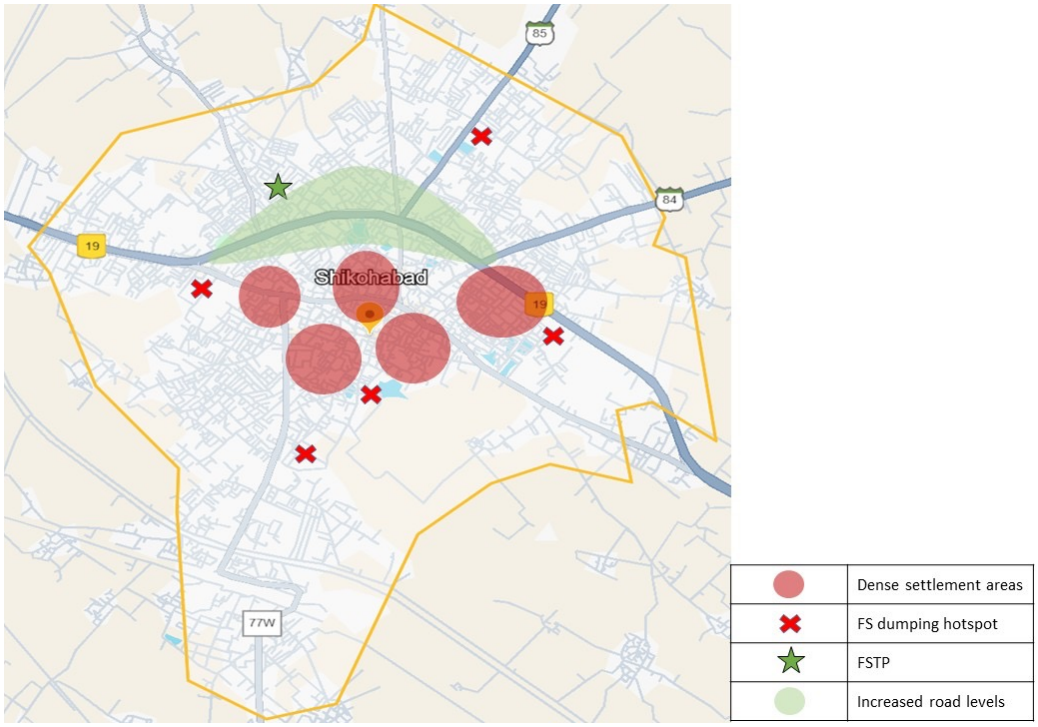


The Municipality has onboarded a contractor who is responsible for operation and maintenance (O&M) of the treatment plant and for providing desludging services that are free of cost to households. This has resulted in an increased number of reported desludgings in the town.

Around 200 families belonging to Scheduled Caste (SC) community living in two wards of the town still do not have access to toilets, and those provided by the local government are not fit for use. The SC families used community toilets for some time, but maintenance by the municipality was irregular, resulting in dirty seats and faulty water supply, forcing the community to practise open defecation. In other areas, the SC community is not allowed by other communities to use the community toilet in the neighbourhood.

Map 4 highlights densely populated areas along with areas that have recently got new roads and increased ground level (mainly along NH 19), faecal sludge treatment plants (FSTPs) and indiscriminate faecal sludge dumping hotspots like areas in Burharai, Shambhunagar and Sagar Colony. Two private operators have been identified to be operating in Shikohabad.

Map 4: Map of Shikohabad highlighting different areas



Note: Map based on field visits and interviews

Contributors impacting desludging

On the basis of Map 4, the data was collected, analysed and interpreted.

The following factors impact desludging numbers positively in the town in descending order of gravity:

1. **Containment size:** Around 50 per cent of the households have fully lined tanks. Their average size is almost twice[8] that of average-sized septic tanks in the city. Out of this, one-eighth the tanks are large-sized.[9] Thus, in general, these would have even lower desludging frequency compared to similar systems in other towns. However, road construction and general increase in ground-level work in some of the wards that started about a year

A containment at a lower ground level due to a recent levelling of roads

ago made 2,000 households raise their plinth levels as well. Along with this, households also got their containments emptied without the containment getting full as construction was underway and they took advantage of free desludging initiative of the municipality. This work is still ongoing in some wards.

While the number of desludgings have increased, this situation is short-lived. Due to large-sized tanks, two or more trips are required to empty the tank. The larger number of trips recorded at the plant creates the impression that more households are getting their tanks emptied.

2. **Containment type:** The town has 35 per cent septic tanks, which is higher than any other surveyed town. It is observed that containments as per standards show better desludging numbers as compared to non-standardized containment systems. Along with this, Shikohabad town has only 10 per cent semi-lined containments, the lowest amongst all four towns. The lower this number, the lower is the effect on desludging, i.e. the lower is the number of desludgings.

The aforementioned factors have shown higher numbers of desludging, which are also supported by the following:

1. **Town area and location of FSTP:** The town is only 8.46 km^2 in area, resulting in shorter distances to travel and less time taken for fulfilling any desludging requests. In addition, the location of the treatment plant is adjacent to the main road within the municipal boundary area and all the places in the town are within a distance of 3–5 km.

2. **Free desludging service:** The municipality provides free desludging services to all households in the town. This has motivated households to go for desludging even when it's not absolutely necessary.

While these factors boost desludging numbers, around 5 per cent of the households have their toilets directly connected to open drain, which reduces overall desludging numbers.

The following factors considered barriers to desludging in the town are negligible from the perspective of the whole town.

1. Affordability: Affordability is an issue for the poorest or the poor, forcing them

to practise open defecation. This segment includes daily wage workers, slum dwellers, and labourers who earn less than Rs 10,000/month. However, these numbers are approximately 1 per cent of the total population.[10]

2. Tolerance to smell: Based on the field observations, it was found that people delay getting desludging services unless and until it is unavoidable. This delay, however, has a timeframe of a few days to one to two months at a stretch, which is insignificant with regard to the frequency of desludging, which is generally done every few years.

Stakeholders' perspective

From the household survey, the key takeaway related to desludging was that desludging frequency for septic tanks was five to seven years while that of fully lined tanks was five to 12 years and for semi-lined tanks it shoots up to more than 15 years. Due to recent road-levelling exercise by the municipality in a few wards, households opt for desludging of containment even at half-full volumes, which have temporarily increased desludging numbers.

Interaction with ward councilor in Shikohabad

The desludgings are carried out by the contractor hired by the municipality. The contractor is primarily engaged for O&M of the treatment plant. The municipality provides free desludging services to encourage more desludgings. There are private operators here, but they operate more in the larger town Firozabad, which is around 30 km away.

Interaction with masons revealed that newer households prefer to construct fully lined tanks more as they are cheaper by almost 50 per cent in comparison to septic tanks. Semi-lined containments are still fairly prevalent in older/densely populated areas.

Ward councilors and sanitation supervisors had excellent knowledge about the wards. They provided numbers of households with different type of containments with great accuracy, which helped in estimating the overall sanitation scenario of the town. They also detailed and facilitated physical verification of households, including outliers such as those with no toilets.

Interaction with government officials helped to conclude that the municipality is putting in a lot of effort to improve treatment plant utilization. Location of the treatment plant and the small size of the town also supports in the initiative.

Utilization of treatment plant

The reported number of tankers reaching the plant are five to six per day, i.e. 18 KLD of sludge. We needed to find out if there was a gap in actual reported numbers and theoretical potential, which could indicate the maximum capacity utilization of the treatment plant. Unlined or semi-lined containment systems and off-site sanitation were left aside for the sake of calculation as they require no or less frequent desludging.

Theoretically, five containments should require desludging each day in Shikohabad. Based on the average containment size, leaving 25 mm (as per the IS code) as seeding material at the time of desludging, the plant could easily run at above 90 per cent capacity. This number matches the number of actual desludgings reported. There is a mismatch in the numbers of actual sludge quantity, i.e. 18 KLD, and theoretical sludge quantity, i.e. 30 KLD. In other words, the number of actual desludgings and theoretical desludgings is same, i.e. five. If we, however, convert this figure into volume of sludge, there is a discrepancy as the actual quantity of sludge—based on the volume of vacuum tankers operating in the ULB—is 18 KLD and theoretical quantity based on the average-sized tanks from the field visit is 30

Table 8: Calculations for estimation of theoretical desludging potential of Shikohabad

Number of septic tanks	8,279
Household size	4.53, taking it as 5
Average size of tank	5,097 litres
Septage generation (litres/capita/year)	120 (as per IS code)
Average desludging frequency of a unit (years)	5,097/120*5 = 8.4
Septic tanks to be desludged/day (A)	8,279/8.4*300 = 3
Number of fully lined tanks	11,828
Number of large-sized tanks	1,183
Number to be considered	10,645
Average size of the tank	9,514 litres
Septage generation (litres/capita/year)	120 (as per IS code)
Average desludging frequency of a unit (years)	9,514/120*5 = 15.8
Septic tanks to be desludged/day (B)	10,645/15.8*300 = 2
Total containments to be desludged/day	A + B = 5

Source: CSE

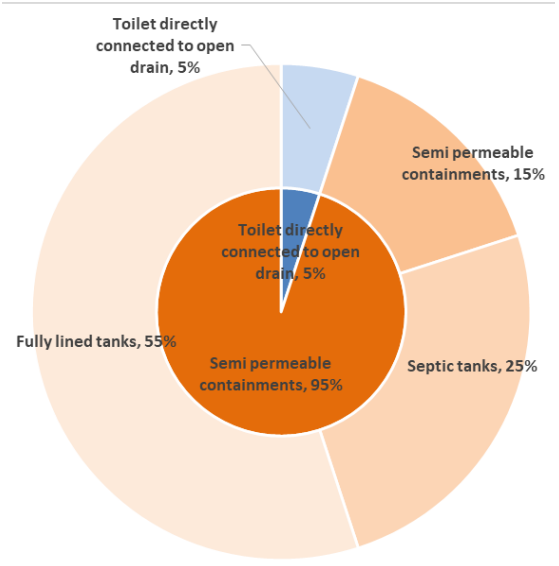
KLD. This could be due to sludge being dumped along the way. For example, only one vacuum tanker trip reaches the plant from the household where two tanker trips are needed to empty the containment system. Also, non-reporting of trips undertaken by the private operators can result in this mismatch of numbers.

As per IS code 2740 (Part 1), 1985, septic tanks should be emptied once in every two to three years. As per the IS code, the minimum depth of a septic tank should be 1 m or 3.2 feet and the prescribed emptying frequency corresponds to it. Also, code suggests emptying once the depth of scum and the sludge exceed half the depth of the tank. But the takeaway from the field is that while the length-to-width ratio and measurement corresponds to the standards, the depth mainly observed is more than thrice the standard.

Gonda

In Gonda, every fourth household has a septic tank. 55 per cent of the households are dependent on fully lined tanks, one-fourth of these are large-sized tanks. These lined tanks are the second largest ones amongst all four towns after Shikohabad. 15 per cent of the area is densely populated with narrow lanes. Apart from occasional one or two other types of containments, most of the households in the area had semi-lined containments. It was also observed that in many instances these containments are built outside of the houses.

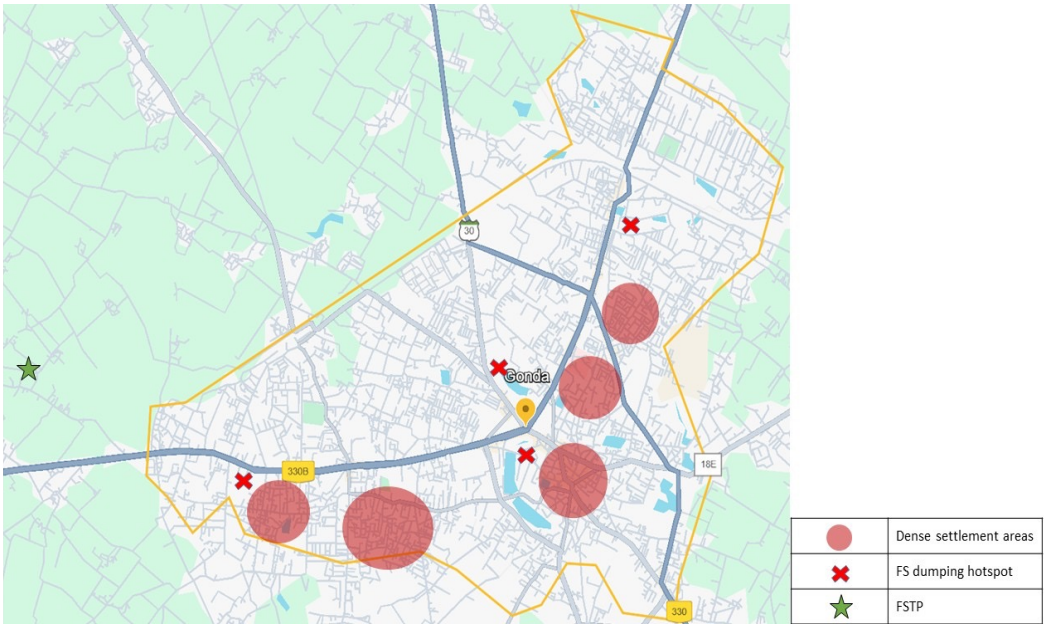
Figure 4: Status of sanitation systems status in Gonda



The municipality has taken onus of O&M of the treatment plant as well as desludging services that they receive while also pressurizing private operators to empty the sludge in the treatment plant.

Map 5 highlights densely populated areas along with FSTPs and indiscriminate faecal sludge dumping hotspots in areas such as Kalandarpur Chaubey, Malviya Nagar and Daduwa Bazar. Two private operators have been so far been formalized by the municipality.

Map 5: Map of Gonda with different areas highlighted



Note: The map is based on field visits and interviews

Contributors impacting desludging

The data was anlaysed and interpreted with the help of the Map 5 and the data collected.

The following factors impact desludging numbers in the town in descending order of gravity:

1. **Containment size:** Around 55 per cent of the households have fully lined tanks. Their average size is twice[11] that of average-sized septic tanks in the city. 10 per cent of the total are large sized,[12] thus requiring desludging at lower intervals. It was observed that newer households, especially from middle-income group preferred fully lined tanks in place of septic tanks as these can be constructed at half the cost of a septic tank. These are prevalent in peri-urban and newer settlement areas.

2. **Containment type:** 15 per cent of the households have containment structures that have semi-lined wall (honeycombed). As per the survey results, these don't have any specific size and varied as per the requirements of the households. It was revealed that these get emptied in not less than 15 years. All such households are located in the red-marked category on the map, i.e., the old town and densely populated parts. An observation made during the field visit was

that on many instances these were made in the middle of the lane. Most often, it was a single household's containment but on a few occasions it was seen that two to three related families shared the containment.

3. **Households directly discharging into open drains:** 5 per cent of the households still lack any type of containment structure. This is for two reasons, i.e. one, households have limited areas, especially in dense and narrow lane areas and, two, the financial condition of households does not allow them to opt for a containment structure. This is out of fear for money needed, initially for its construction and then for getting it emptied once it gets full.

Households with containment systems outside their premises

A narrow lane in Gonda

While the above factors should create a hindrance in desludging numbers, it could be inferred from the interviews and field survey that the efforts from the municipality is responsible for good reported numbers at the treatment plant.

Apart from these, affordability and low tolerance to smell in the town are considered barriers to desludging. These, however, are of negligible significance from whole town's perspective.

Stakeholders' perspective

From the household survey, the key takeaway related to desludging was that the frequency of desludging for septic tanks was three to five years, that for fully lined tanks was five to 10 years and for semi-lined tanks it shoots up to more than 15 years. Households prefer to call private operators over government ones as they provide timely services and pay without much bargaining.

Private operators get more calls for desludging from nearby towns and villages than from Gonda. Both the operators registered with the municipality decant sludge at the treatment plant regularly as the treatment plant falls in their operating area.

Interaction with masons revealed that newer households prefer to construct fully lined tanks more as they are cheaper by almost 50 per cent in comparison to septic tanks. Semi-lined containments are still substantial in numbers in older and/or densely populated areas.

Ward councilors and sanitation supervisors had excellent knowledge about the wards. They provided numbers of households with different type of containments with great accuracy that helped in estimating the overall sanitation scenario of the town. They also detailed out and facilitated physical verification of households including the ones with outliers like the one having no toilets.

Interaction with government officials helped in concluding that the good plant utilization is due to proactive efforts by the municipality. Municipality has heftily fined operators found dumping sludge indiscriminately.

Treatment plant's utilization

The reported number of tankers reaching the plant are five and six per day, i.e. 18–20 KLD of sludge. We need to find out if there is a gap between actual desludgings and theoretical potential, which could indicate us the maximum capacity utilization of the treatment plant. Unlined and semi-lined containment systems and off-site sanitation are left aside for the sake of calculation as they require no or less frequent desludging.

Table 9: Calculations for estimation of theoretical desludging potential of Gonda

Number of septic tanks	5,276
Household size	6.9 (taking it as 5)
Average size of tank	3,539 litres
Septage generation (litres/capita/year)	120 (as per IS code)
Average desludging frequency of a unit (years)	3,539/120*5 = 5.8
Septic tanks to be desludged/day (A)	5,276/5.8*300 = 3
Number of fully lined tanks	11,608
Number of large-sized tanks	2,110
Number to be considered	9,498
Average size of the tank	8,459 litres
Septage generation (litres/capita/year)	120 (as per IS code)
Average desludging frequency of a unit (years)	8,459/120*5= 14.09
Septic tanks to be desludged/day (B)	9,498/14.09*300 = 2
Total containments to be desludged/day	A + B = 5

Theoretically, five containments should require desludging each day in Gonda. Based on the average containment size, leaving 25 mm (as per IS code) as seeding material at the time of desludging, the plant could easily run at full capacity. This number matches the number of actual desludgings reported. However, there is a mismatch in the numbers of actual sludge quantity, i.e. 18 KLD and theoretical sludge quantity, i.e. 25 KLD. In other words, number of actual desludgings and theoretical desludgings is same i.e. five. However, if we covert it into volume of sludge, there is a discrepancy as the actual sludge quantity based on the volume of vacuum tankers operating in the ULB is 18 KLD and theoretical quantity based on the average-sized tanks from the field visit is 25 KLD. This could be due to dumping of sludge along the way. For example, only one vacuum tanker trip reaches the plant from the household where two tanker trips are needed to empty the containment system. Also, non-reporting of trips undertaken by the private operators can result in this mismatch of numbers.

As per IS code 2740 (Part 1), 1985, septic tanks should be emptied once in every two to three years. As per the IS code, the minimum depth of a septic tank should be 1 m or 3.2 ft and the prescribed emptying frequency corresponds to it. Also, the code suggests emptying once the depth of scum and the sludge exceed half the depth of the tank. But the takeaway from the field is that while the length-to-width ratio and measurement corresponds to the standards, the depth mainly observed is more than thrice the standard.

Key findings

1. Raebareli

- Containment size, containment type, increasing sewer network and households directly discharging into the open drains are the factors affecting desludging in decreasing order of impact.

- While the actual numbers of desludgings are higher (five to six times per day) as reported by private operators, not all the emptied sludge reaches the treatment plant (two to three times per day). This is due to weak monitoring by the municipality.

- Fully lined tanks are 1.46 times bigger than septic tanks, with a desludging frequency of three more years than septic tanks. Based on the household survey, average desludging frequency observed for septic tanks was three to five years.

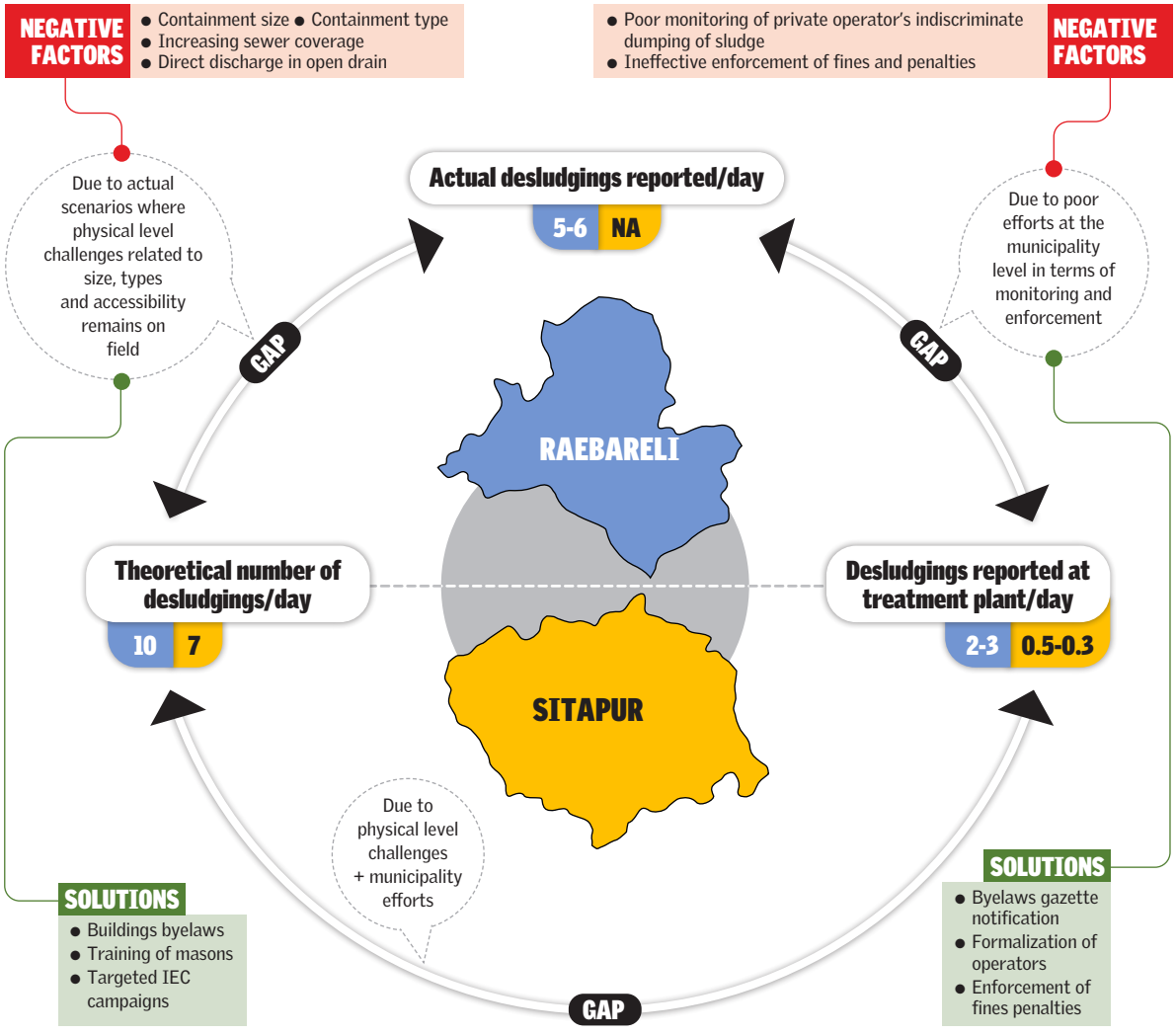
- Theoretically, 10 containments could be desludged each day in Raebareli. Based on the average containment size, the plant could easily run at full capacity. The discrepancy in actual and theoretical numbers could be due to:
  a. Challenges related to containment:
     - Recently constructed household which are still yet to be emptied;
     - Households that have upgraded to septic tanks or fully lined tanks in the recent past; and
     - Household size considered is higher than actual number of persons living

  b. Challenges related to level of efforts by the municipality:
     - Poor monitoring of private operator's indiscriminate dumping of sludge; and
     - Ineffective enforcement of fines and penalties on the private operators (no private operator fined/penalized so far by the ULB for indiscriminate dumping).

2. Sitapur

- Containment size, containment type and households directly discharging into the open drains are the factors affecting desludging in decreasing order of impact. While a small part of the town is sewered, its significance is not enough to have an impact on the overall desludging scenario of the town.

Figure 5: Overview of decoded desludging in Raebareli and Sitapur



- Fully lined tanks are twice the size of septic tanks in the towns. There is lack of sufficient data to comment on desludging frequency as the only two out of 90 households reported availing desludging services in the past and also no vacuum tanker operator was available for interview.

- Few of the wards which have majority of the fully lined tanks have steep roads where desludging vehicle movement is not possible. Thus, impacting mechanical desludging.

- One decanting every two or three days is reported at the treatment plant. There is lack of information on actual desludgings in the town as private operators were not available during the field visit. During the field survey also very few households reported availing desludging services in the past. The presence of only one private operator also suggests that desludging is not prevalent in considerable numbers in the city.

- Theoretically, seven containments should require desludging each day in Sitapur. Based on the average containment size, the plant could easily run at 80 per cent capacity. Insights from the field, however, suggests that the treatment plant is overdesigned. The discrepancy in actual (here reported) and theoretical numbers could be due to:
  a. Challenges related to containment:
     - Households that have upgraded to septic tanks or fully lined tanks in the recent past;
     - Abundance of recently constructed household which are still yet to be emptied; and
     - Household size and the actual number of persons residing are less than the average household size considered.

  b. Challenges related to level of efforts by the municipality:
     - Lack of information about desludgings done by private players; and weak monitoring of indiscriminate dumping (the ULB has no record of charging private operators fine in the past).

3. Shikohabad

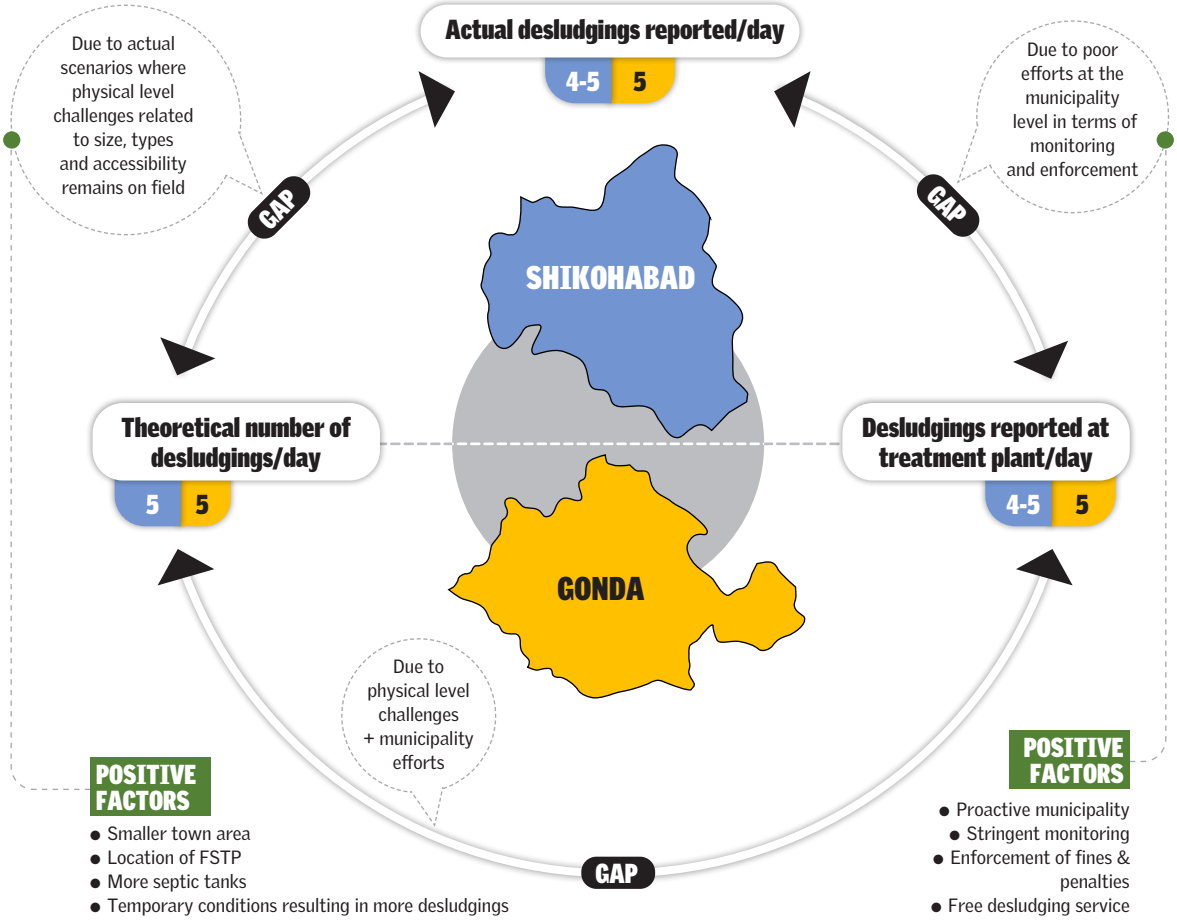
- The containment size here is almost twice the average, which should lower the need for desludging. Due to road construction and general increase in ground-level work in some of the wards, which started about a year ago, a large number of households have got their containments emptied. This has resulted in influx of desludgings which is temporary in nature and will not sustain for a long time.

- Higher numbers of septic tanks and lower numbers of semi-lined containment systems have a positive impact on desludging numbers.

- Apart from the above factors, small town areas and location of FSTP creates a conducive environment for increased number of desludgings. Efforts by the municipality such as free desludging service to the households also aids to the numbers. However, due to above mentioned temporary conditions, the desludging numbers may dip in the future.

- Theoretically, five containments should require desludging each day in Shikohabad. Based on the average containment size, the plant could easily run at above 90 per cent capacity. This number matches the number of actual desludgings reported. However, there is a mismatch in the numbers of actual sludge quantity. This could be due to dumping of sludge on the way.

Figure 6: Overview of decoded desludging in Shikohabad and Gonda



4. Gonda

- Containment size, containment type and households directly discharge into open drains, impacting the desludging numbers. The efforts from the municipality are currently offsetting these factors and resulting in better desludging numbers at the treatment plant.

- The municipality has administered better control over private operators through daily follow ups, proactive fines (total fine collected so far is around Rs 50,000) to operators for indiscriminate dumping which is not observed in other three towns.

- Theoretically, five containments should require desludging each day in Gonda. Based on the average containment size, the plant could easily run at 80 per cent capacity. This number matches the number of actual desludgings reported. There is, however, a mismatch in the numbers of actual sludge quantity. This could be due to dumping of sludge on the way. For example, only one vacuum tanker trip reaches the plant from the household where two tanker trips are needed to empty the containment system.

Recommendations

Based on the analysis of the four towns, it is observed that despite the towns having similar characteristics, they show varying degree impacts of different factors on desludging. Efforts to minimize the impacts such that treatment plant utilization can be increased to the maximum potential is the need of the hour. For this to happen, recommendations are put forward that focus on ensuring an increase in reported desludging at the treatment plant. This is important as underutilization of the treatment plants is an issue in Uttar Pradesh and elsewhere.

It is also crucial to ensure that whatever sludge is emptied in the town reaches the treatment plant as indiscriminate dumping results in contamination of the groundwater and poses a significant threat to humans and the environment in general.

Methods to increase number of desludgings should be applied in the town to satisfy capacity utilization of the treatment plant. These include:

1. Better monitoring mechanism

Proactive monitoring of private operators by the municipality is the first step that ensures that all sludge that is emptied reaches the treatment plant. Fines and penalties for indiscriminate dumping should be levied by the municipality. This could be enforced through faecal sludge and septage management (FSSM) byelaws. In addition, formalizing the private desludging operators and making them a part of the government system as an extended arm of the municipality should be prioritized.

2. Targeted capacity building and awareness programs to increase overall desludgings

Capacity building of all the operators, including government and private, should be regularly trained regarding safe desludging practices and fines and penalties related to indiscriminate dumping of sludge. Special focus should be given to those operators who are active in the wards where majority of the containment systems are septic tanks and fully lined tanks. Special targeted programmes and campaigns in these wards can be planned to raise awareness about desludging. This could aid in increasing the overall desludging numbers of the town.

3. Developing and implementing scheduled institutional desludging plan

In order to ensure that a minimum quantity of sludge reaches the treatment plant, the municipality can develop and implement scheduled institutional desludging plan. In simple terms, it is mandatory cleaning of septic tanks of all government owned or managed establishments. A guideline[13] for improving treatment plant utilization through scheduled institutional desludging was issued by the UP state government.

4. Future containments as per IS code and inclusion in building byelaws

For all future construction, ensure households have septic tanks as per IS 2470. This should be included in building byelaws of all the towns. A check to authenticate this could be done at the time of approval of plan/map of a household at the municipality level. This would result in higher desludging intervals and better supernatant quality.

FOOD FOR THOUGHT

Realistic sizing of treatment plant

Many of the treatment plants in UP are still not functioning at the optimum capacities. As of April 2025, 15 FSTPs out of 36 and three out of 19 co-treatment plants were running at 20 per cent or below capacity. This could be due to treatment plants being designed using estimates of volume of containment systems which were generalized for all the plants across UP, resulting in same capacity of all the treatment plants.

Theoretically, for quantification of faecal sludge in a town and thus designing a treatment plant, transportation method is the most accurate as it gives data closest to the on-ground reality. Alternatively, choosing a value which is nearer to value obtained from two other methods, i.e., the population method and volume-of-containment-systems method. However, there are some drawbacks in all three methods as well. These include:

- The transportation method cannot give future projections or impact of new tankers as there is no certainty that there will be an increase or decrease in the number of desludgers.
- Some towns in UP have no private desludging operators, making government operators the only source for any information which reduces the reliability of the data.
- Even collecting data that reflects the reality is problematic for operators due to a language barrier.
- Using all three methods is time-consuming and resource-intensive.
- Population method only considers sludge accumulation and not volume of the entire amount of sludge emptied.

Based on the data collected from the field, a modified version and methodology for quantification of sludge for designing capacity of the treatment plant is proposed as follows:

- Conduct ward-level sample field survey using a ward map of the town to identify containments in three categories, i.e. septic tanks, fully lined tanks and semi-lined or partially lined containments.
- Also, identify households with toilets discharging directly to open drains and connected with sewers, if any.
- Similar-natured wards can be skipped during the ward-level survey to save time.

- Translate the numbers identified in step 1 and 2 in percentage terms.
- Using the household survey questionnaire, calculate average size of septic tanks and fully lined tanks.
- Identify large-sized tanks i.e. tanks twice the size of average-sized fully lined tanks.
- Consider the following formula where actual numbers of households should be considered while designing for a treatment plant.

Households percentage for considering designing treatment plant = (ST%) + [(FLT%) – (Large sized FLT%)] – [(Semi lined% + DD%) * NL factor] – (Sewered%)

Where,
ST% = Percentage of households connected with septic tanks

FLT% = Percentage of households connected with fully lined tanks

Large-sized FLT% = Percentage of households connected with large sized fully lined tanks (large-sized tanks should be greater than 1.5 times or more than that of average-sized fully lined tanks in the town)

Semi-lined % = Percentage of households connected with semi or partially lined containments (honeycombed)

DD% = Percentage of households having toilets directly connected to open drains

NL factor = Narrow lanes factor with maximum value of 0.3 (Based on field survey, households in narrow lane areas have one-third emptying frequency of that of ST and FLT)

Sewered % = Percentage of households connected with sewer

- Once the percentage of households calculated in step 7, we can use the population (septage generation rate as 120 l/c/y used by CSE) method to arrive at a realistic capacity of the treatment plant that is closer to actual desludgings numbers.
- A safety factor for safeguarding against future considerations can be added at last.

Note:
The above method is based on the experience gained from the field in Uttar Pradesh and is more suitable for medium-populated towns and might not hold true in other places and geographies. People interested in planning FSSM projects can experiment using the above method and check whether the approach involved helps in planning a realistic-sized FSTP or co-treatment plant.

Notes and references

1. https://www.cseindia.org/guidelines-for-improving-treatment-plant-utilization-12557

2. Average fully lined tanks (5,663 litres)/Average septic tanks (4,077 litres)

3. Here, defined as twice of average sized fully lined tanks (5,663 litres) obtained from data from household surveys and interviews from private operators and masons
4. Estimated calculation based on the numbers gathered from interviews of the ward councilors and comparing with overall households in the town.

5. Densely populated areas identified based on stakeholder interviews having older unplanned settlements, narrow roads and a comparatively higher number of households appearance as per Google Earth

6. Average fully lined tanks (7,135 litres)/Average septic tanks (3,567 litres)

7. Here, defined as twice of average sized fully lined tanks (7,135 litres) obtained from data from household surveys and interviews from masons, ward councilors

8. Average fully lined tanks (9,514 litres)/Average septic tanks (5,097 litres)

9. Here, defined as twice of average sized fully lined tanks (9,514 litres) obtained from data from household surveys and interviews from masons, ward councilors

10. Estimated calculation based on the numbers gathered from interviews of the ward councilors and comparing with overall households in the town.

11. Average fully lined tanks (8,495 litres)/Average septic tanks (3,539 litres)

12. Here, defined as twice of average sized fully lined tanks (8,495 litres) obtained from data from household surveys and interviews from masons, ward councilors

13. https://www.cseindia.org/guidelines-for-improving-treatment-plant-utilization-12557

Annexures

Annexure 1: Household survey questionnaire

Date: ...../...../2025 **Name of area .....**

1. Information related to Toilet and Containment

Respondents	1	2	3	4	5	6	7	8	9	10
1. Gender (M/F)										
2. Age (years)										
3. Nature of ward (S, N, P, O)										
S: Sewer, N: Narrow lanes, P: Peri-urban, O: Old town area										
4. Household size (number)										
5. Do you have a toilet? (Y/N)										
6. If no, where do you go? (CT, PT, OD)										
CT: Community toilet, PT: Public toilet, OD: Open defecation										
7. If ST/CT/ PT, What is the containment? (ST, P, T, NC)										
ST: Septic tank, Pit : Pit latrine, T: Tank, NC: No containment										
8. No. of toilets in your home										
9. Toilet is connected to (S, ST , UP, OD/G, LIO, LSO, FLT)										
S: Sewer, ST: Septic tank, UP: Unlined pit, OD: Open drain/ground, LIO: Lined tank/pit impermeable walls with open bottom, LSO: Lined pit semi-permeable walls with open bottom, FLT: Fully lined tank										
10. If circular, size? (Diameter x Depth)										
11. If quadrilateral, size? (L x B x H)										
12. Tank outlet connected to? (SP, OD, OG, WB, N)										
SP: Soak pit , OD: Open drain, OG: Open ground, WB: Waterbody, N: No outlet										
13. Percentage share of (9) in ward (Educated estimate)										

Identifying containments:

- Septic tank: L/B ratio 2 or 3:1, all four walls and bottom-lined, one or two baffle walls or two or three chambers
- Unlined pit: Kachha hole in the ground
- LIO: All four walls/pit circumference fully lined but with open bottom
- LSO: All or some walls or pit circumference have honeycombed structure with open bottom
- FLT: Fully lined tank except L/B ratio ff 2 or 3:1 and w/o baffle walls or chambers

2. Information related to emptying

	1	2	3	4	5	6	7	8	9	10
1. Frequency of emptying the containment system (years) OR In how much time does the containment system get filled? (years)										
2. Have you emptied your tank by desludgers? (Y/N)										
3. By whom: government or private? (G/P)										
4. If private, manually or mechanically? (MA/MC)										
MA: Manually, MC: Mechanically										
5. Reason for private? (Q, L, E)										
Q: Quick service, L: Lower fees, E: Easier approachability										
6. Charges for emptying/trip (₹)										
7. Where is septage discharged after emptying? (AF, OG, SWD, R, N)										
AF: Agricultural field , OG: Open ground, SWD: Storm-water drain, R: River, N: No idea										
8. How far is the location? (km)										
MISCELLANEOUS										
1. How do you get drinking water? (MS, H, W, M)										
MS: Municipal supply water, H: Hand pump, W: Well, M: Motor										
2. If H/W/M, depth of groundwater table?										
3. Witnessed open dumping of sludge? (Y/N)										
4. Place of dumping										
5. Difficulty in raising request? (Y/N)										

NOTES: .....

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Annexure 2: Government official questionnaire

Date: ...../ /2025 Place: .....

1. Name and designation .....
2. Contact number .....
3. Number of government vacuum tanker vehicles .....
4. No. of desludging requests per day/week/month .....
5. Desludging charges/trip .....
6. Process of registering a request .....
   .....
   .....
   .....
7. Time taken from registration of request to completion .....
8. No. of private operators in the city .....
9. No. of private operators registered .....
10. Fine taken for indiscriminate dumping of sludge (Y/N) .....
11. If yes, how much was the last fine, min. and max. (Rs) .....
12. Place of dumping of faecal sludge .....
13. Mention more such places .....
14. No. of CT and PT .....
15. Average desludging frequency of CT/PT .....
16. Initiative to promote desludging .....
    .....
    .....
    .....
17. Any arrangement with nearby ULBs .....
18. Areas having narrow lanes .....
19. Sewered and non-sewered wards .....

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Annexure 3: Private operator questionnaire

Date: ...../ /2025 Place: .....

1. Name and mob. no. .....
2. Number of vehicles owned .....
3. Capacity of vehicle (s) .....
4. Average no. of trips/day .....
5. Average size of the septic tanks/lined tanks .....
6. Average distance per trip .....
7. Area(s) of service .....
8. Area(s) with highest demand for desludging .....
9. Desludging charges/trip .....
10. Where is sludge emptied? .....
11. Reason .....
12. Penalized for dumping? (Y/N) .....
13. If yes, amount .....
14. Any official dumping site? .....
15. No. of private operators in the city .....
16. PPEs used, if any, during desludging process .....
17. Major issue running the business
    I. .....
    II. .....
18. Working full-time or part-time .....
19. Receive desludging requests from narrow lane areas (Y/N) and number .....
    .....
20. How do you manage in such areas? .....

More than 700 urban local bodies (ULBs) out of 762 in Uttar Pradesh rely heavily on on-site sanitation systems, implying that faecal sludge generation and its storage in some quantum or form happens on-site. As of April 2025, 55 towns had either faecal sludge treatment plants (FSTPs) or co-treatment facilities operating at various capacities. Currently, however, 15 out of 36 towns with FSTPs and three out of 19 towns with co-treatment have less than 20 per cent capacity utilization for treating the sludge generated from these systems. The remaining towns have better utilization.

Why is there fluctuating capacity utilization in towns?

CSE undertook a study to explore the primary and secondary factors responsible for this and to enhance understanding of 'desludging' and its associated attributes in four towns—two with poor capacity utilization reported and two with better capacity utilization. Addressing concerns around plant utilization in Uttar Pradesh is crucial as many plants run far below capacity, posing a question mark over the initial planning on the one-size-fits-all approach. The findingd of this study are expected to lead to a realistic sizing of FSTPs in the future.

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