SFD Report

Kanpur
India

Final Report

This SFD Report – Initial Level - was prepared by
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SFD Report Kanpur, India, 2020

Produced by:

Apurva Rai, Population Services International (PSI)

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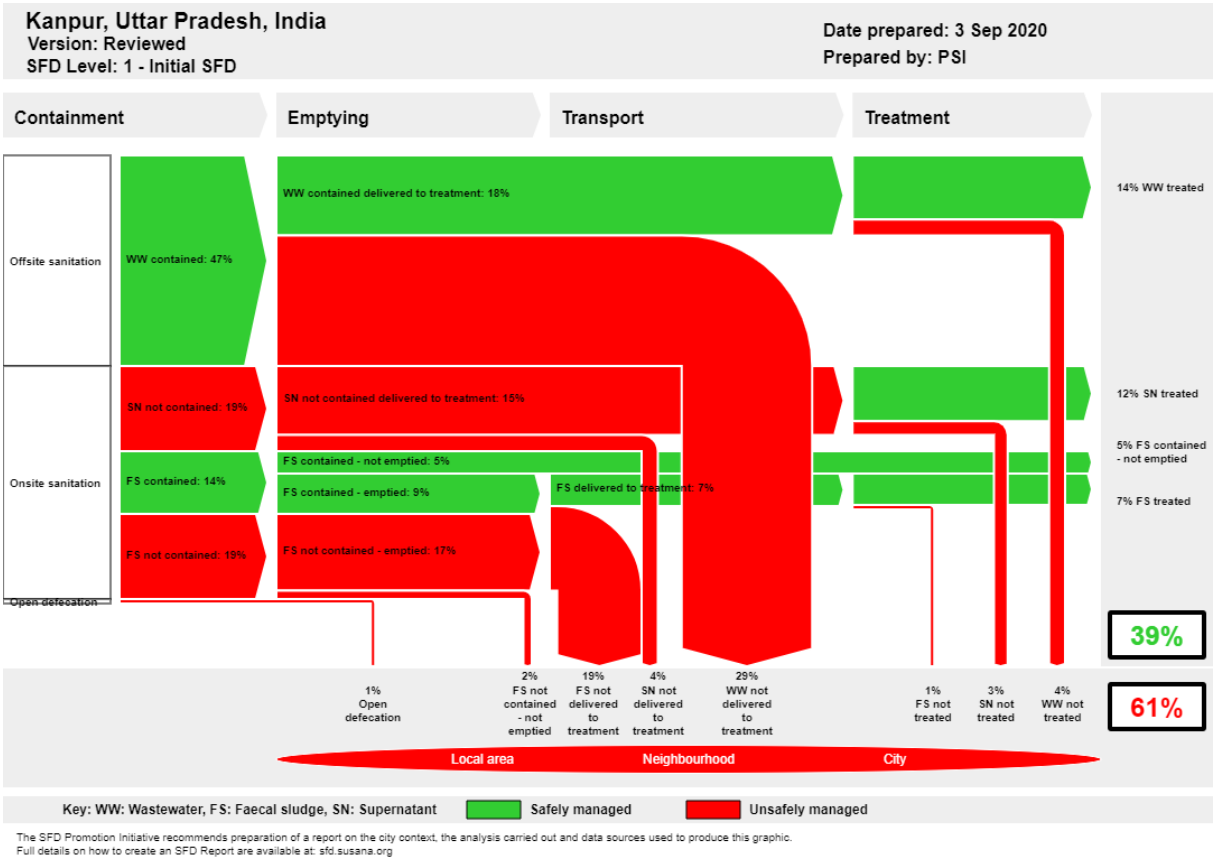
1. The Diagram



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

2. Diagram information

SFD Level:

This is a level 1- Initial SFD report.

Produced by:

Population Services International.

Status:

Final SFD report.

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3. General city information

Kanpur is the tenth most populous city in India and the largest city within the state of Uttar Pradesh. It is situated on the southern bank of Ganga River (KMC, n.d.). Kanpur is a part of the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and the Smart City Mission of the Government of India (GoI). The urban local body in Kanpur is Kanpur Municipal Corporation (KMC). The total area of jurisdiction is 260 km^2. The KMC jurisdiction area is divided in 9 zones namely: Zone 1, Zone 2, Zone 3, Zone 4, Zone 5, Zone 6, Aerodrome, Armapur Estate, Cantonment and COD. There are 110 election wards in KMC. The population of KMC jurisdiction area as per census 2011 is 27,65,348 with 522,242 households (HHs). The estimated population of the Kanpur agglomeration is 30,11,693 and the total households at 532,665 (KMC, 2020). Decadal growth rate of the city is 8.9%. HH size is 6 people per household. Average density of the city is 11,583.43 persons/km^2. For the purpose of this report, the KMC population has been considered.

The Kanpur Metropolitan Area (KMA) as delineated by KMC under the Jawaharlal Nehru Urban Renewal Mission is spread over an area of 1,640 km^2. The total population of KMA is estimated at 5 million. KMA includes the Kanpur Nagar Nigam area, 8 kilometres around KMC boundary and newly included 47 villages of Unnao district on the north-eastern side which spreads till Murtaza Nagar; in the west its limit is up to Akbarpur Nagar Panchayatraj limit; in the eastern side the limit has been expanded on the road leading to Fatehpur and is extended up to the metropolitan region area which includes the area of Shukla ganj nagar palika, Unnao Nagar Palika, Akbarpur Nagar panchayat and Bithur Nagar Panchayatraj area (Unknown, 2018).

Kanpur is located in the south-western plains of river Ganga (GOI, 2015). It has a relatively flat alluvial plain at an elevation of about 410 ft. (125 m) above sea level. The climate is of a tropical nature and shade temperature varies from 35 F (1.6 °C) to 120 F (48.8 °C) while the relative humidity varies from 15% to 85%. Rainy season generally extends from June to September, with the period of maximum rain fall normally occurring during the months of July and August. The total rain fall varies between 18" (457.2 mm) to 30" (762 mm) (JKV, n.d.).

4. Service outcomes

Containment

According to Census of India, approximately 62.5% of households were connected to the sewerage network. In 2011, the total households in the city were 522,242 while in 2020, the households have increased to 532,665. The number of households connected to the sewerage system are 250,290 which accounts to 47%.

According to census, 19.4% of households were connected to septic tanks, 1.2% of households were dependent on other systems, 1.4% was dependent on pit latrines, 0.3% of households were disposing night soil directly into drain, 6.9% was dependent on public toilets and 7% practised open defecation.

However, from the new set of data available from Jal Kal Vibhag (JKV), KMC, Jal Nigam and triangulated from other sources, it is claimed that 7% of households, which are dependent on public toilets, are using septic tanks connected to a soak pit; 15% of households are utilizing septic tanks connected to open drains; 23% of households have fully lined tanks connected to open drains; 6% of households, which have toilets either constructed under Swachh Bharat Mission (SBM) or along with Pradhan Mantri Awas Yojna (PMAY) houses, are connected to twin pit systems; 1% of households are connected to lined tanks with permeable walls locally called as *kuddi* (ASCI, 2013) and 1% of households still practice open defecation.

Emptying

Emptying frequency differs across the city and is dependent on the size of the septic tank and the willingness of the owner to get it emptied. As per KII with a Private Tank Operator (PTO), it was noted that in the central part of the city, which is densely populated, the emptying frequency ranges from 2 months to 6 months for structures such as lined pits, while for septic tanks and fully lined tanks the emptying period can vary between 2-3 years or, in case of bigger sizes, the emptying frequency can go up to 5-10 years. As per KII with PTO, there are 31 PTOs with 51 desludging tanker-mounted trucks in the city. The capacity of these vehicles is either 5,000 litres or 6,000 litres. These trucks operate across the city.

Transport

The sewerage network currently caters to 47% of the population. The transport efficiency of the sewerage network is 38.4% (KMC, 2015). The sewerage network spread across the city is an extension of brick sewers which were first laid in 1904 and then extended in 1952 to cater to the increase in population. The brick sewers are laid predominantly in the old parts of the city and are partially defunct due to encroachment, dumping of waste into drains which results into silting, overflowing, and damage/failure of drainage as well as the sewerage system (KMC, 2015). There have been up gradation and maintenance works which are under progress in AMRUT mission and SMART Cities.

Open drains in the city carry 371 Million Litres per Day (MLD) of wastewater (WW) of which 300 MLD has been tapped. 13 out of 16 drains which carry household WW and industrial effluent have been tapped earlier which account to 160 MLD (KMC, 2015). Sisamau drain, which is considered to be the largest drain in Asia, has also been tapped and diverted. Sisamau drain carries 140 MLD of WW (this has been tapped) and 80 MLD is diverted to Bingawan Sewage Treatment Plant (STP) while 60 MLD is diverted to Jajmau STP (MWRRDGR, 2018). Open drains are significant to the study since OSS, which are connected to open drains, are continuously discharging effluent which make up of the 371 MLD in the city. The total wastewater delivered to the treatment plant is 80% of the total WW collected from the city.

The trucks charge a base fees of INR 500 (US$ 7) for a distance of 1.5-2 km (from assembly point to desludging point), and increase in distance is negotiated with extra charge. On an average, PTOs empty 2-3 containments in a day. Of the 31 PTOs, only 3 PTOs (who own 9 desludging vehicles) are registered with KMC. Currently, only 10-12 tipping trips are recorded at the Bingawan STP.

Treatment and disposal

The total WW generated in Kanpur is ~541 MLD of which 371 MLD is WW from drains and 170 MLD is sewage from sewer network. The WW from the sewer network and tapped open drains/nullahs is treated at STPs located in different parts of the city. Kanpur has 7 STPs with a combined treatment capacity of 502 MLD

(SMCG, 2019). Operational details of the STPs are provided as follows:

The total operational capacity of STPs in the city is 80%. Treated wastewater from the STPs is discharged in river Ganga. The untreated wastewater from untapped drains continues to flow into river Ganga.

FS collected from the city is currently being discharged at Binganwan Sewerage Treatment Plant (STP). As only 9 tankers tip 10-12 times a day at Bingawan STP, therefore only 9% of the sludge can be assumed to be safely transported to the STP. FS is decanted at a designated point in the STP premise. The sludge from the remaining PTOs is decanted at various low lying areas of the city or into the river.

Total FS generated in the city is 753 KiloLitres per Day (KLD). On an average, 690 KLD are emptied in a day, of which only 9% reached the co-treatment facility at Bingawan.

5. Service delivery context

National Urban Sanitation Policy (NUSP) was issued in 2008 by the Ministry of Housing and Urban Affairs (MoHUA, GoI), formerly known as Ministry of Urban Development (MoUD). The policy aims to: raise awareness, promote behaviour change; achieve open defecation free cities; develop citywide sanitation plans; and provide 100% safe confinement, transport, treatment and disposal of human excreta and liquid wastes. The NUSP mandates states to develop state urban sanitation strategies and work with cities to develop City Sanitation Plans (CSPs).

NUSP identifies the constitution of multi-stakeholder task force, known as city sanitation taskforce (CSTF) as one of the reforms to be taken up to start the city sanitation planning process. CSTF has now been renamed as Swachh Bharat City Level Task Force (SBCLTF) (MoUD, 2014).

The Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Act, 1974 have provisions relating to sanitation services and environmental regulations. It applies to households and cities with regard to disposing wastes into the environment. ULBs/ utilities also have to comply with discharge norms for effluent released from sewage treatment plants and to pay water cess under the Water Cess Act, 1977 (MoUD, 2013).

In February 2017, MoHUA issued the National Policy on Faecal Sludge and Septage Management (FSSM). The policy aims to set the context, priorities, and direction for, and to facilitate, nationwide implementation.

The Uttar Pradesh Water Supply and Sewerage Act, 1975:

An act to facilitate the establishment of corporation, authorities and organizations for the development and regulation of water supply and sewerage services, related matters. According to this act, the corporation has powers to fine the owner of the improper/damaged septic tank.

The Uttar Pradesh Urban Sanitation Policy, 2010:

In 2010, the Director of Local Authorities, Uttar Pradesh issued the Uttar Pradesh Urban Sanitation Policy (UPUSP). The policy is inspired from the NUSP. The UPUSP mandates the cities to establish City Sanitation Task Force (CSTF) and to elevate the consciousness about sanitation in municipal agencies, government agencies and most importantly, amongst the people of the city. UPUSP specifically highlights the importance of safe and hygienic facilities with proper disposal and treatment of sludge from on-site installations (septic tanks, pit latrines, etc.) and proper operation and maintenance (O&M) of all sanitary facilities. As of now, there are very few cities that have finalized their CSPs, and it remains a major drawback in the implementation of the UPUSP.

Uttar Pradesh Faecal Sludge and Septage Management (FSSM) Policy, 2019:

The goal of the Uttar Pradesh State Septage Management Policy (UPSSMP) is to improve water quality and protect public health in urban areas of the State by 2023. The objective is to enhance the ability of local implementers to build and operate septage treatment systems for urban centres and promote the behaviour change and supporting environment needed for systems to be effective and sustainable. The main strategy is to facilitate a bottom-up, demand-driven project development process by providing State Government support and incentives. As per estimation, 9 lakh ($9x10^5$) Individual Household Latrines (IHHLs) constructed under SBM (U) over the last 3 years also warrant immediate attention on Septage Management (SM). Sanitation coverage in 610 ULBs are completely dependent on septic tanks. There are 72 lakh ($72x10^5$) On-site Sanitation Systems (OSS) which generates approximately 5,000 MLD of sewerage. This highlights the magnitude of effort required for addressing environmental and public health safety on account of untreated sewerage/septage (UDD, UP, 2019).

6. Overview of stakeholders

An overview of stakeholders has been provided as follows:

Table 1: Key Stakeholders.

Key Stakeholders	Institutions/ Organizations
Public Institutions	Minsitry of Housing and Urban Affairs (MoHUA), National Ganga Council, Ganga Pollution Control Unit, UP Jal Nigam (UPJN), Urban Development Department (UDD), Kanpur Municipal Corporation, Authority (DUDA) Uttar Pradesh Pollution Control Board, Varanasi, Uttar Pradesh (UPPCB), State Mission for Clean Ganga (SMCG)
Non-governmental Organizations	Population services International
Private Sector	private emptiers

7. Process of SFD development

Data are collected through secondary sources. City was visited to conduct KIIs with relevant stakeholders to fill in the gaps in data and cross-check the data collected. To start with, a relationship between sanitation technologies defined in Census of India and that defined in the project was established. The data were then fed into the Graphic Generator to calculate the excreta flow in terms of percentage of population. Overall, 39% of excreta is safely managed in the city and the rest 61% is discharged untreated to the environment, including the 1% of the people in the city defecating in the open, hence shown unsafe in the SFD graphic.

Limitations of the SFD graphic:

The SFD graphic is dependent on secondary and the true picture of the city may differ. The data were available at different time lines. For example, data on containment were extracted from census 2011 while emptying and transportation data were collected through KIIs conducted in 2020.

8. Credibility of data

Two key sources of data are used: Census of India, 2011 and published documents of relevant departments. Most of the data are then updated by KIIs. Overall, 3 KIIs have been conducted with different stakeholders. There were three major challenges to develop the SFD graphic. Census and published/unpublished reports were not able to provide (i) up-to-date data on containment (ii) detailed typology of containment and (iii) actual information about FSM services provided to households.

The Census and published/unpublished reports mostly differentiate between systems connected to the user interface, if any, but does not give information about the design of actual containment systems on ground level or about the disposal of septage and wastewater generated.

11. List of data sources

Below is the list of data sources used for the development of the SFD executive summary:

- Census of India 2011, House listing and housing data, Government of India.
- ASCI, 2013. City Sanitation Plan for Kanpur, Kanpur: Kanpur Municipal Corporation.
- GOI, 2015. Mechanization and Technology Division, Department of Agriculture, Cooperation and farmer welfare, Government of India.
- JKV, n.d. Jal Kal Vibhag.
- KMC, 2015. AMRUT Service level improvement plan, Kanpur.
- KMC, 2020. Population estimates, Kanpur: Kanpur Municipal corporation.
- KMC, n.d. Kanpur Municipal Corporation.
- MoUD, 2013. Advisory on Septage Management , Delhi: Ministry of Urban Development.
- MoUD, 2014. Guidelines for Swachh Bharat Mission, Delhi: Ministry of Urban Development, Government of India.
- SMCG, 2019. Kanpur Sewerage Profile- State Mission Clean Ganga.
- UDD, UP, 2019. Uttar Pradesh Faecal Sludge and Septage Management Policy, s.l.
- KIIs with representatives from Kanpur Municipal Corporation, Jal Kal Vibhag,

Jal Nigam and Urban development authority.

SFD Kanpur, Uttar Pradesh, India, 2020

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Abbreviations

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
ASCI	Administrative Staff college of India
BIS	Bureau of Indian Standard
CB	Census Board
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health & Engineering Organization
CSE	Centre for Science and Environment
CSP	City Sanitation Plan
CSTF	City Sanitation Task Force
CT	Community Toilet
DUDA	District Urban Development Authority
EWS	Economically Weaker Sections
FC	Finance commission
FGD	Focus Group Discussion
FS	Faecal Sludge
FSM	Faecal Sludge Management
FSSM	Faecal Sludge and Septage Management
GoI	Government of India
GoUP	Government of Uttar Pradesh
HH	Households
INR	Indian National Rupee
JKV	Jal Kal Vibhag
KII	Key Informant Interview
KMA	Kanpur Metropolitan Area
KMC	Kanpur Municipal Corporation
M.Corp	Municipal Corporation
MLD	Million Liters per Day
MoHUA	Ministry of Housing and Urban Affairs
MoUD	Ministry of Urban Development
MPS	Main Pumping Station
NIUA	National Institute of Urban Affairs
NMCG	National Ganga Clean Mission
NUHM	National Urban Health Mission
OD	Open Defecation
ODF	Open Defecation Free
OSS	Onsite Sanitation System
PMAY	Pradhan Mantri Awas Yojna
PT	Public Toilet
PTO	Private tank operator
SFD-PI	Shit Flow Diagram Promotion Initiative
SBCLTF	Swachh Bharat City Level Task Force
SBM	Swachh Bharat Mission
SBM (U)	Swachh Bharat Mission (Urban)
SFD	Shit Flow Diagram
SLB	Service Level Benchmarks
SM	Septage Management
SMCG	State Mission Clean Ganga
SN	Supernatant
SPS	Sewage Pumping Station

STP	Sewage Treatment Plant
TCPD	Town and Country Planning Department
TCPO	Town and Country Planning Organisation
UDD	Urban Development Department
ULB	Urban Local Body
UPAVP	Uttar Pradesh Awas Vikas Parishad
UPJN	Uttar Pradesh Jal Nigam
USAID	United States Agency for International Development
USD	United State Dollars (1 USD = 73 INR)
WSS	Water Supply and Sewerage
WW	Wastewater

1 City context

Kanpur is the tenth most populous city in India and the largest city within the state of Uttar Pradesh. It is situated on the southern bank of Ganga River (KMC, n.d.). Kanpur is a part of the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and the Smart city Mission of the Government of India (GoI). The urban local body in Kanpur is Kanpur Municipal Corporation (KMC). The total area of jurisdiction is 260 km^2. The KMC jurisdiction area is divided in 9 zones namely: Zone 1, Zone 2, Zone 3, Zone 4, Zone 5, Zone 6, Aerodrome, Armapur Estate, Cantonment, and COD (Figure 1). There are 110 election wards in KMC. The population of KMC jurisdiction area as per census 2011 is 2,765,348 with 522,242 households (HHs). The estimated population of the Kanpur agglomeration is 3,011,693 and the total households at 532,665 (KMC, 2020). Decadal growth rate of the city is 8.9%. HH size is 6 people per household. Average density of the city is 11,583.43 persons/km^2. For the purpose of this report, the KMC population has been considered.

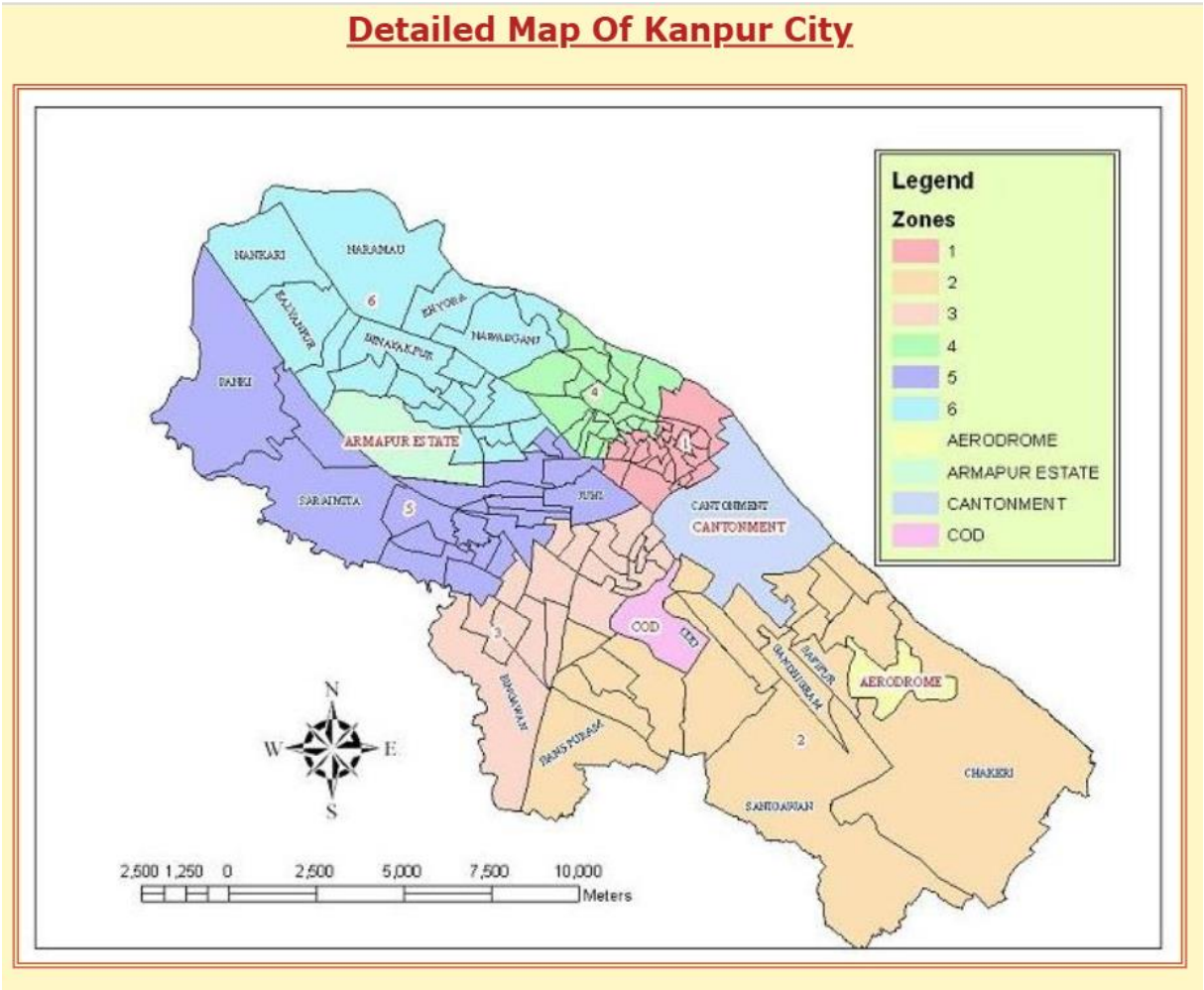

Figure 1: Kanpur base map (Source: Kanpur Municipal corporation).

The Kanpur Metropolitan Area (KMA) as delineated by KMC under the Jawaharlal Nehru Urban Renewal Mission is spread over an area of 1,640 km^2. The total population of KMA is estimated at 5 million. KMA includes the Kanpur Nagar Nigam area, 8 kilometres around KMC boundary and newly included 47 villages of Unnao district on the north-eastern side which spreads till Murtaza Nagar; in the west its limit is up to Akbarpur Nagar Panchayatraj limit; in the eastern side the limit has been expanded on the road leading to Fatehpur and is extended up to the metropolitan region area which includes the area of Shukla ganj nagar palika, Unnao Nagar Palika, Akbarpur Nagar panchayat and Bithur Nagar Panchayatraj area (Unknown, 2018).

Kanpur is located in the south-western plains of river Ganga (GOI, 2015). It has a relatively flat alluvial plain at an elevation of about 410 ft. (125 m) above sea level. The climate is of a tropical nature and shade temperature varies from 35 F (1.6 ^oC) to 120 F (48.8 ^oC) while the relative humidity varies from 15% to 85%. Rainy season generally extends from June to September, with the period of maximum rain fall normally occurring during the months of July and August. The total rain fall varies between 18" (457.2 mm) to 30" (762 mm) (JKV, n.d.).

2 Service Outcomes

The analysis is based on data available from Census of India, 2011, published reports of government, non-profit organizations and reconnaissance household survey. Data collected from secondary sources are triangulated. Data on the containment are available in Census 2011. Data have been cross-checked and updated by Key Informant Interviews (KIIs). Data on emptying, transport, treatment and disposal of faecal sludge are collected through existing reports and KIIs with private emptiers and parastatal bodies. However, most of the data are qualitative.

2.1 Overview

To start with, a relationship between sanitation technologies defined in Census of India and the variables defined in the project is established. Then, the population dependent on those systems is represented in terms of percentage of population, as shown in Table 1.

Table 1: Sanitation technologies and contribution of excreta in terms of percentage of population.

S. No.	Sanitation technologies and systems as defined by:		SFD reference variable	Percentage of Population
	Census of India	SFD Promotion Initiative		
1	Piped sewer system	User interface discharges directly to a centralized foul/separate sewer.	T1A1C2	62.5
2	Septic tank	Septic tank connected to open drain or storm sewer	T1A2C6	19.4
3	Other Systems	User interface discharges directly to open ground	T1A2C8	1.2
4	Pit latrine with slab	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, general situation	T1A5C10	1.4
5	Pit latrine without slab	Unlined pit no outlet or overflow, general situation	T1A6C10	0.4
6	Night soil disposed into open drain	User interface discharges directly to open drain or storm drain	T1A1C6	0.9
7	Public latrine	Septic tank connected to open drain or storm sewer	T1A2C6	6.9
8	Open defecation	Open defecation	T1B11C7 TO C9	7
7	Service latrine	User interface discharges directly to 'don't know where"	T1A1C9	0.3

Source: (Census of India, 2011)

2.1.1 Sanitation facilities

This section presents on existing sanitation facilities in institutions, commercial establishments, slums and facilities for tourists.

Community and public toilets: There are 222 community toilets in the city which have been constructed and/or repaired under Swachh Bharat Mission. There are 163 public toilets in the city. Therefore, there are a total of 385 community and public toilets in the city.

Healthcare facilities: There are 82 graduation colleges and 406 hospitals/dispensaries.

Industrial areas: Kanpur is a hub of leather industries, however further details on sanitation facilities is not available. Information on effluent which is generated at these industries was earlier let off into river Ganga via drain, however post interventions under NMCG drains are being tapped and sent off to Common Effluent Treatment Plants (CETP).

Due to the lack of data on excreta generated from schools, industries, education and healthcare facilities and industries, these data were not taken into consideration for the production of the SFD graphic.

2.1.2 Containment

According to Census of India, approximately 62.5% of households were connected to sewerage network. In 2011, the total households in the city were 522,242 while in 2020 the households have increased to 532,665. The number of households connected to the sewerage system are thus 250,290 which accounts to 47% (system T1A1C2).

According to census, 19.4% of households were connected to septic tanks, 1.2% of households were dependent on other systems, 1.4% was dependent on pit latrines, 0.3% of households were disposing night soil directly into drain, 6.9% was dependent on public toilets and 7% practised open defecation.

However, from the new set of data available from Jal Kal Vibhag (JKV), KMC, Jal Nigam and triangulated from other sources, it is claimed that 7% of households, which are dependent on public toilets, are using septic tanks connected to soak pit (system T1A2C5); 15% of households are utilizing septic tanks connected to open drains (system T1A2C6); 23% of households have fully lined tanks connected to open drains (system T1A3C6); 6% of households, which have toilets either constructed under SBM or along with PMAY houses, are connected to twin pit systems (and considered to be fully lined tanks (sealed), no outlet or overflow, system T1A3C10, since these systems are cylindrical shaped with semi-spherical bottom. They are completely lined with slight perforations for liquid portion to seep out. The faecal sludge in these systems remains completely contained and are/can be eventually used as manure); 1% households are connected to lined tanks with permeable walls locally called as *kuddi* (ASCI, 2013) (and considered to be lined pits with semi-permeable walls and open bottom, no outlet or overflow, system T1A5C10, because these are systems constructed by digging up the earth and lines in honey comb structure) and 1% households still practice open defecation (system T1B11 C7 TO C9).

Sizes of the containment systems/Onsite Sanitation Systems (OSS) such as septic tanks and fully lined tanks vary across the city. The size of the containments is usually decided on the basis of space availability and affordability of the households. Due to no standardization being

followed while constructing the containment system, few households have constructed their containments large in capacity irrespective of household size. Figure 2 shows the SFD selection grid.

List A: Where does the toilet discharge to? (i.e. what type of containment technology, if any?)	List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?)									
	to centralised combined sewer	to centralised foul/separate sewer	to decentralised combined sewer	to decentralised foul/separate sewer	to soakpit	to open drain or storm sewer	to water body	to open ground	to 'don't know where'	no outlet or overflow
No onsite container. Toilet discharges directly to destination given in List B		T1A1C2			Significant risk of GW pollution Low risk of GW pollution					Not Applicable
Septic tank					Significant risk of GW pollution T1A2C5	T1A2C6				
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution	T1A3C6				T1A3C10
Lined tank with impermeable walls and open bottom	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution					Significant risk of GW pollution Low risk of GW pollution
Lined pit with semi-permeable walls and open bottom	Not Applicable									Significant risk of GW pollution T1A5C10
Unlined pit										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable						T1B11 C7 TO C9			Not Applicable

Figure 2: SFD selection grid.

2.1.3 Emptying

Emptying frequency differs across the city and is dependent on the size of the septic tank and the willingness of the owner to get it emptied. As per KII with a Private Tank Operator (PTO), it was noted that in the central part of the city, which is densely populated, the emptying frequency ranges from 2 months to 6 months for structures such as lined pits, while for septic tanks and fully lined tanks the emptying period can vary between 2-3 years or, in case of bigger sizes, the emptying frequency can go up to 5-10 years.

As per KII with PTO, there are 31 PTOs with 51 desludging tanker-mounted trucks in the city. The capacity of these vehicles is either 5,000 litres or 6,000 litres. These trucks operate across the city. Some of the main functioning areas for the PTOs are Yashoda nagar, Galla mandi, Vasant vihar. Kanpur city is divided into 4 districts for sewerage-related administration. Table 2 provides information of sewered and unsewered areas.

Table 2: Sewerage districts of Kanpur.

District	Type	Area
District 1	Completely Sewered	Area along the river Ganga (Nawab Ganj, Cantonment, Jajmau)
District 2	Mostly sewered. Only southern part is left	Yasoda nagar, COD, Naubasta, Barra
District 3	Unsewered	IIT, Kalyanpur, Armapur, Defence Colony
District 4	Sewered	Sanigawan, Sajari, Chakeri, Mathurapur

Source: Jal Kal Vibhag, KMC

Faecal sludge (FS) emptied from OSS is transported using tractor-mounted tankers operated by PTOs (Figure 3). New tanker-mounted trucks cost anywhere between INR 7.5 Lakhs (US$ 10.000) and above. The maintenance for a month of these vehicles is between INR 8,000 - INR 9000 (US$ 109 - US$123) and upwards, while the driver is paid INR 9,000/month (US$ 123/month) and the helper receives INR 5,000 - INR 7,000/month (US$ 68 - US$ 95/month). The emptiers advertise their contact numbers using wall paintings and distribution of business cards.

Figure 3: PTO tanker-mounted tractor (Source: Apurva/PSI,2020).

2.1.4 Transport

The sewerage network currently caters to 47% of the population. The transport efficiency of the sewerage network is 38.4% (KMC, 2015). The sewerage network spread across the city is an extension of brick sewers which were first laid in 1904 and then extended in 1952 to cater to the increase in population. The brick sewers are laid predominantly in the old parts of the city and are partially defunct due to encroachment, dumping of waste into drains which results into silting, overflowing, and damage/failure of drainage as well as the sewerage system (KMC, 2015). There have been up gradation and maintenance works which are under progress in AMRUT mission and SMART Cities (details provided in section 3.3.2 Investments). Details of Sewage Pumping Station (SPS) and Main Pumping station (MPS) are provided in Table 3.

Table 3: Zone-wise detail of SPS and MPS.

No.	Zone	Name
1	1	Guptarghat
2	2	Hanspuram Sumpwell No 2
3	2	Sawarn Jayanti 0r Phase 8
4	2	Shyam Nagar
5	2	Sanigawan Chandra Nagari
6	3	Virat Nagar
7	3	Barra 2
8	3	K block
9	3	I block
10	3	Gaushala
11	3	Vaidehi Nagar
12	4	Nawabganj
13	4	Parmat
14	4	Babaghat
15	5	Barra 8
16	5	Barra 4
17	5	Gujani
18	5	Panki B block
19	5	Panki Sundernagar
20	6	Awas Vikas Y3 main sumpwell
21	6	Awas Vikas Y3 mini sumpwell near shiv mandir
22	6	Awas Vikas Y3 mini sumpwell canal side
23	6	Kakadev Hitkari Nagar
24	6	Avas Vikas Y1 Keshavpuram Main sumpwell
25	6	Khyaura Bargar

Source: Jal Kal Vibhag, KMC

Open drains in the city carry 371 Million Litres per Day (MLD) of wastewater (WW) of which 300 MLD has been tapped. 13 out of 16 drains which carry household WW and industrial effluent have been tapped earlier which account to 160 MLD (KMC, 2015). Sisamau drain, which is considered to be the largest drain in Asia, has also been tapped and diverted. Sisamau drain carries 140 MLD of WW (this has been tapped) and 80 MLD is diverted to Bingawan Sewage Treatment Plant (STP) while 60 MLD is diverted to Jajmau STP (MWRRDGR, 2018). Open drains are significant to the study since OSS, which are connected to open drains, are continuously discharging effluent which make up of the 371 MLD in the city. The total wastewater delivered to the treatment plant is 80% of the total WW collected from the city.

The trucks charge a base fees of INR 500 (US$ 7) for a distance of 1.5-2 km (from assembly point to desludging point) and increase in distance is negotiated with extra charge. On an average, PTOs empty 2-3 containments in a day. Of the 31 PTOs, only 3 PTOs (who own 9 desludging vehicles) are registered with KMC. Currently only 10-12 tipping trips are recorded at the Bingawan STP.

As only 9 tankers tip 10-12 times a day at Bingawan STP, therefore only 9% of the sludge can be assumed to be safely transported to the STP. FS is decanted at a designated point in the STP premise. The sludge from the remaining PTOs is decanted at various low lying areas of the city or into the river, untreated.

The total FS generated in the city is 753 Kilolitres per Day (KLD). On an average, 690 KLD is emptied in a day, of which only 9% reaches the co-treatment facility at Bingawan.

Population Services International (PSI), the nodal agency working and advocating faecal sludge and septage management (FSSM) in Kanpur, has brought together the PTOs and KMC in 2020. PSI aims to register all PTOs with the municipal body and effectively work towards transport and treatment of all FS generated and collected in the city.

2.1.5 Treatment and disposal

Kanpur is an industrial city. There are many tanneries which discharge water in the open drains. The industrial effluent along with domestic grey and black water results in such a large quantity of wastewater produced. The total WW generated in Kanpur is ~541 MLD of which 371 MLD is WW from drains and 170 MLD is sewage from sewer network. A lot of the drains in the city, which receive predominantly industrial water, is redirected to Common Effluent treatment plants (this wastewater is also accounted in the 541 MLD figure presented). The WW from the sewer network and tapped open drains/nullahs is treated at STPs located in different parts of the city. Kanpur has 7 STPs with a combined treatment capacity of 502 MLD (SMCG, 2019). Operational details of the STPs are provided in Table 4.

Table 4: STPs in Kanpur.

STP location	Total Capacity (MLD)	Total Operation Capacity (MLD)	Total current operational capacity (MLD)	Efficiency
Jajmau	130	130	98	75%
Jajmau	27	27	24	89%
Jajmau	5	5	4.81	96%
Jajmau	43	43	43	Non-operational, ready for operation
Bingawan	210	210	180	86%
Sajari	42	42	15	36%
Baniyapurwa	15			Under construction
Panki	30			Under construction
Totals	502	457	364.81	
% treated			80%	

Source: (SMCG, 2019)

The total operational capacity of the STPs in the city is 80%. Treated wastewater from the STPs is discharged in river Ganga, while untreated wastewater from untapped drains continues to flow into river Ganga. Figure 4 shows the STPs located at Baniyapurwa, Bingawab and Sajar.

Figure 4: STPs located at Baniyapurwa, Bingawab and Sajar (Source: Apurva/PSI, 2020).

FS collected from the city is currently being discharged at Binganwan Sewerage Treatment Plant (STP), which has an efficiency of 86%.

2.2 SFD Matrix

The SFD matrix for Kanpur city is provided Table 5.

Table 5: SFD Matrix.

Kanpur, Uttar Pradesh, India, 3 Sep 2020. SFD Level: 1 - Initial SFD
Population: 3011693
Proportion of tanks: septic tanks: 50%, fully lined tanks: 50%, lined, open bottom tanks: 50%

System label	Pop	W4a	W5a	F3	F4	F5	S4e	S5e
System description	Proportion of population using this type of system	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A1C2 Toilet discharges directly to a centralised foul/separate sewer	47.0	38.0	80.0					
T1A2C5 Septic tank connected to soak pit	7.0			90.0	9.0	86.0		
T1A2C6 Septic tank connected to open drain or storm sewer	15.0			90.0	9.0	86.0	81.0	80.0
T1A3C10 Fully lined tank (sealed), no outlet or overflow	6.0			90.0	100.0	100.0		
T1A3C6 Fully lined tank (sealed) connected to an open drain or storm sewer	23.0			90.0	9.0	86.0	81.0	80.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	1.0			90.0	9.0	86.0		
T1B11 C7 TO C9 Open defecation	1.0							

Source: SFD-PI

2.2.1 SFD matrix explanation

Definition and estimation of different variables (used to make the SFD graphic) are explained in Table 6.

Table 6: Description of variables used for defining containment systems.

S. No.	SFD Promotion initiative	SFD Reference variable	Percentage of households
1.	Toilet discharges directly to a centralized foul/separate sewer	T1A1C2	47
2.	Septic tank connected to soak pit	T1A2C5	7
3.	Septic tank connected to open drain or storm sewer	T1A2C6	15
4.	Fully lined tank (sealed) connected to an open drain or storm sewer	T1A3C6	23
5.	Fully lined tank (sealed), no outlet or overflow	T1A3C10	6
6.	Lined pit with semi-permeable walls and open bottom, no outlet no overflow	T1A5C10	1
7.	Open Defecation	T1B11C7	1

Offsite systems

Population connected to sewerage system or T1A1C2 accounts to 47%. The efficiency of the T1A1C2 is 38%, thereby only 18% of the wastewater (WW) contained is delivered to the treatment plant. 29% of the WW is not contained and thereby not delivered to the treatment plant, eventually going untreated to the environment. Of the WW received at the treatment plant, only 14% of the WW is treated due to the efficiency of the STP. 4% of the WW received remains untreated.

Assumptions for offsite systems:

1. The efficiency of the sewerage drain is 38% (variable W4a set to 38%).
2. 80% of the wastewater delivered to the STP is treated (variable W5a set to 80%).
3. The Graphic Generator uses rounding off decimal digits.

Onsite Systems

53% of the city is dependent on OSS, out of which 7% of the population is dependent on septic tanks connected to soak pit (T1A2C5) where there is a 'low risk' of groundwater pollution, 15% of the population is dependent on septic tanks connected to open drain or storm sewer (T1A2C6), 23% of the population is dependent on fully lined tanks (sealed) connected to open drain or storm sewer (T1A3C6), 6% of the population is dependent on fully lined tanks (sealed), no outlet or overflow (T1A3C10) while 1% is dependent on lined pits with semi-permeable walls and open bottom, no outlet or overflow (T1A5C10) where there is a 'low risk' of groundwater pollution.

Assumptions for Onsite Systems:

1. There is no clear differentiation between the volume of effluent and solid FS generated from septic tanks and fully lined tanks, hence to reduce the maximum error, it is assumed to be 50% each.
2. It is also assumed that 90% of the population (dependent on onsite systems) gets their system emptied when full. Thus, variable F3 for systems T1A2C5, T1A2C6, T1A3C6 and T1A5C10 is set to 90%).
3. It is also assumed that 90% of the system is emptied during the emptying process to let the degradation properties be maintained in the system. Thus, variable S4e for systems T1A2C6 and T1A3C6 is set to 81%.
4. As mentioned above, 9 of 51 tankers are registered, and hence it is assumed for calculation purposes that the average size of tankers is 5,000 litres. Tankers plying to STP have an average trip size of 1.3 while tankers disposing into the open have an average trip size of 3. Therefore, it has been assumed that, in a day, only 9% of the FS emptied from OSS reached the STP, while the remaining 91% is disposed in the open (Table 7). Therefore, variable F4 for systems T1A2C5, T1A2C6, T1A3C6 and T1A5C10 is set to 9%.

Table 7: Details of FS emptying and transport.

Details of FS Empting and Transport		
Average volume of tanker vehicles	5,000	litres
Private tanker vehicles	51	units
Private tank operators	31	units
Tanker vehicle discharging in the open	42	units
Average trips of tanks discharging waste in the open	3	units
Estimated FS collected by tanker vehicles discharging in the open	630,000	litres
Tanker vehicles tipping at STP	9	units
Average Trips of tanker vehicles tipping at STP	1.3	units
Estimated FS collected by tanker vehicle tipping at STP	60,000	litres
Total FS collected	690,000	litres
% FS reaching STP	**9%**	

Source: KII with PTO; PSI, 2020

5. FS reaching the STP is treated at an efficiency of 86% at the Bingawan STP. Thus, variable F5 for systems T1A2C5, T1A2C6, T1A3C6 and T1A5C10 is set to 86%.
6. Variable S5e for systems T1A2C6 and T1A3C6 is set to 80% since the total efficiency of the STPs that also treats supernatant form those systems is 80%.
7. FS generated in twin pits (modelled as fully lined tanks with no outlet, system T1A3C10) is considered to be treated at site in line with the technology type as explained in section 2.1.2. Therefore, variables F4 and F5 were both set to 100%.

Open defecation

Kanpur was declared Open Defecation free on 24th April, 2018 by the Ministry of Housing and Urban Affairs, Government of India (MoHUA, 2018). However, various newspaper reports and sanitation studies suggest otherwise, therefore to depict a holistic situation the city has not been considered as open defecation free (DTE, 2019).

2.3 SFD Graphic

Figure 5 shows the SFD graphic for the city where 39% of the excreta generated are safely managed while 61% of the excreta generated are unsafely managed.

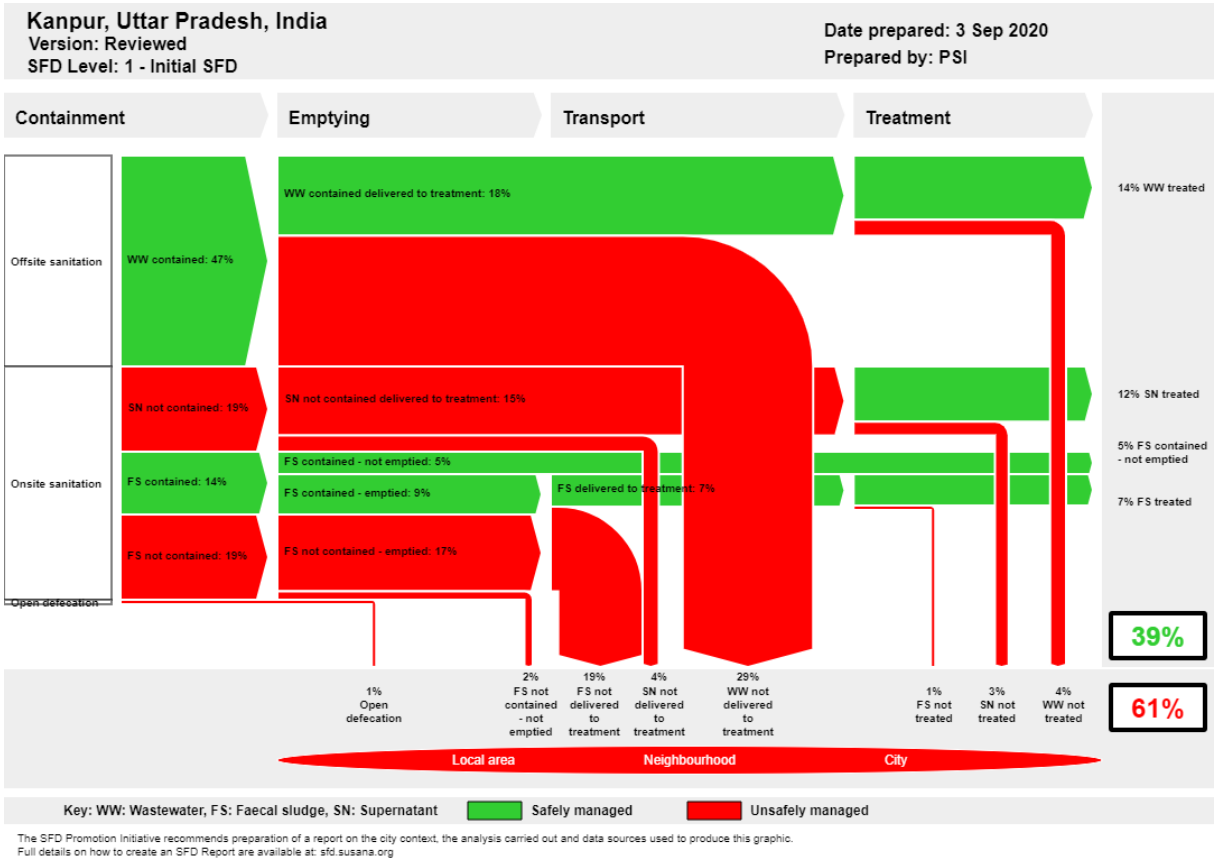

Figure 5: SFD graphic (Source: SFD-PI).

The 19% of Supernatant (SN) not contained is attributed to 7% of SN from system T1A2C6 and 12% of SN from system T1A3C6 (Refer to point 1 under “Assumptions for onsite sanitation systems”). The 15% of SN not contained and delivered to the treatment plant is attributed to 6% of SN from system T1A2C6 and 9% of SN from system T1A3C6 (Refer to point 1 under “Assumptions for offsite sanitation systems”). The 4% of SN not delivered to treatment is attributed to 1% from system T1A2C6 and 3% from system T1A3C6. 12% of SN is treated which is attributed to 5% of SN from system T1A2C6 and 7% of SN from system T1A3C6 (Refer to point 6 under “Assumptions for onsite sanitation systems”). The 3% of SN which is not treated is attributed to systems T1A2C6 and T1A3C6.

The 14% of FS contained is attributed to 7% of FS from system T1A2C5, 6% of FS from system T1A3C10 and 1% of FS from system T1A5C10. The 5% of FS contained-not emptied is attributed to 4% of FS from system T1A2C5 and 1% of FS from system T1A5C10. The 9% of FS contained-emptied is attributed to 3% of FS from system T1A2C5, 5% of FS from system T1A3C10 and from system T1A5C10. The 7% of FS delivered to the treatment plant is attributed to 5% FS from system T1A3C10 and the remaining 2% originates from systems T1A2C5, T1A5C10, T1A2C6 and T1A3C6.

The 19% of FS not contained is attributed to 7% of FS from system T1A2C6 and 12% of FS from system T1A3C6 (Refer to point 1 under “Assumptions for onsite sanitation systems). The 17% of FS not contained-emptied is attributed to 6% of FS from system T1A2C6 and 11% of FS from system T1A3C6 (Refer to point 2 and 3 under “Assumptions for onsite sanitation

systems). The 2% of FS not contained is attributed to 1% of FS from system T1A2C6 and 1% of FS from system T1A3C6 (Refer to point 4 under “Assumptions for onsite sanitation systems). The 19% of FS not delivered to treatment plant is attributed to 6% of FS from system T1A2C6, 3% of FS from system T1A2C5, 9% of FS from system T1A3C6 and the remaining originates from system T1A5C10 (Refer to point 4 under “Assumptions for onsite sanitation systems).

2.4 Risk of groundwater contamination

Uttar Pradesh is covered with rich fertile soil and underlain by a large thickness of alluvium, making it one of the richest groundwater repositories of the world. Groundwater levels have been taken from India WRIS Project (India-WRIS, n.d.). For the purpose of this report, septic tanks connected to soak pits (7%) and lined pits (1%) were assumed to be located in areas of low risk of groundwater contamination.

The SFD graphic assessment includes the risk of groundwater pollution as an important factor in determining whether the sanitation systems are located in areas of low/high risk of groundwater pollution. If the risk of contamination to groundwater is low, then the FS is considered “contained”.

2.5 Discussion of certainty/uncertainty levels of associated data

There were three major challenges to develop the SFD graphic. Published/unpublished reports were not able to provide (i) up-to-date data on containment (ii) detailed typology of containment and (iii) actual information about FSM services provided to households.

The assumption regarding the amount of FS emptied as compared to FS generated has high impact on the overall SFD graphic. A reliable method for estimating quantities of FS generated on a citywide scale do not yet exist, and it is complicated because the containment size and emptying period greatly vary. The amount of FS emptied is not clear because the private emptiers empty sewage from sewer-holes, septage from government and private institutions and commercial establishment.

3 Service delivery context

3.1 Policy, legislation and regulation

3.1.1 Policy, legislation and regulation at national level

In 2008, the Ministry of Housing and Urban Affairs (MoHUA), formerly known as Ministry of Urban Development (MoUD) issued the National Urban Sanitation Policy (NUSP). The policy aims to: raise awareness; promote behaviour change; achieve open defecation free cities; develop citywide sanitation plans; and provide 100% safe confinement, transport, treatment and disposal of human excreta and liquid wastes. The NUSP mandates states to develop state urban sanitation strategies and work with cities to develop City Sanitation Plans (CSPs). NUSP specifically highlights the importance of safe and hygienic facilities with proper disposal and treatment of sludge from on-site installations (septic tanks, pit latrines, etc.) and proper operation and maintenance (O&M) of all sanitary facilities. Furthermore, it explicitly states that cities and states must issue policies and technical solutions that address onsite sanitation, including the safe confinement of Faecal Sludge (FS) (USAID, 2010). The objectives of NUSP are to be realized through CSPs and state sanitation strategies. NUSP identifies the constitution of the multi-stakeholder task force as one of the principal activities to be taken up to start the city sanitation planning process. As per the requirement of CSP, a major role is to be played by the members of institutions, organizations, individuals, NGOs, academics, media representatives, local councillors, industry owners, consultants, representatives of private sector, etc. Constitution of Swachh Bharat City Level Task Force (SBCLTF) formerly known as City Sanitation Task Force (CSTF) is facilitated by drawing members from these groups in consensus with citizens who will be constantly supporting the CSP preparation by analysing the strengths and competencies required to overcome the current situation and to improve sanitation facilities (MoUD, 2014). In Kanpur, Population Services International (PSI), an international development agency is working with Kanpur Nagar Nigam. This partnership has established a faecal sludge and septage management taskforce and helped the private tank operators register at a subsidised rate LNN.

A CSP for Kanpur was prepared in 2013 under the JNNuRM scheme by Administrative Staff College of India (ASCI) for KMC (ASCI, 2013).

The advisory note on septage management in urban India, issued by MoHUA in 2013, recommends supplementing CSPs with a Septage Management Sub-Plan (SMP), prepared and implemented by cities. Septage here broadly refers to not only FS removed from septic tanks but also that removed from pit latrines and similar on-site systems. This advisory provides a reference to CPHEEO guidelines, Bureau of Indian Standard (BIS), and other resources that users of this advisory may refer, for details while preparing their SMP (MoUD, 2013). The advisory clearly discusses the techno-managerial and socio-economic aspects of septage management in India and provides guidelines for Urban Local Bodies (ULBs) to plan and implement SMP.

The Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Act, 1974 have provisions relating to sanitation services and environmental regulations. It applies to households and cities with regard to disposing wastes into the environment. ULBs/

utilities also have to comply with discharge norms for effluent released from sewage treatment plants and to pay water cess under the Water Cess Act, 1977.

The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act is enacted in 2013. This act prohibits employment of manual scavengers and insanitary latrines - Laying strong emphasis on rehabilitation of manual scavengers. The broad objectives of the act are to eliminate insanitary latrines, prohibit the employment of manual scavengers and the hazardous manual cleaning of sewer and septic tanks, and to maintain a survey of manual scavengers and their rehabilitation (MoSJE, 2014).

In February 2017, MoHUA issued the National Policy on Faecal Sludge and Septage Management (FSSM). The policy aims to set the context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all ULBs such that safe and sustainable sanitation becomes a reality for all in each and every household, street, town and city in India (MoUD, 2017).

The Fourteenth Finance Commission (FC-XIV) was constituted by the President of India under Article 280 of the Constitution on 2 January 2013 to make recommendations for the period 2015-20. Its assignments include distribution of revenue between union and state; devising formula for grant; suggesting method to augment resources for local bodies; and taking care of any matter referred to it (NIUA, 2014).

Model Municipal Building Bye-laws 2016 prepared by Town and Country Planning Organization (TCPO). Building Bye-laws 2016 is used to regulate coverage, height, building bulk, and architectural design and construction aspects of buildings so as to achieve orderly development of an area. They are mandatory in nature and serve to protect buildings against fire, earthquake, noise, structural failures and other hazards. It includes chapters on green buildings and sustainability provisions, rainwater harvesting, Wastewater (WW) reuse and recycle, installation of solar roof top photo voltaic norms, revised norms for adequate toilet facilities for women and public conveniences in public buildings and mandatory provisions for segregated toilet facilities for visitors in public buildings (TCPO, 2016).

3.1.2 Policies, legislations and regulations at state level and ULB level

According to the Constitution of India, water and sanitation are state subjects. Statutory powers are conferred to the state for making laws on water and sanitation. Some of the policies, laws and regulations are listed below:

The Uttar Pradesh Water Supply and Sewerage Act, 1975:

An act to facilitate the establishment of corporation, authorities and organizations for the development and regulation of water supply and sewerage services, related matters. According to this act, the corporation has powers to fine the owner of the improper/damaged septic tank.

The Uttar Pradesh Urban Sanitation Policy, 2010:

In 2010, the Director of Local Authorities, Uttar Pradesh issued the Uttar Pradesh Urban Sanitation Policy (UPUSP). The policy is inspired from the NUSP. The UPUSP mandates the cities to establish City Sanitation Task Force (CSTF) and to elevate the consciousness about sanitation in municipal agencies, government agencies and most importantly, amongst the

people of the city. UPUSP specifically highlights the importance of safe and hygienic facilities with proper disposal and treatment of sludge from on-site installations (septic tanks, pit latrines, etc.) and proper operation and maintenance (O&M) of all sanitary facilities. As of now, there are very few cities that have finalized their CSPs, and it remains a major drawback in the implementation of the UPUSP.

Uttar Pradesh Faecal Sludge and Septage Management (FSSM) Policy, 2019:

The goal of the Uttar Pradesh State Septage Management Policy (UPSSMP) is to improve water quality and protect public health in urban areas of the State by 2023. The objective is to enhance the ability of local implementers to build and operate septage treatment systems for urban centres and promote the behaviour change and supporting environment needed for systems to be effective and sustainable. The main strategy is to facilitate a bottom-up, demand-driven project development process by providing State Government support and incentives. As per estimation, 9 lakh ($9x10^5$) Individual Household latrines (IHHLs) constructed under SBM (U) over last 3 years also warrant immediate attention on Septage Management (SM). Sanitation coverage in 610 ULBs are completely dependent on septic tanks. There are 72 lakh ($72x10^5$) On-site Sanitation Systems (OSS) which generate approximately 5,000 MLD of sewerage. This highlights the magnitude of effort required for addressing environmental and public health safety on account of untreated sewerage/septage (UDD, UP, 2019).

Uttar Pradesh Municipal Building Bye-Laws, 2008: Issued by Housing Department, Government of Uttar Pradesh, the codes specify standards and design consideration for installation of toilets and septic tank.

Uttar Pradesh Finance Commission: It is a committee pertaining to the state of Uttar Pradesh, established with a purpose of reviewing the financial implementations of the state. The main purpose of this committee is to formulate implementation of financial policies pertaining to the state of Uttar Pradesh. The Finance Commission is set up under the Article 243 Sec I of the Indian Constitution, which orders that the Governor of the state would, at the end of every fifth year establish a Finance Commission for the purpose of reviewing, within the introduction of the 73rd Amendment of the Constitution Act, 1992 (BMOI, 2016).

3.1.3 Institutional roles

The MoHUA is the nodal ministry for policy formulation and guidance for the urban water supply and sewerage sector. The ministry's responsibilities include broad policy formulation, institutional and legal frameworks, setting standards and norms, monitoring, promotion of new strategies, coordination and support to state programmes through institutional expertise and finance. The ministry is also responsible for managing international sources of finance. The Central Public Health and Environmental Engineering Organisation (CPHEEO), created in 1953, is the technical wing of the MoHUA, which advises the ministry on all technical matters and collaborates with the State Agencies about water supply and sanitation activities. CPHEEO plays a critical role in externally funded and special programmes. CPHEEO also plays a central role in setting design standards and norm setting for urban water supply and sanitation (Planning Commision, 2002).

National Council for Rejuvenation, Protection and Management of River Ganga (referred as National Ganga Council) formerly known as National Ganga River Basin Authority (NGRBA), which was constituted under the provisions of the Environment (Protection) Act (EPA),1986.

The Council aims at ensuring effective abatement of pollution and rejuvenation of the River Ganga by adopting a river basin approach to promote inter-sectoral co-ordination for comprehensive planning and management, maintenance of minimum ecological flows in the river Ganga with the aim of ensuring water quality and environmentally sustainable development (NMCG, 2017a).

State Mission for Clean Ganga-Uttar Pradesh (SMCG-UP) is an extended arm of National Mission for Clean Ganga (NMCG) for the state of Uttar Pradesh which is implementing the Namami Gange and other programmes through various executing agencies. At state level, it is an implementing arm of State Ganga Committee constituted vide S.O. 3187 E dated 7th October, 2016 under Environment protection act 1986 to implement River Basin Management Programme prepared and approved by the National Ganga River Basin Authority & SMCG-UP. The main objectives of SMCG are to monitor the executed programme of National Ganga River Basin Authority at State level and to evaluate and audit itself or to get it evaluated and audited and to implement the recycling and reuse of water, rain water harvesting, decentralized sewage treatment system, water conservation and conservation procedures (SMCG, 2016).

The 74th Constitutional Amendment Act of 1992 reformed the sector by transferring responsibility for domestic, industrial, and commercial water supply and sewerage (WSS) from state agencies, such as Departments of Public Health Engineering and State Water Boards, to Urban Local Bodies (ULBs). This transfer has resulted in a variety of implementation models, as well as a lack of clarity in roles and responsibilities of state and local agencies, resulting in large gaps in implementation (USAID, 2010).

Management and delivery of urban basic services in Kanpur is governed by various institutions. Table 8 shows the institutions responsible for policy making, service provision and regulation of urban services:

Table 8: Institutional roles and responsibilities.

Institutions	Roles and responsibilities
Urban Development Department (UDD)	Policy formulation, preparation of municipal bye-laws, monitoring and evaluation of programmes, supervision of municipal administration, coordination with related state government departments, liaison with the central government and external funding agencies, administrative and financial management of municipalities and implementation of development programmes.
Kanpur Municipal Corporation (KMC)	Water supply and sewerage, public health, sanitation, conservancy and solid waste management, urban poverty alleviation by providing infrastructure, provision and maintenance of urban amenities and facilities such as parks, gardens, playgrounds, provision and maintenance of the lighting in the public streets, corporation markets, public buildings. Registration of births and deaths, O&M of burial grounds, cremation grounds, etc. The ULB has a vital role in design, develop, plan and implement ULB level FSSM strategy, set up and ensure operation of systems for 100% safe and sustainable collection, transport, treatment and disposal of faecal sludge and septage, monitor and evaluate FSSM strategy and implementation plan and Implement Municipal Bye-laws.
Jal Kal Vibhag, Kanpur Municipal Corporation (JKV, KMC)	• Ensuring uninterrupted pure drinking water supply in the city. • Providing citizens sewer facility. • Creating awareness among citizens about water conservation. • Preventing infection in water supply. • Transparency in the work of Jal Sansthan and to provide better facilities to citizens. • Operation and maintenance of Sewerage facilities in the city.

Kanpur Development Authority	• Overall development of city. • Making & implementation of Master Plan. • Planning for infrastructure for KDA colonies and its construction. • Zoning of the city. • Maintenance of KDA colonies till their handing over to KNN.
Uttar Pradesh Jal Nigam (UPJN)	Carry out the functions of – • Preparation, execution and promotion of ULB and state level plans of water supply and sewerage schemes. • Establishment of standards for water supply and sewerage in the state.
Uttar Pradesh Awas Vikas Parishad (UPAVP)	Its functions are to: • Plan and develop affordable housing to the economically weaker section of the society. • To ensure prudent financial results with appropriate accounting principles. • To plan and develop centres of excellence at strategic locations across the state. • To maintain an effective public grievance redressal mechanism and set standards by adhering to time-frame and schedules.
State Urban Development Authority (SUDA) / District Urban Development Authority (DUDA)	Its functions are to– • Execute various government schemes for urban development and employment generation. • Create urban infrastructure, including water supply. • Undertake tasks related to urban infrastructure to generate local employment. Construct community toilets and link it to sewer lines, etc. • Lay sewerage network according to plan made by Jal Nigam. • Regulate and help ULBs set up systems to ensure financial sustainability in provision of sanitation services.
Uttar Pradesh Pollution Control Board (UPPCB)	Regulation, licensing for environmental check, etc. Monitor the compliance of the standards regarding groundwater, ambient air, leachate quality and the compost quality, including incineration standards as specified in Schedule II, III & IV of 'The Water (Prevention and Control of Pollution) Act 1974 '.

3.1.4 Service provision

Institutional arrangements for water supply and sanitation in Indian cities vary greatly. Typically, a state-level agency is in charge of planning and investment, while the local government (Urban Local Bodies) is in charge of operation and maintenance (NIUA, 2005). Some of the largest cities have created municipal water and sanitation utilities that are legally and financially separate from the local government. However, these utilities remain weak in terms of financial capacity. In spite of decentralization, ULBs remain dependent on capital subsidies from state governments. Tariffs are also set by state governments, which often subsidize operating costs (Planning Commision, 2002).

Furthermore, when no separate utility exists, there is no separate allocation of accounts for different activities within a municipality. Some states and cities have non-typical institutional arrangements. For example, in Rajasthan, the sector is more centralized and the state government is also in charge of operation and maintenance while in Mumbai, the sector is more decentralized and local government is also in charge of planning and investment (NIUA, 2005).

3.1.5 Service standards

1. Service Level Benchmarks (SLB), 2008: Issued by the Ministry of Urban Development in 2008, the SLB seek to (i) identify a minimum set of standard performance parameters for the water and sanitation sector that are commonly understood and used by all stakeholders across the country; (ii) define a common minimum framework for monitoring

and reporting on these indicators and (iii) set out guidelines on how to operationalize this framework in a phased manner. The SLB refers to improving service through better provision and delivery. It evaluates the performance of urban services provided by different ULBs throughout the country.

2. General Standards for Discharge of Environmental Pollutants – The Environment (Protection) Rules, 1986 (Schedule VI): Issued by Central Pollution Control Board (CPCB), a statutory organisation constituted in September 1974 under the Water (Prevention and Control of Pollution) Act, 1974. General standards are notified with respect to parameters for safe discharge of effluent to inland surface water/public sewers/land for irrigation/marine coastal areas.
3. Manual on Sewerage & Sewage Treatment, Second Edition, 2013: This manual was developed by Central Public Health and Environmental Engineering Organization (CPHEEO). It provides detailed designs and guidelines for various technologies of wastewater management.
4. Code of Practice for Installation of Septic Tanks, 1985: Issued by, Bureau of Indian Standards. The code specifies standards and design consideration for installation of septic tanks.

3.2 Planning

3.2.1 Service targets

State governments must put in place targets for delivery of essential services provided by the local bodies viz. water supply, sewerage, solid waste management and storm water drains in line of handbook for SLB by MoHUA. State government must notify or cause all ULBs to notify by the end of a fiscal year the service standards and targets (PAS, 2009-16).

The Swachh Bharat Mission (SBM), one of the flagship programmes of the government of India, was launched on October 2nd 2014 by MoHUA. SBM-Urban aims to eliminate open defecation, eradicate manual scavenging, augment the capacity of ULBs and generate awareness about sanitation and its linkage with public health during the mission period till 2019.

The SBM (urban) aims to ensure that no new insanitary toilets are constructed during the mission period and that pit latrines should be converted into sanitary latrines. The target group for construction of household units of toilets thus is (i) 80% of urban households engaging in open defecation, remaining 20% of households practising open defecation are assumed to be catered by community toilets due to constraints of space (ii) all households with insanitary latrines (iii) all households with single-pit latrines (MoUD, 2014). Table 9 provides an overview of service delivery targets and Table 10 outlines an overview of service delivery progress in accordance with SBM.

Table 9: Service delivery targets in accordance with SLBs.

Sanitation service chain	Parameter	National benchmark	Time-frame to achieve benchmark
Containment	Coverage of toilets	100%	2019
Transport	Coverage of sewer network services	100%	2031
	Collection efficiency of the sewerage network	100%	2031
Treatment	Adequacy of sewage treatment capacity	100%	2031
	Quality of sewage treatment	100%	2031
End-use/disposal	Reuse and recycling	20%	2031
Other	Cost recovery	100%	2031
	Efficiency of collection of charges	100%	2031
	Redressal of customer complaints	80%	2031

Source: Adapted from (MoUD, 2008), (MoUD, 2010)

Table 10: Service delivery progress in accordance with SBM.

SBM Head	Total toilets built (M.Corp)
Individual Household Toilets (IHHT)	15,901
Community Toilets (CT)	222
Public toilets (PT)	163

Source: Geoportal for Urban Missions (http://geourbanmissions.gov.in/?)

3.2.2 Investments

Kanpur is a designated NMCG city, an AMRUT city and a Smart city. Under both the missions of the central government, the city has been assigned funds under various infrastructure development initiatives. For the sanitation purposes, the details of funds allocated to the city for various projects is enlisted in Table 11.

Table 11: Funds under various projects.

Mission and Project Detail	Funds (INR)	Funds (USD)
NMCG		
In-situ bioremediation for treatment of sewage carrying drains- Muir drain	0.58 crores	0.078 million
Sisamau drain rehabilitation	63.80 crores	8.6768 million
Rehabilitation of existing Sewage Treatment Infrastructure, Development of Sewage Treatment Plant at Panki (30 MLD)	967.23 crores	131.5433 million
AMRUT		
Sewerage Work District-III Zone-I	99.81 crores	13.5746 million
Construction of House connecting chambers in Sewerage District-4, Kanpur	29.35 crores	3.9916 million
Extension of Sewer Network in Sewerage District-4, Kanpur	47.21 crores	6.420 million
Protection work at 210 MLD STP in Bingawan	3.72 crores	0.505 million
Kanpur Sewerage Scheme District - II Part - B	69.85 crores	9.4996 million
Sewerage Work District-III Zone-I	99.81 crores	13.574 million

Source: (NMCG, 2019), AMRUT Uttar Pradesh (http://amrutup.in/pages/project-list.html), (https://nmcg.nic.in/csr/biodrains.aspx)

3.3 Equity

3.3.1 Current choice of services for the urban poor

The Ministry of Housing and Urban Poverty Alleviation (MoHUPA) in 2010 directed municipalities to allot a minimum of 25% of their annual budget as a fund to create basic services to the urban poor. In respect to the reform, the Kanpur Nagar Palika allotted a considerable amount of funds for the urban poor such as provision of basic services and development of infrastructure, implementing programmes/projects targeting the urban poor in the city. There are 412 slums in the city comprising of 152,214 households. Of the 412 slums, 101 are notified and 311 are non-notified. About 30% of the population lives in the slums (RCUES, 2014).

3.3.2 Plans and measures to reduce inequity

Under Pradhan Mantri Awas Yojna (PMAY), a total of 41,234 houses have been sanctioned, 17,631 houses have been grounded while 3,580 houses have been completed in Kanpur city. In Kanpur (CB), 112 houses have been sanctioned, grounded and completed (PMAY-U, 2020). There are 13 shelters built by National Urban Livelihood mission and 19 which have been built by KMC (MoHUA, 2020).

3.4 Outputs

3.4.1 Monitoring and reporting access to services

Data on service levels should be collected, documented and reported to MoHUA according to the format prescribed by SLB framework.

Progress on SBM gets reflected on mission progress dashboard in the SBM-Urban website. Of 4,041+ Municipalities in 650+ districts, 3,802 ULBs are active. 75 million plus cities are being monitored separately.

3.4.2 Stimulating demand for services

The following activities may stimulate demand for services:

- Awareness generation on septic tank construction, regular emptying of septic tanks through awareness campaigns.
- Awareness campaigns on ill effects of environmental degradation because of disposal of untreated septage into local environment.
- Capacity building of ULB staff on septage management.
- Skill development for local masons and plumbers.
- Monitoring and regulation of private emptiers.

It is recognized that the end objectives and corresponding benefits of SBM cannot be achieved without proper management of faecal sludge and septage across the sanitation service chain. Further, it is well understood that sewerage coverage will not meet the complete sanitation needs in all areas, and a strategy which is a combination of OSS and offsite (decentralised and centralized) must co-exist in all cities and must be given equal attention. However, the

current policies are not explicit enough and also do not provide an outcome-focused direction on this issue (MoUD, 2017).

3.4.3 Strengthening service provider roles

Funding is estimated for septage management initiatives under rapid assessment for FSSM supported by the MoHUA and GoI through National Alliance for Faecal Sludge and Septage Management (NFSSM). These funds can be used to buy vacuum tankers, building treatment facility, etc. LNN has to make use of these funds to strengthen the services. At present, there are no detailed plans for strengthening service delivery.

SBM majorly provides funds for access to toilets but thereafter lacks funds for treatment and disposal of sewage and FS throughout the service chain. The service delivery of sewage and FS treatment and disposal can be met through converging the two-national flagship programmes – SBM and NMCG. The ULB can take the benefit of the programmes and strengthen the services along the value chain and achieve the goals of both programmes.

4 Stakeholder Engagement

Due to the COVID pandemic, stakeholder interviews were conducted telephonically. The interviews were conducted with private tank owners and their staff. Overall, 3 KIIs were conducted with emptier, Jal Kal Vibhag engineer and Jal Nigam Engineer (see appendix 7.1).

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7 Appendix

7.1 Appendix 1: Stakeholder identification

Table 12: Tracking of engagement.

S. No.	Name of Organisation	Designation
1.	Gupta Ji- Trimurti company	Private Tank operator
2.	Jal Kal Vibhag- Kanpur Municipal Corporation	Engineer
3.	Jal Nigam – Uttar Pradesh	Engineer

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