

# MANAGING SEPTAGE IN CITIES OF UTTAR PRADESH

An analysis of  
the sanitation  
chain in 30 cities,  
through SFDs



CENTRE FOR SCIENCE AND ENVIRONMENT

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# INTRODUCTION

## ➤ THE SCENARIO IN UTTAR PRADESH

According to Census 2011, Uttar Pradesh has an urban population of 44.47 million people – which is 11.79 per cent of the total urban population of the country. The state has 653 urban local bodies (ULBs) including 17 Municipal Corporations (Nagar Nigams), 198 Nagar Palika Parishads and 438 Nagar Panchayats. The ULBs, with their limited local resources and state support, are responsible for provision of municipal services.

A sanitation snapshot of urban Uttar Pradesh clearly indicates that households with onsite sanitation systems (see Box: *The three pathways*) like septic tanks (47 per cent) far exceed those with sewer connections (28 per cent). According to the State Annual Action Plan 2017-20, most cities have reported more than 80 per cent coverage of latrines, but out of the 60 AMRUT cities, 34 have reported zero efficiency regarding collection and treatment of sewage.

In the absence of even a single city that is completely seweraged; most households, institutions, commercial areas and public/community toilets in the state depend on onsite sanitation systems like septic tanks and pit latrines. And as there is no designated site for disposal, the emptied faecal sludge ends up in open drains/nullahs/open fields, which eventually lead to polluting

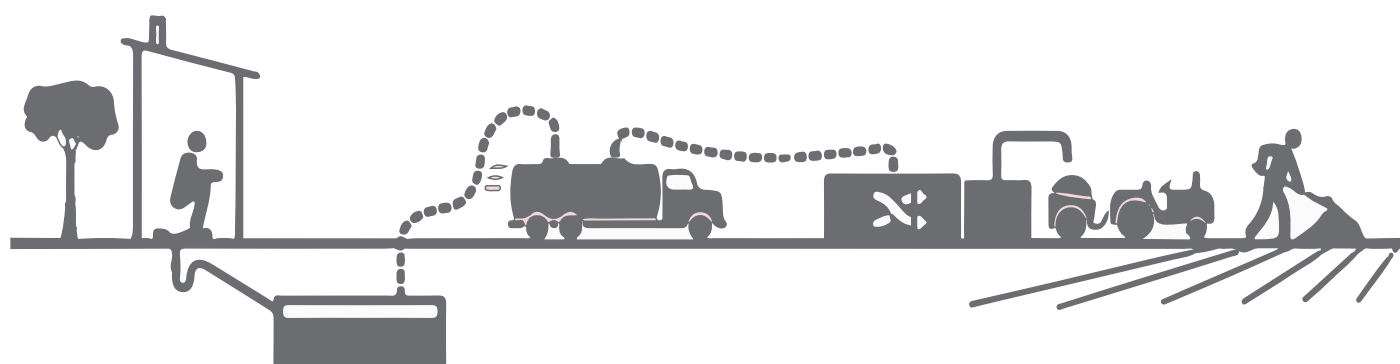
the Ganga. According to the Central Pollution Control Board (CPCB), the main stem of the river receives 121.52 tonnes per day of BOD load from domestic sewage generated in Uttar Pradesh. A considerable amount of faecal coliform has also been detected in the river (see Box: *Sewage vs faecal sludge*).

## ➤ CSE'S FSSM STUDY OF UTTAR PRADESH

Safe containment, emptying, transport, treatment and end use of faecal sludge and septage is known as Faecal Sludge and Septage Management (FSSM). CSE has analysed 30 cities of the state through all the stages of their sanitation chain (see Figure 1: *Sanitation chain*) – this briefing paper is an effort towards documenting the analysis.

One of the aims of the Union Ministry of Housing and Urban Affairs, under the Swachh Bharat Mission (SBM), is containment of human waste. The ministry, recognising that the end objectives and corresponding benefits of SBM cannot be achieved without proper management of faecal sludge and septage across the sanitation chain, has notified a National Policy on FSSM in February 2017. According to this policy, each state in India — and eventually, cities – is supposed to notify an FSSM action plan/strategy/operative guidelines.

Figure 1: Sanitation chain



	Containment	Emptying and transport	Treatment	Disposal and end use
Definition	An onsite sanitation system into which a user interface discharges	Manual or motorized removal and transportation of faecal waste from the containment system	Process of converting faecal sludge into a product that is safe for end use	Disposal or utilization of output products derived from sanitation systems
Examples	Septic tanks, soakpits and cesspools	Vacuum trucks or carts	FSTPs, constructed wetlands and dewatering	Manure

The CSE study links itself to this national objective by aiming to analyse the sanitation scenario of Uttar Pradesh, so that the need for FSSM can be quantified for some of the major cities in the state.

To understand the FSSM requirement, CSE is developing an SFD – Shit Flow Diagram (see Box: *What is an SFD?*) — for each of the state’s 62 major cities. For this purpose, the state has been divided into seven zones of eight or nine cities each (see Figure 2: *Need assessment of FSSM in Uttar Pradesh*). The CSE team conducted secondary research before visiting each city; in the cities, it conducted key informant interviews, focussed group discussions and field observations.

This work has been divided into two phases — 25 cities were visited in Phase 1 and the rest in Phase 2. The analysis of data collected in Phase 1, along with five cities (Agra, Bijnor, Chunar, Ramnagar and Gangaghat) that already have an SFD, is presented in this report.

**Figure 2: Need assessment of faecal sludge and septage management in Uttar Pradesh**



**THE THREE PATHWAYS** Excreta generated in a city can follow three pathways:

- **Offsite sanitation:** Toilets connected to drainage networks like a sewerage system which conveys the excreta away from the site, preferably to a sewage treatment plant.
- **Onsite sanitation:** Toilets connected to a tank or a pit, which stores the excreta within the site. These systems generally produce partially treated effluent and faecal sludge/septage that needs periodic emptying.
- **Open defecation:** Users do not have an access to a toilet and hence defecate in the open.

**SEWAGE VS FAECAL**

**SLUDGE** Sewage is untreated wastewater which contains faeces and urine — this wastewater gets conveyed through the sewerage system. Generally, grey water from the kitchen and bathroom also become part of sewage. The BOD of sewage ranges from 150-350 mg/l and all sewage treatment plants are designed for this load. Faecal sludge/septage is semi-solid slurry — it is emptied out of septic tanks/pits and is much more concentrated than sewage. The BOD of faecal sludge ranges from 1,000-20,000 mg/l.

**WHAT IS AN SFD?**

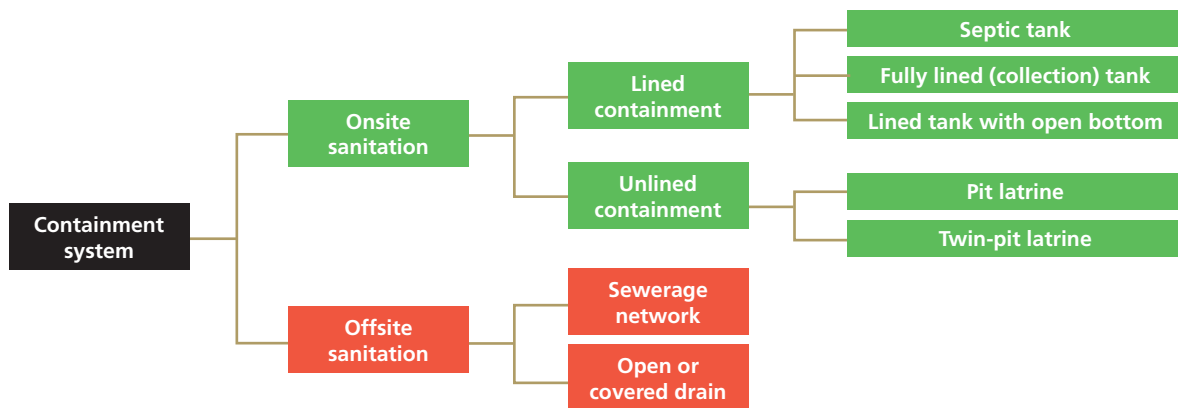
An excreta flow diagram (also often described as Shit Flow Diagram, SFD) is a tool to readily understand and communicate how excreta physically flows through a city or town. SFDs show how excreta is or is not managed as it moves from defecation to disposal or end-use. The SFD report presents the service delivery context of the city or town and the data sources used for the assessment.

# CONTAINMENT

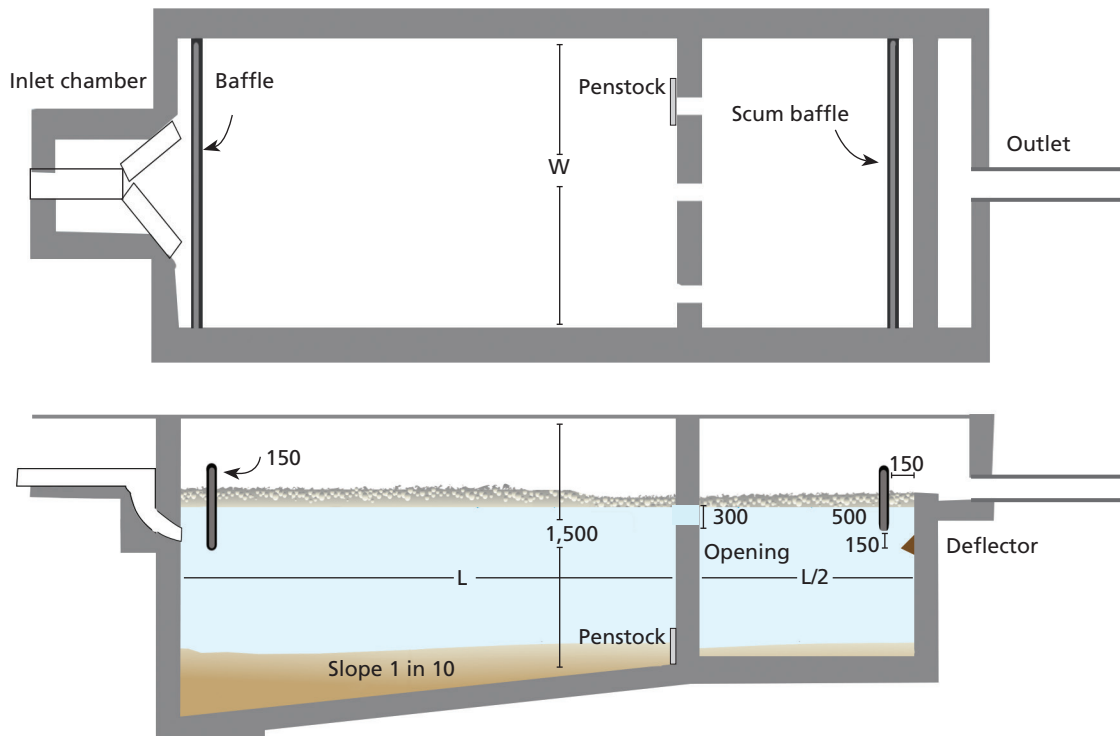
Containment system, to which toilet is connected to, helps in restricting the human interaction with excreta either through offsite sanitation system like underground drainage network or through onsite sanitation system like septic tank, refer *Figure 3: Type of containment system*. In Uttar Pradesh, CSE team found various types of systems in place, which are modifications of septic tank, as prescribed by Bureau

of Indian Standards, refer *Figure 4: Standard septic tank design*. Due to unplanned growth in urban areas and minimal enforcement of building bye-laws the designs implemented on ground are a prerogative of the households and masons. To reduce the frequency of emptying, households prefer to build tanks as big as possible and leave the bottom of the tank open.

**Figure 3: Type of containment system**



**Figure 4: Standard septic tank design**



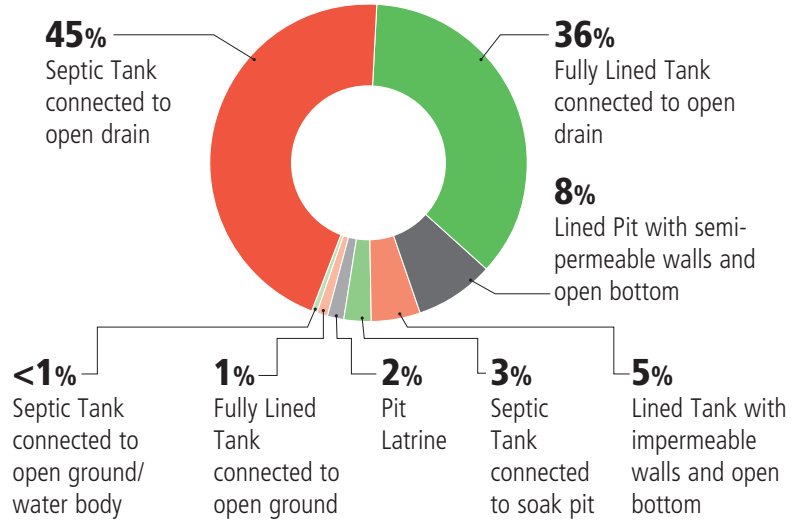
All measurements in millimetres (mm)

Source: Manual on Sewerage and Sewage Treatment—Part A: Engineering. CPHEEO, 2012

**THESE CONTAINMENT SYSTEMS GENERATE TWO TYPES OF BY-PRODUCTS:**

- (i) **Faecal sludge**, that should be emptied periodically but is only emptied when the tank gets full and there is a backflow to the toilet
- (ii) **Effluent**, the semi-treated liquid component, which ideally should be infiltrated into ground through a soak-pit (in case of low risk of ground water pollution) or undergo further treatment, but is discharged into open drains

**Figure 5: Break up of containment systems**



**Septic tank connected to open drain**



**Fully lined tank under construction**



**Outlet of a containment discharging into open drain**

# EMPTYING

The process of extracting faecal sludge/septage from onsite sanitation systems is known as emptying. It is done both mechanically and manually. The Prohibition of Employment of Manual Scavengers and their Rehabilitation Act, 2013 prohibits employment or engagement of manual scavengers, however in many locations in U.P., which are inaccessible to mechanical emptying, manual scavenging is prevalent.

Other than manual emptying, mechanized methods include use of vacuum trucks or tractor-mounted vacuum tankers. Mechanized systems are usually accompanied by a driver and a helper (sometimes two helpers). No personal protective equipment (PPE) is used by the operators while emptying the tanks or pits, posing a serious health risk.

There is no schedule of emptying maintained in any of the cities, and the user calls for an emptying service only when the tanks get full with sludge. This service is majorly provided by private operators but in some cities government trucks also ply. The majority of the personnel involved in emptying business, belong to a particular caste and there is a notion that people from that caste, who were initially involved in manual scavenging, would only do this job. In many cities safai karamcharis, contracted with the government, would also end up doing manual scavenging to earn quick money. Fees charged for emptying, ranges from INR 500 to 3000 across the state, and in general a tanker does 1-3 trips per day. Break up of emptiers is shown in *Figure 6: Type of emptying*.

**Mechanical emptying of containment system**

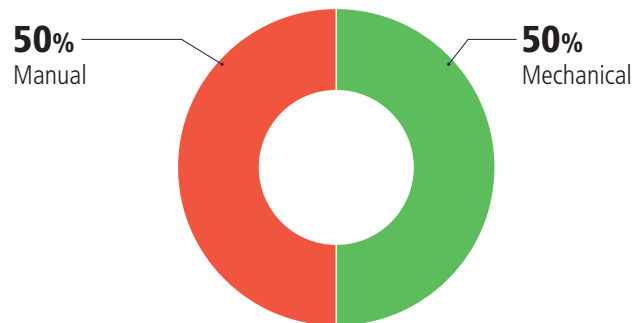




### THE PROHIBITION OF EMPLOYMENT AS MANUAL SCAVENGERS AND THEIR REHABILITATION ACT, 2013

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

Figure 6: Type of emptying



Emptying of a pit latrine



Softening of sludge through stick for emptying

# TRANSPORT

Faecal sludge/septage and waste water/sewage both need to be transported to the treatment/disposal site. Sewage is conveyed using underground drainage network also called sewerage network. In absence of sewerage network, the septic tank's effluent (supernatant) along with grey water, finds its way into storm water drains/open drains/nullahs. On the other hand, the emptied faecal sludge is collected in a container installed on a vehicle to transport it to the designated site of disposal.

In case of manual emptying a cycle cart is used to transport faecal sludge. Whereas for mechanized emptying, tractors, mini trucks and indigenously developed vehicles mounted with suction pumps are predominantly used. Two main types of vehicles used are shown in *Figure 7: Two types of vehicles prominent in Uttar Pradesh*. The capacities of tanks attached to vehicles vary from 500 to 10,000 litres. Break up of types of vehicle prominent in Uttar Pradesh is given in *Figure 8: Types of vehicles used*

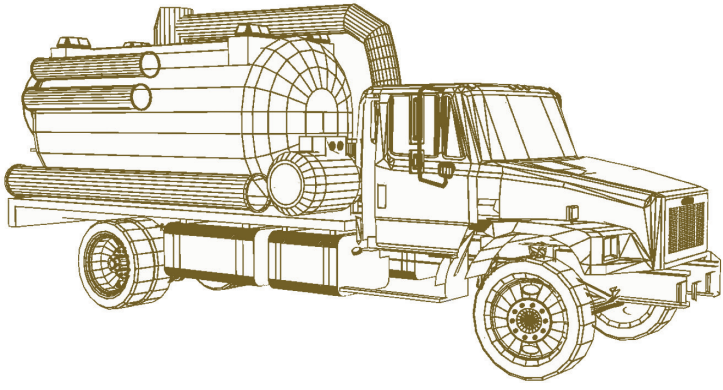
*Suction cum sewer jetting machine*



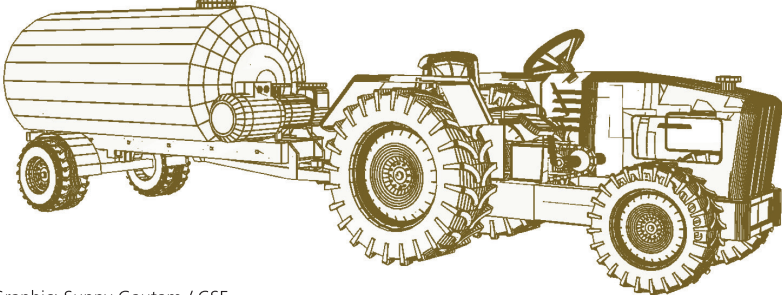
*Tractor mounted vacuum tanker*

Figure 7: Two types of vehicles prominent in Uttar Pradesh

A truck-mounted vacuum tanker



Tractor-mounted vacuum tanker

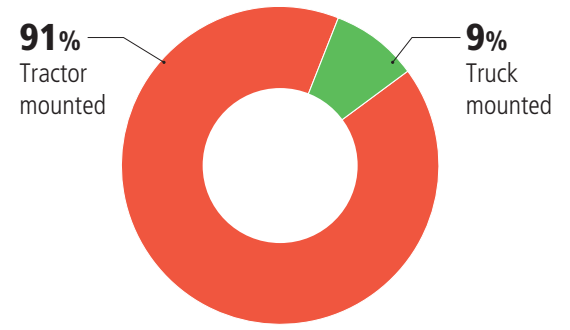


Graphic: Sunny Gautam / CSE

Government owned vacuum tanker



Figure 8: Types of vehicles used



Household discharging wastewater directly into nullah



# TREATMENT AND DISPOSAL

Wastewater, faecal sludge and supernatant, all three should be properly treated and/or safely disposed for improved sanitation. Though, faecal sludge is most concentrated of all, its treatment is not given due attention in the state. It's often disposed of untreated in storm-water drains, nullahs, canals, vacant plots, and agricultural fields.

Sewage and supernatant with or without treatment end up into lakes and rivers of the State. Many at times the untreated faecal sludge also finds its way into the water bodies, as the operator dumps the faecal sludge to the

nearest drain/nullah from the site of emptying. There is no regulation in place to restrict the uncontrolled dumping of faecal sludge in and around the cities.

Jhansi is the first city in UP to implement faecal sludge treatment plant, which was recently commissioned, as the authorities realised that laying down of sewerage network was not possible due to rocky strata. Despite treatment plant in place, due to lack of regulation, there is no binding to the truck operator to dispose the collected sludge in the treatment plant and hence uncontrolled dumping is still observed.



*Wastewater treatment plant*

*Faecal sludge treatment plant, Jhansi*

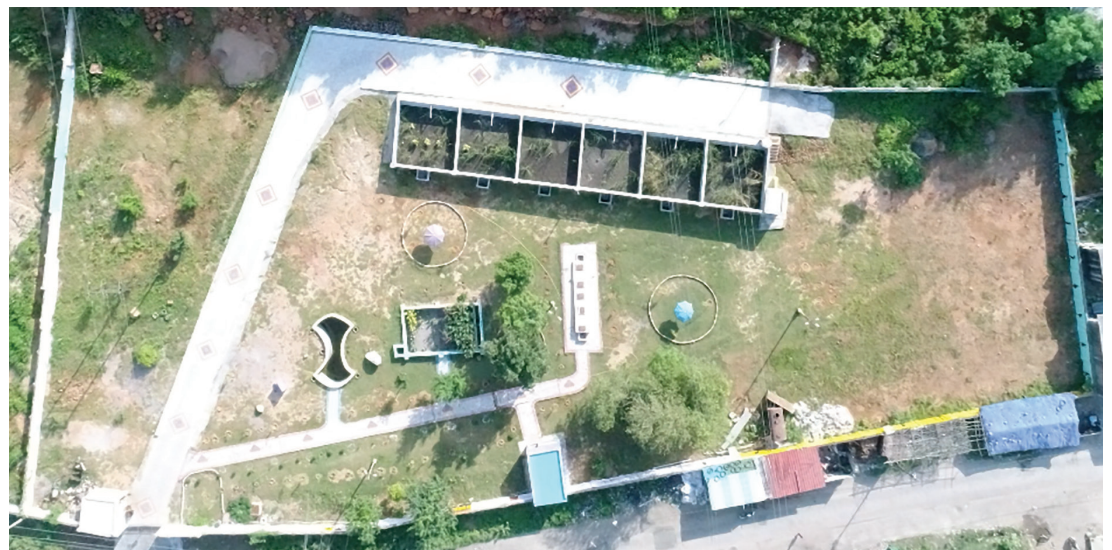
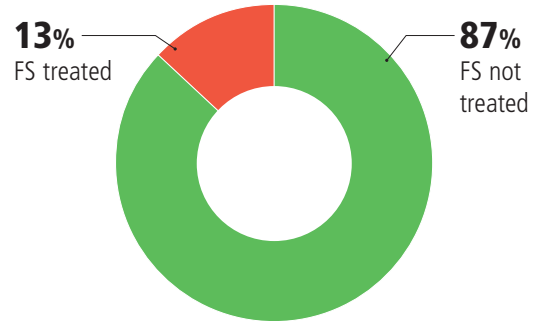
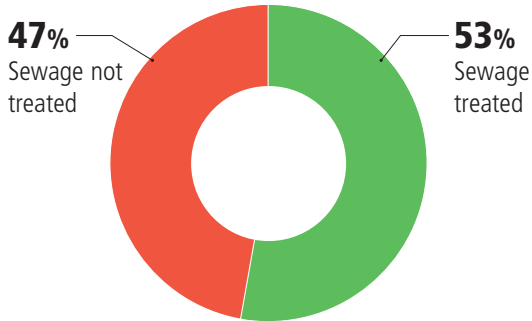


Figure 8: Pie charts showing WW treated and FS treated



Faecal sludge discharged on land



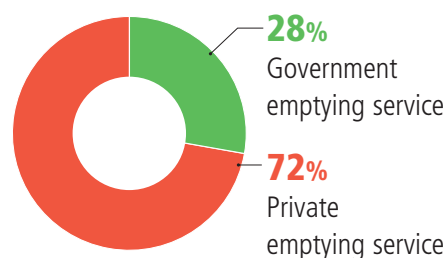
Faecal sludge discharged in open drain

# CITIES WITH POPULATION OF MORE THAN 10 LAKH

## CHARACTERISTICS OF THE CLUSTER

- Around **44% population is dependent on centralized sewerage** system, but wastewater of only 28% is safely treated
- **32% population dependent on tanks connected to open drains**
- In absence of scheduled desludging, only **40-50% of FS generated** gets emptied, rest remains in the tank and reduces the treatment efficiency of the septic tank
- There are **38 STPs with cumulative capacity** of 1560 MLD which receive 1265 MLD of sewage as on date
- More than **30 private operators** are registered with local bodies
- As a preliminary measure Allahabad, Meerut and Lucknow have allowed the discharge of collected faecal sludge to its pumping stations and Kanpur allows it to be directly discharged into its STP.
- The FS collected by unregistered operators is disposed in drains/ fields/ponds

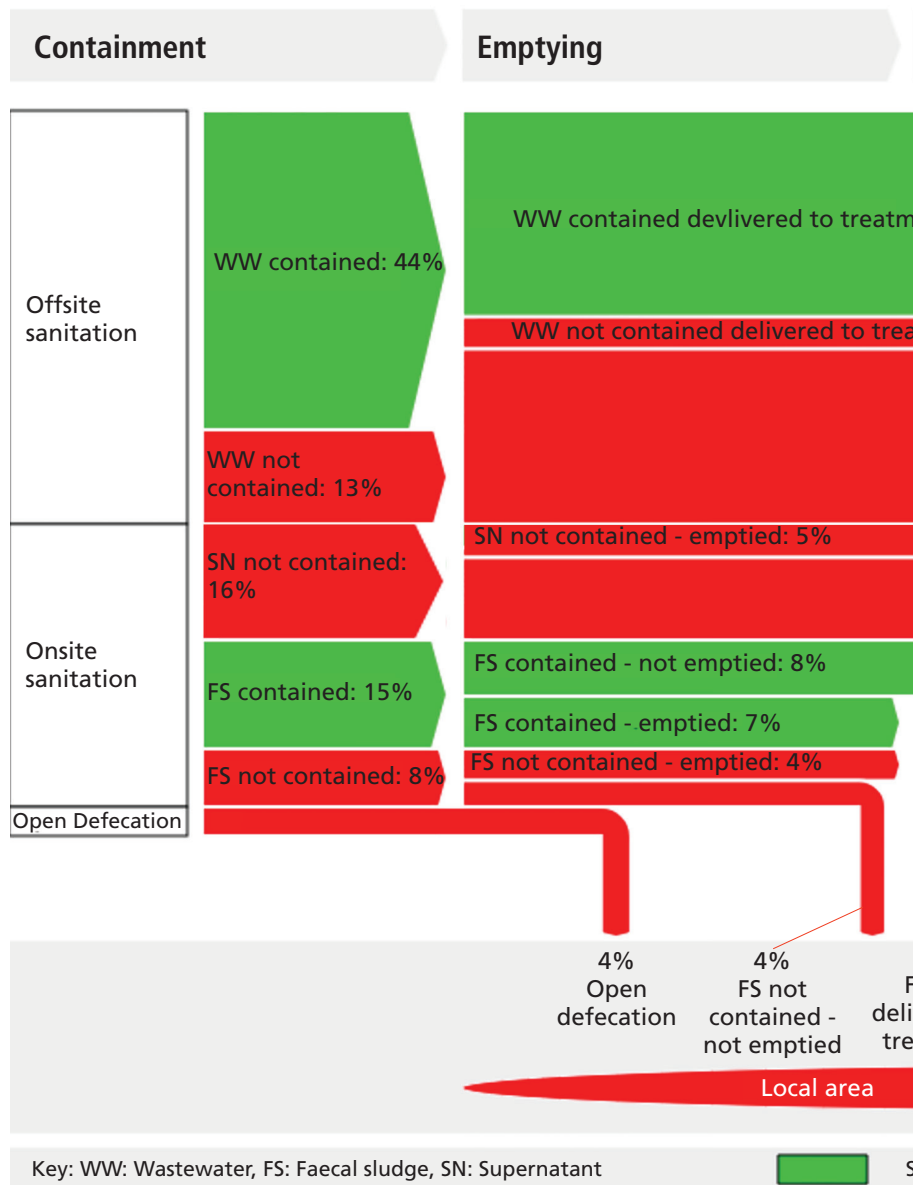
## Vehicles plying in the cluster



## Cluster 1, Uttar Pradesh, India

Version: Draft

SFD Level: 2 - Intermediate SFD





**Target towns / cities under programmes**

City	Population	FS collected based on current demand (in KLD)	FS generated in KLD (based on once in 3 years emptying)
Allahabad	11,12,544	72	223
Varanasi	11,98,491	22	246
Aligarh	8,89,408	84	346
Meerut	13,05,429	230	370
Kanpur	27,65,348	320	388
Lucknow	28,17,105	350	673
Agra	18,74,542	260	479
<b>Total</b>	<b>1,19,62,867</b>	<b>1,338</b>	<b>2,725</b>

Date prepared: 16 October 2018

Prepared by: CSE

**EXPLANATION OF SFD**

**39%** of the population is dependent on onsite sanitation systems like septic tanks and pits, 30% of which have correctly designed systems, but excreta of roughly 16% is managed

**Around 12%** population never gets their tanks emptied or get them emptied only after 15-20 years

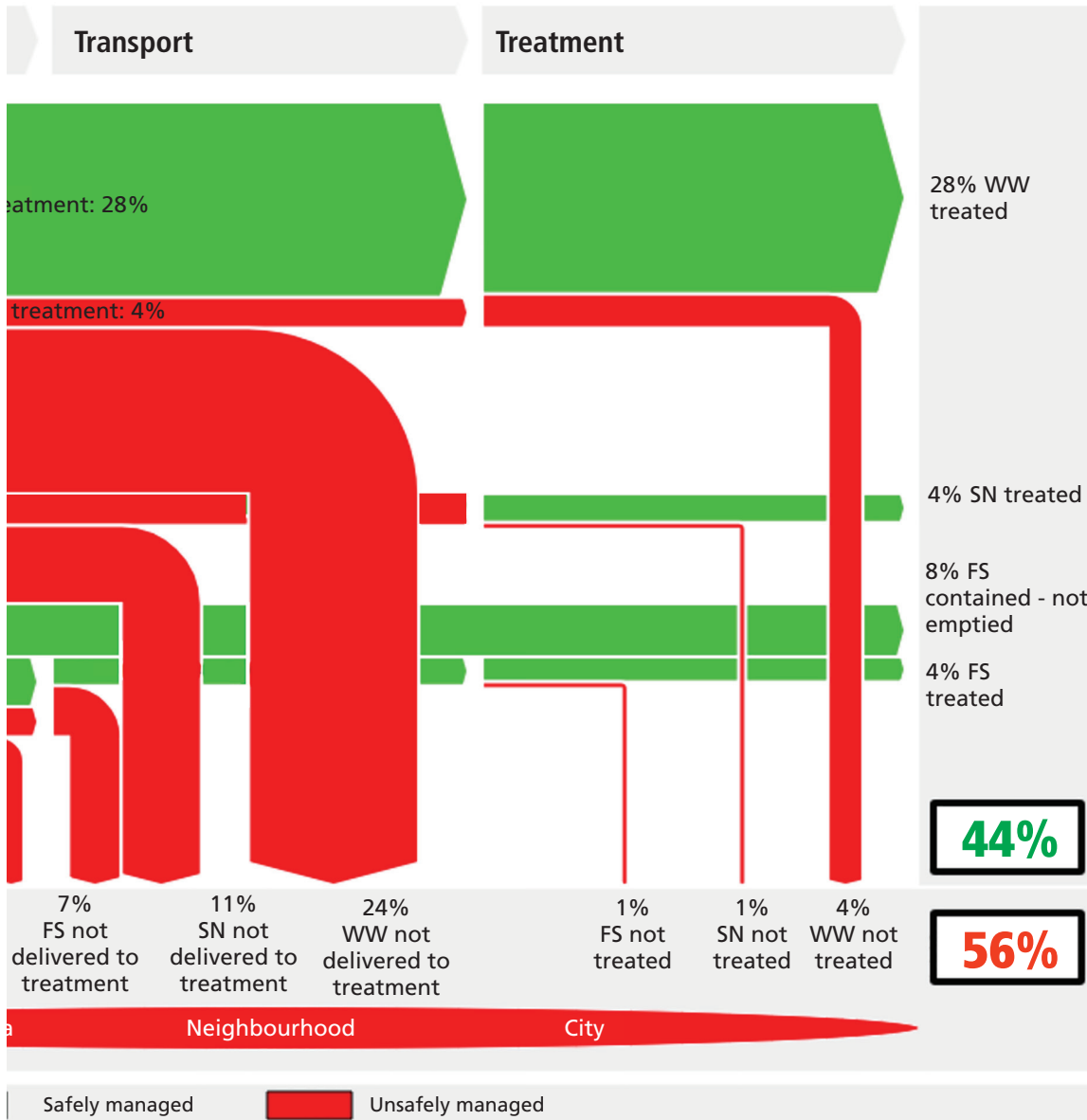
**4%** population still defecates in open

**8%** 'FS contained -not emptied' only means that sludge is safely contained in lined systems which are not emptied for long time

**4%** SN treated denotes that some drains are being tapped to treat the liquid waste.

**4%** FS treated denotes that either it is getting discharged into drains that gets tapped or it is discharged into sewerage system and gets co-treated with sewage at STP

**Overall excreta of 44%** population is being managed despite inefficient emptying and transport

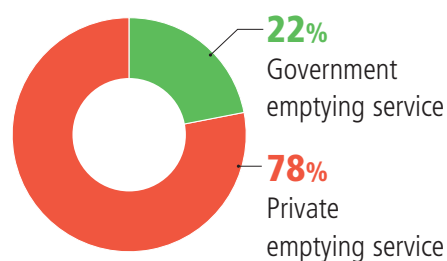


# CITIES WITH POPULATION BETWEEN 5 AND 10 LAKH

## CHARACTERISTICS OF THE CLUSTER

- More than **70% population is dependent** on tanks connected to open drain and roughly half of them qualify to be called as septic tanks
- In absence of scheduled desludging, only **30% of FS generated gets emptied**, rest remains in the tank and reduces the treatment efficiency of the septic tank
- **40% of the vacuum tankers are truck** mounted rest all are tractor mounted
- Due to inaccessible tanks, **manual emptying is rampant**
- There are **4 STPs of cumulative capacity of 133 MLD** which receives only 81 MLD sewage and 1 FSTP of 6 KLD, which receives around 3KLD as on date
- Only **Jhansi has a designated disposal site**, in rest of the cities the collected faecal sludge is disposed in drains/fields/ponds

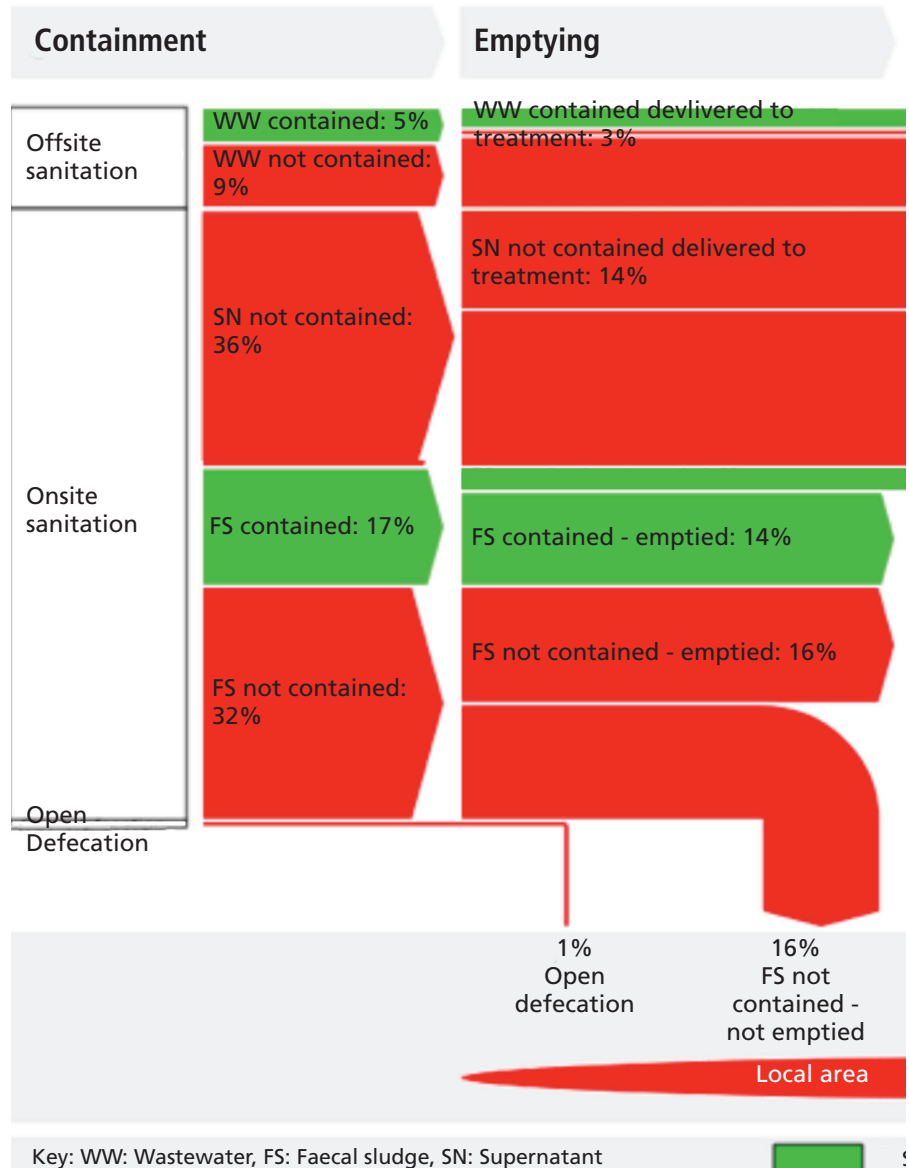
## Vehicles plying in the cluster



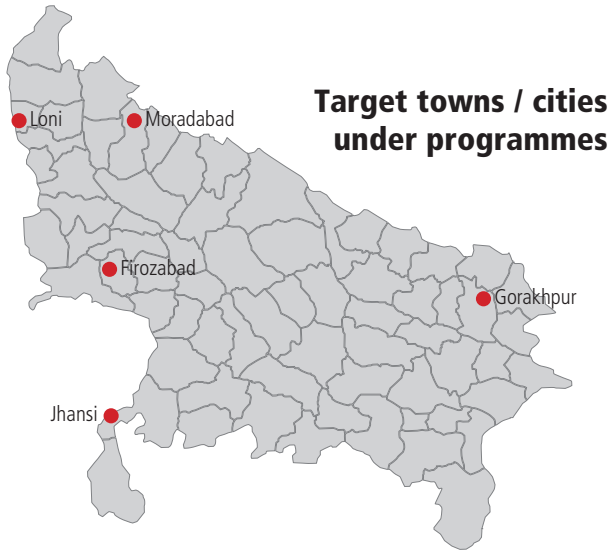
## Cluster 2, Uttar Pradesh, India

Version: Draft

SFD Level: 2 - Intermediate SFD



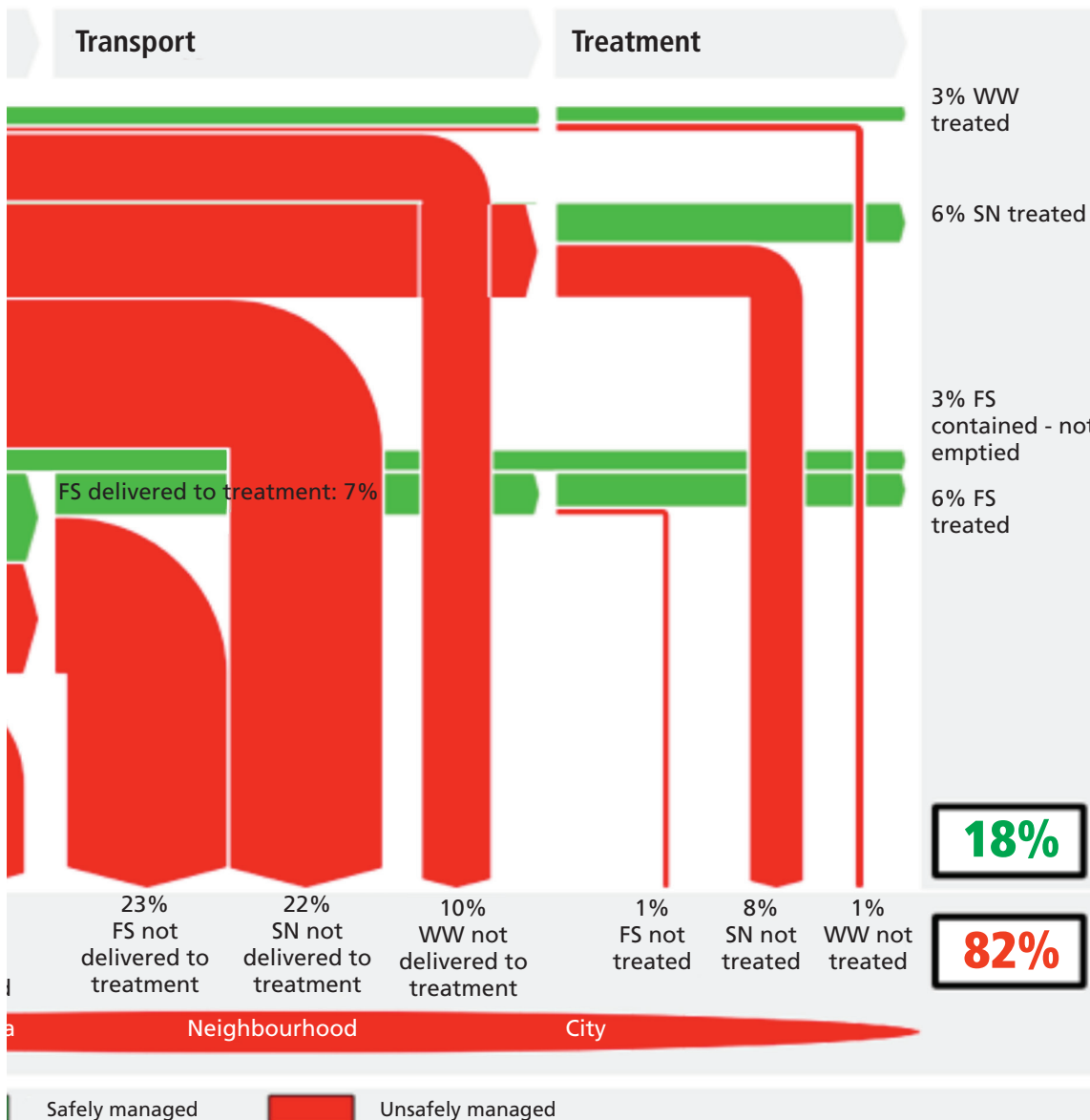




City	Population	FS collected based on current demand (in KLD)	FS generated in KLD (based on once in 3 years emptying)
Jhansi	5,07,293	10	222
Firozabad	6,03,797	55	242
Moradabad	8,87,871	243	478
Gorakhpur	6,73,446	120	314
Loni	5,16,082	50	235
<b>Total</b>	<b>31,88,489</b>	<b>474</b>	<b>1,491</b>

Date prepared: 15 October 2018

Prepared by: CSE



### EXPLANATION OF SFD

**14%** of the population is dependent on offsite sanitation systems, 5% of which are connected to sewerage network but excreta of only 3% is managed through STPs

**85%** of the population is dependent on onsite sanitation systems like septic tanks and pits, 34% of which have correctly designed systems, but excreta of roughly 15% is managed.

**Around 20%** population never gets their tanks emptied or get them emptied only after 15-20 years

**1%** population still defecates in open

**6% SN and 6% FS** treated denotes that a lot of drains are being tapped to treat the liquid waste. As a lot of times the collected FS is dumped in drains, the FS also gets for treatment

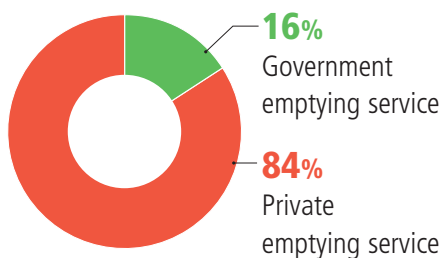
**Overall excreta of 18%** population is being managed despite inefficient emptying and transport

# CITIES WITH POPULATION BETWEEN 1.2 AND 5 LAKH

## CHARACTERISTICS OF THE CLUSTER

- More than **60% population** is dependent on tanks connected to open drain and 28% of them qualify to be called as septic tanks
- In absence of scheduled desludging, only **40-50% of FS generated gets emptied**, rest remains in the tank and reduces the treatment efficiency of the septic tank
- 94% of the vacuum tankers are tractor mounted rest are truck mounted
- Due to inaccessible tanks, manual emptying is rampant
- There is only 1 STP of 12 MLD in Ayodhya which receives only 6 MLD sewage as on date
- There is no designated disposal site for the collected faecal sludge hence it is disposed in drains/fields/ponds

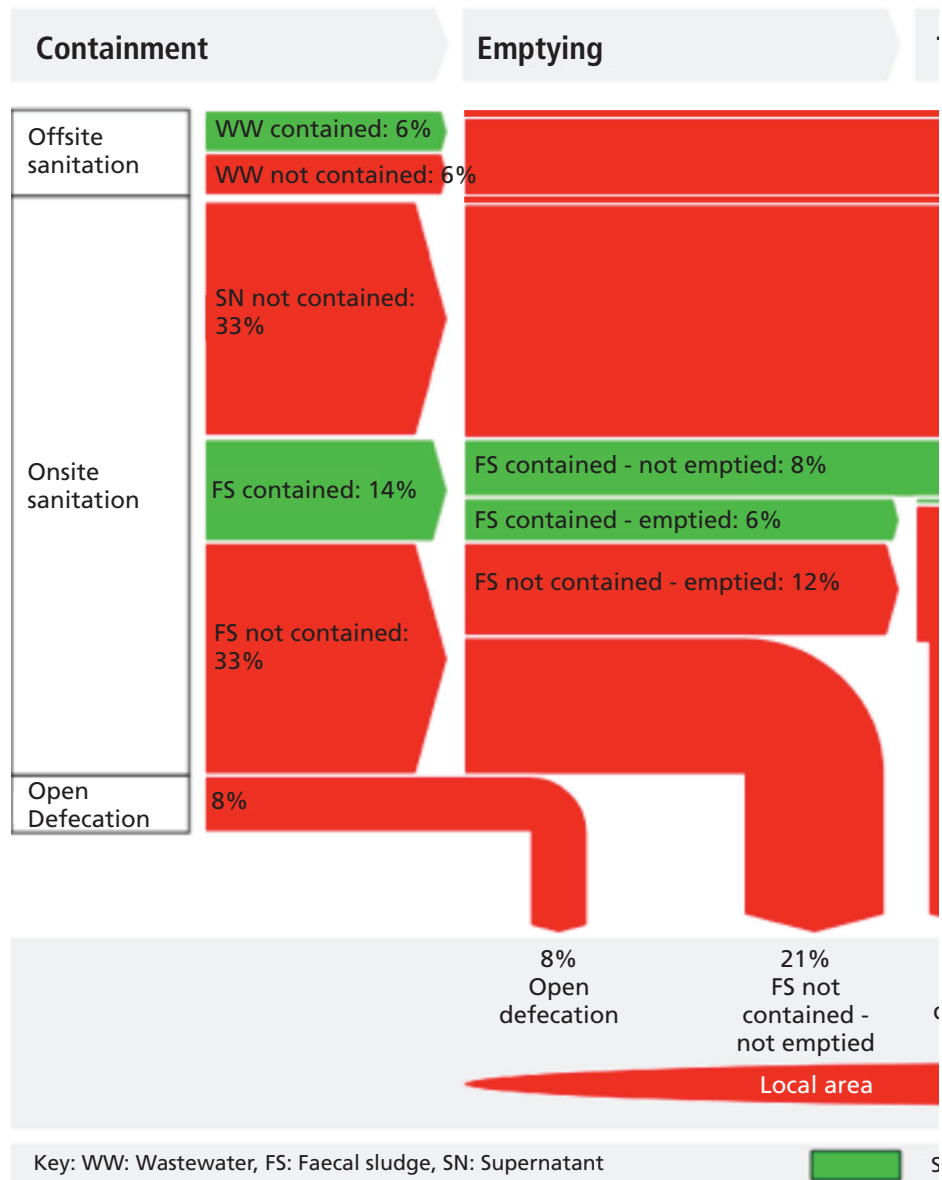
## Vehicles plying in the cluster

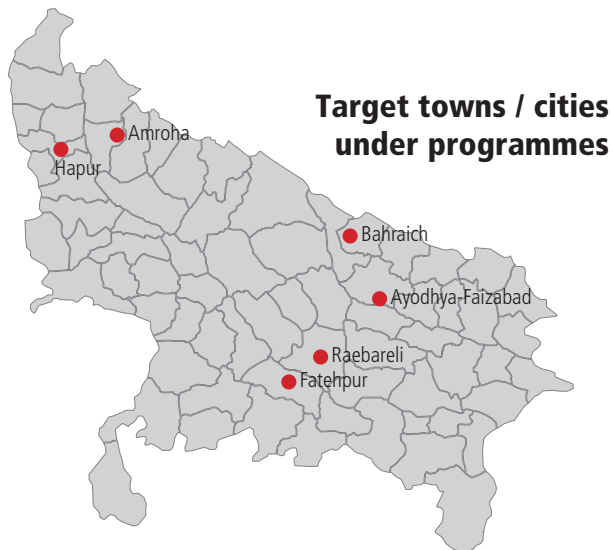


## Cluster 3, Uttar Pradesh, India

Version: Draft

SFD Level: 2 - Intermediate SFD





City	Population	FS collected based on current demand (in KLD)	FS generated in KLD (based on once in 3 years emptying)
Bahraich	1,86,223	30	74
Raebareli	1,91,316	40	65
Fatehpur	1,93,193	40	101
Amroha	1,98,471	78	109
Ayodhya-Faizabad	2,21,118	40	95
Hapur	2,62,983	58	107
<b>Total</b>	<b>12,53,304</b>	<b>286</b>	<b>551</b>

Date prepared: 16 October 2018

Prepared by: CSE

### EXPLANATION OF SFD

**12%** of the population is dependent on offsite sanitation systems, 6% of which are connected to sewerage network but excreta of only 1% is managed through STP

**80%** of the population is dependent on onsite sanitation systems like septic tanks and pits, 28% of which have correctly designed systems, but excreta of roughly 9% is managed

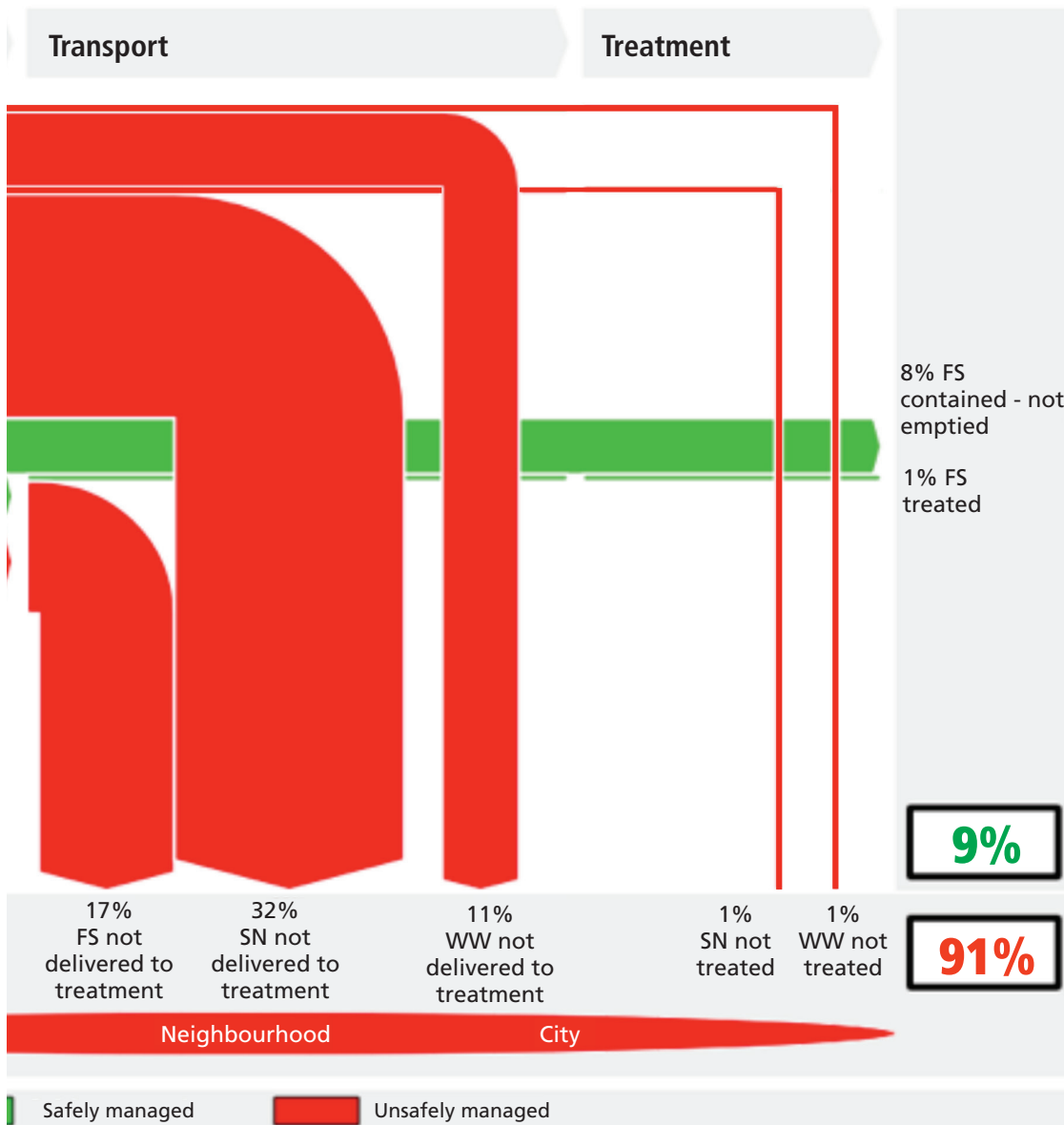
**Around 27%** population never gets their tanks emptied or get them emptied only after 15-20 years

**8%** population still defecates in open

**8%** 'FS contained -not emptied' only means that sludge is safely contained in lined systems which are not emptied for long time

**1% SN and 1% FS** treated denotes that some drains are being tapped to treat the liquid waste. As a lot of times the collected FS is dumped in drains, the FS also gets treated

**Overall excreta of 9%** population is being managed despite inefficient emptying and transport

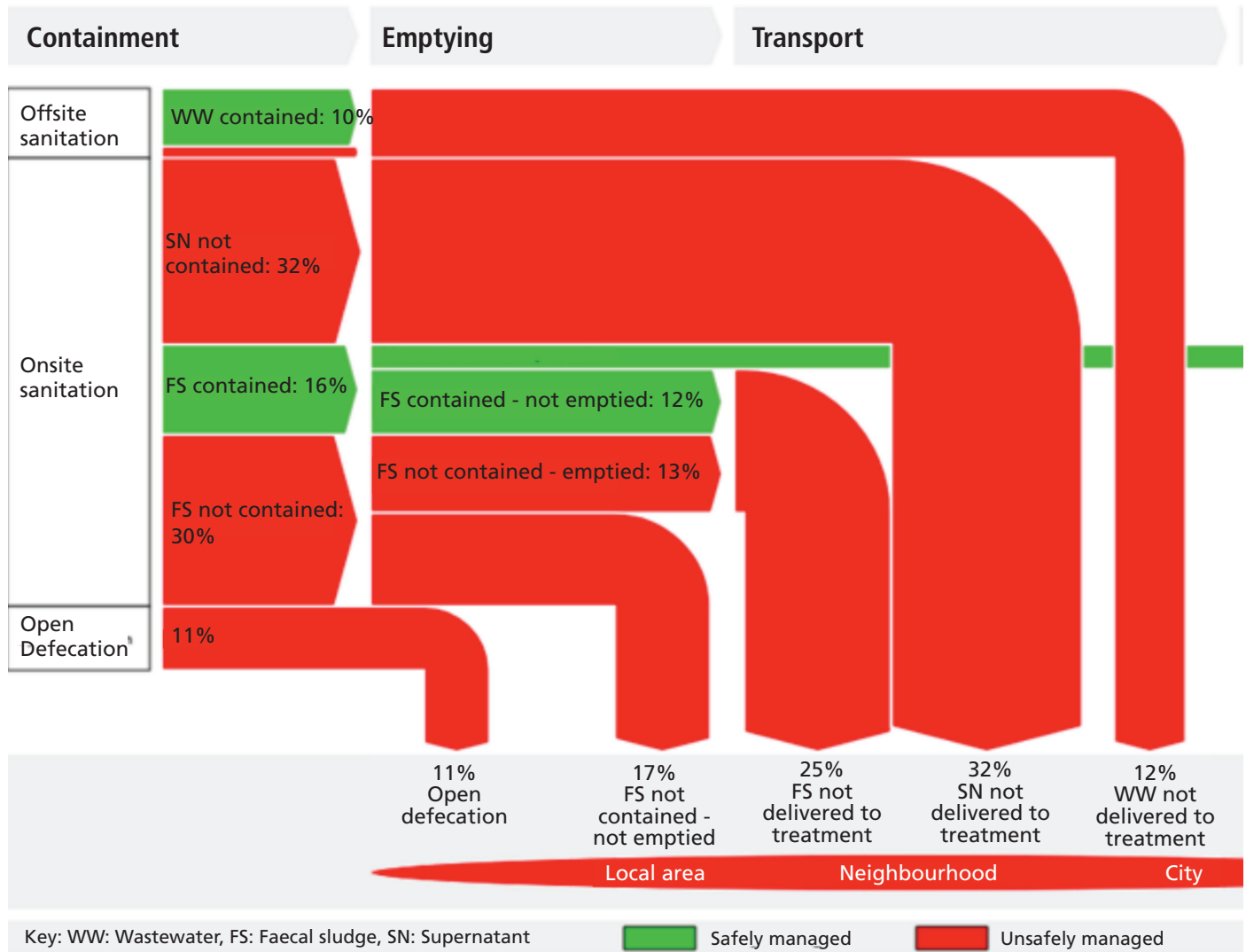


# CITIES WITH POPULATION LESS THAN 1.2 LAKH

## Cluster 4, Uttar Pradesh, India

Version: Draft

SFD Level: 2 - Intermediate SFD



### CHARACTERISTICS OF THE CLUSTER

- More than **60% population is dependent** on tanks connected to open drain and roughly half of them qualify to be called as septic tanks
- **Ramnagar, Chandousi and Baraut have some kind of sewerage network**, but there is negligible treatment of waste water
- Quite a few households don't even have an open drains in their neighbourhood
- In absence of scheduled desludging, **only 50% of FS generated gets emptied**, rest remains in the tank and reduces the treatment efficiency of the septic tank
- **95% of the vacuum tankers are tractor mounted**
- Due to inaccessible tanks, manual emptying is rampant
- Except Bijnor no other city has any sewage treatment plant, **24 MLD STP at Bijnor is yet to be commissioned**

Date prepared: 16 October 2018  
Prepared by: CSE

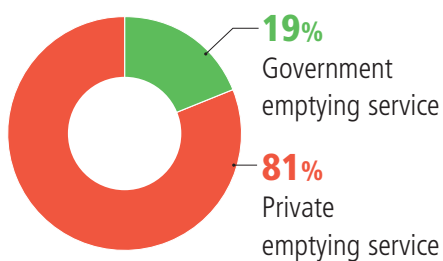
**Treatment**

4% FS contained - not emptied

**4%**

**96%**

**Vehicles plying in the cluster**



**Target towns / cities under programmes**



City	Population	FS collected based on current demand (in KLD)	FS generated in KLD (based on once in 3 years emptying)
Saidpur	24,338	3	11
Hastinapur	26,452	3	11
Chunar	37,185	4.5	15
Ramnagar	49,132	4.5	4
Gangaghat	84,072	6	39
Bijnor	93,297	12	49
Baraut	1,03,764	32	51
Balia	1,04,424	34	35
Shikohabad	1,07,300	10	43
Deen Dayal Upadhyay (Mughalsarai)	1,09,650	34	48
Chandousi	1,14,383	50	53
Basti	1,14,657	38	50
<b>Total</b>	<b>9,68,654</b>	<b>231</b>	<b>409</b>

**EXPLANATION OF SFD**

**12%** of the population is dependent on offsite sanitation systems, 10% of which are connected to sewerage network but collected wastewater is disposed untreated

**77%** of the population is dependent on onsite sanitation systems like septic tanks and pits, 16% of which have correctly designed systems, but excreta of roughly 4% is managed, as it is stored safely in lined structures

**Around 20%** population never gets their tanks emptied or get them emptied only after 15-20 years

**11%** population still defecates in open

**Overall excreta of 4%** population is being managed despite inefficient emptying and transport

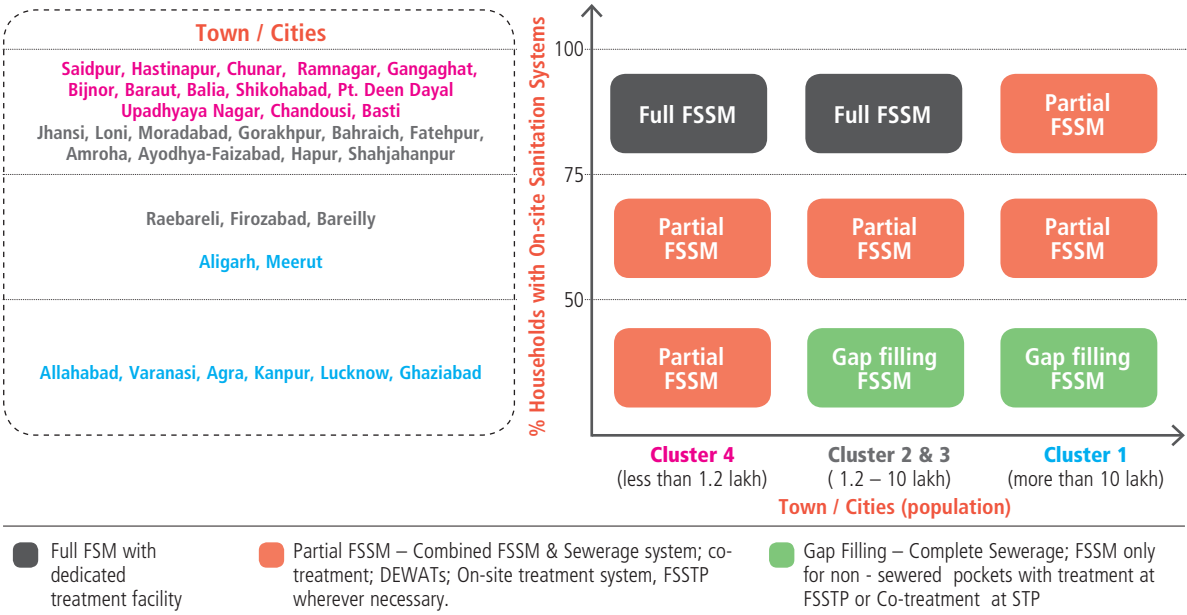
# PROPOSED ACTION PLAN FOR CITIES

Category	Actions	Year 1				Year 2			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>CLUSTER 1</b> > 10 Lakh population	A1	█	█						
	A2	█	█	█					
	A4	█	█	█	█	█			
	A3 + A6 + A13			█	█	█			
	A7 + A9				█	█	█	█	█
	A8	█	█	█	█	█	█	█	█
	A10 + A15						█	█	█
	A11						█	█	█
	A12 + A14	█	█	█	█	█	█	█	█
<b>CLUSTER 2 &amp; 3</b> 1.2 - 5 Lakh population and 5 - 10 Lakh population	A1	█	█	█					
	A2	█	█	█	█				
	A4	█	█	█	█	█	█		
	A3 + A5 + A6 + A13				█	█	█		
	A7 + A9					█	█	█	█
	A8	█	█	█	█	█	█	█	█
	A10 + A15 + A16								█
	A11							█	█
	A12 + A14	█	█	█	█	█	█	█	█
<b>CLUSTER 4</b> < 1.2 Lakh population	A1	█	█						
	A2	█	█	█					
	A4		█	█	█	█	█	█	
	A3 + A5 + A13			█	█	█			
	A7 + A9				█	█	█	█	█
	A8	█	█	█	█	█	█	█	█
	A10 + A15 + A16								█
	A11								█
	A12 + A14	█	█	█	█	█	█	█	█

- A1:** Baseline data collection and formation of City Sanitation Task Force
- A2:** Preparation of city - level strategy on Faecal Sludge and Septage Management including decentralised liquid waste management
- A3:** Regulating & licensing of private desludgers and installation of GPS devices in each vacuum tanker (ULB-owned and private)
- A4:** Preparation of Citywide Sanitation Plan
- A5:** Identification, construction and designation of trenching sites for safe disposal of faecal sludge, till the time scientifically - designed treatment plant is in place
- A6:** Operationalising co-treatment at existing STP and/or co-composting with municipal solid waste wherever feasible for safe treatment of collected FSS
- A7:** Construction and commissioning of faecal sludge treatment plants with effective reuse of bye-products (wherever feasible) for safe management of all the collected FSS
- A8:** Capacity building programme for ULB, service providers, masons, operators etc.
- A9:** Ensure adequate manpower and efficient equipment for collection and transport of FSS
- A10:** Implement scheduled desludging, initially on a pilot-scale and eventually extending across the city
- A11:** Operationalise decentralised wastewater treatment systems for the effluent generated from onsite sanitation systems and greywater
- A12:** All households with individual toilet in non - sewerred areas to have safe onsite sanitation system
- A13:** Incorporate FSS co-treatment modules in the STPs which are in planning/designing/construction phase
- A14:** Conduct GIS survey for geo-tagging of all properties in the city
- A15:** Ensure enforcement of 'The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013' and provisions for penalising the defaulters
- A16:** Gap analysis and construction & commissioning of FSTP(s) for safe management of all the generated FSS , in conjunction with the implementation of scheduled desludging

Year 3				Year 4				Year 5			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

### PROPOSED FSSM APPROACH FOR URBAN AREAS IN UTTAR PRADESH



# FORUM OF CITIES THAT MANAGE SEPTAGE

The 2017 National Policy on Faecal Sludge and Septage Management provides specific milestones for states and urban local bodies. Under its directives, each state and city in the country needs to formulate its own FSSM strategy and integrate it in their respective state/city sanitation plans.

CSE is working with cities in the state to support them on effective septage management. As part of this initiative, it has launched the Forum of Cities that Manage Septage to recognise those urban local bodies which have achieved some progress on FSSM, and to channelize all the initiatives and efforts in a more organized and sustainable form.

## Key Objectives of the Forum

- Developing a knowledge exchange platform for participating cities
- Training and capacity building on interventions across the sanitation chain and citywide sanitation
- Tracking and assessing the progress of cities
- Identifying 'pioneer cities' which can then handhold other cities on technical, economic and social aspects of FSSM and for preparing City Sanitation Plans
- Collating feedback and inputs from Forum cities and providing policy relevant information to state governments and Centre on FSSM
- Documentation of best practices



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