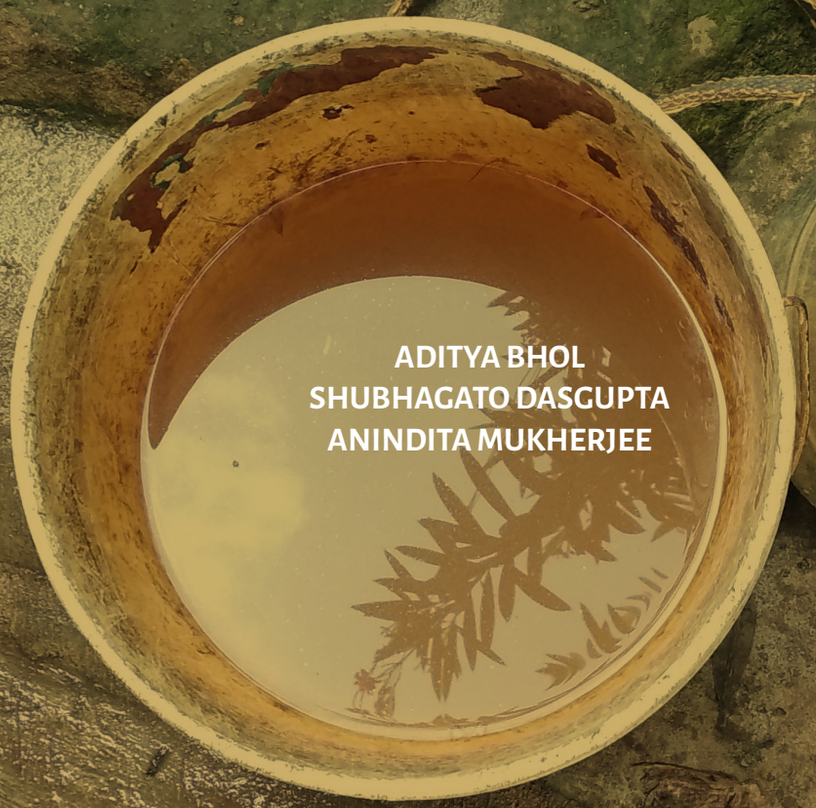
RESEARCH REPORT

PERCEPTIONS:

UNDERSTANDING ON-SITE SANITATION SYSTEM CHOICES IN LARGE DENSE VILLAGES IN INDIA



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SCI-FI SANITATION
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POLICY RESEARCH

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The authors alone remain responsible for any errors and omissions in the present work.

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ABSTRACT

This report aims to explore the nuances of the prevalence of on-site sanitation systems in large and dense villages of India. Villages which have a population of 1000 persons or more and a density of greater than or equal to 400 persons per square kilometre were classified as large and dense villages in earlier research – *Towards a New Research and Policy Paradigm: An Analysis of the Sanitation Situation in Large Dense Villages*. Stimulated by the findings revealing a preferential pattern for selection of on-site sanitation systems in these settlements, a primary household survey was conducted in large and dense villages from five Indian states - Himachal Pradesh, Punjab, West Bengal, Madhya Pradesh and Tamil Nadu. The survey also included qualitative components – stakeholder interviews and transect walks. In this study the survey data has been canvassed to explore the preference patterns of households and the factors guiding them in their decision making for the construction and maintenance of on-site sanitation systems. We find that these large and dense villages exhibit a higher preference for septic tanks over pits in all states except West Bengal where pits are preferred. A majority of households have reported their toilets were private constructions. Broad findings and trends emerging from the survey were discussed in details in the report – *Sanitation in Large and Dense Villages of India: The Last Mile and Beyond*. In this report we discuss targeted questions on the preference patterns for on-site containment systems that are manifested not only by the choices of building septic tanks or pits but also through the large variations in their design and sizes which are influenced by socio-economic, technical and behavioural factors. We also find specific trends in deviations from prescribed design and demand for desludging services by households which are influenced by internal factors such as their social status and economic well-being and by external factors such as availability of mechanised operators or continued reliance on manual cleaning and their costs which cumulatively constitute the supply side of sanitation services.

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LIST OF ABBREVIATIONS

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
CT	Census Town
FSM	Faecal Sludge Management
GWS	Ground Water Sources
IHL	In-house Latrine
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
LDV	Large and Dense Villages
lpcd	Litres Per Capita/ Day
MPCE	Monthly Per Capita Expenditure
NARSS	National Annual Rural Sanitation Survey
OBC	Other Backward Classes
OD	Open Defecation
ODF	Open Defecation Free
OSS	On-Site Systems / On-site Containment Systems
PT/CT	Public Toilet/Community Toilet
SBM	Swachh Bharat Mission
SC/ST	Scheduled Caste/Scheduled Tribe
ST	Statutory Town
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
UIG	Urban Infrastructure and Governance
TSC	Total Sanitation Campaign

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INTRODUCTION

India's urbanisation level as reported by the Census in 2011 was at 31.16 percentage with 377 million people residing in urban areas. Besides the addition of 2744 new towns, urbanisation has involved area expansion, population growth and migration to urban centres. However, the increase in number of statutory towns[1] has only been by 242 newly classified towns compared to Census 2001. Contrastingly, the growth in number of census towns (CTs)[2] has been 2502 from Census 2001 to 2011 bringing their numbers up to 3894 in 2011. A total of 54 million people reside in these census towns which despite their classification as urban areas by the census of India are essentially large and dense villages with urban occupational characteristics and governed as rural areas. Concurrently, the expansion of urban spaces has led to increase in urban agglomerations from 384 in 2001 to 475 in 2011 (Census of India, 2011) which include 981 out-growths. These outgrowth are in whole or part of villages comprising a total of 4 million population. Needless to say, a substantial section of the urbanisation story is explained by villages which are proximate to statutory towns. These administrative divisions have lead differences in sanitation infrastructure between rural and urban areas that needs to be better understood and addressed.

An early effort to understand the sanitation situation within the urbanising pattern in India was undertaken in 2017. The report entitled - Towards a New Research and Policy Paradigm: An Analysis of the Sanitation Situation in Large Dense Villages (Dasgupta et al. 2017) identified and selected a list of large dense villages (LDVs) from Census 2011 (see Methodology) which comprised 3,892 CTs and 1,55,056 villages which account for 41.9 per cent of total population of India. Preliminary analysis of Census 2011 data had revealed a higher prevalence of on-site sanitation systems in CTs at 66 per cent and much lesser open defecation at 18 per cent compared to villages. Taking this analysis forward, an assessment of the sanitation situation in the identified LDVs revealed that they collectively had better sanitation compared to the smaller villages. Moreover, spatial analysis of the identified LDVs revealed that almost 20 per cent of them are within 15 kilometres from Class I cities accounting for 25 per cent of total LDV population and 80 per cent of the LDVs are within 15 kilometres from national highways. It was also seen that there was higher prevalence of on-site sanitation systems (OSS) in LDVs which are proximate to cities with evidently higher access to piped water supply. State-wise assessment of sanitation in LDVs helped make distinctions between states like Kerala which had high LDV population share and a high percentage of septic tanks and West Bengal which despite its high population share of LDVs had very low prevalence of septic tanks and other states. Similarly, other contrasting observations were made which underscored the need for a primary survey in LDVs given the absence of details of OSS in census and other data sources. One of the underlying objectives of conducting a primary survey was to understand the variations in OSS design and volumes and perceptions influencing their prevalence through a cross-sectional analysis involving socio-economic and infrastructural characteristics of households in LDVs.

This report uncovered the need to better understand the drivers for the choice of sanitation infrastructure at the household level as it determines the requirements of associated environmental infrastructure needed for safely managing sanitation waste. Subsequently, a primary household survey and key informants' interview were conducted in 5 states across 15 districts (3 from each state) covering 60 LDVs. The household survey was conducted in Punjab, Himachal Pradesh, West Bengal, Madhya Pradesh and Tamil Nadu covering a total of 3,112 households. Details of the survey methodology are provided in the subsequent section. The survey commenced from November 2018 and ended in January 2019 and subsequently a white paper was published in March 2019 titled – Sanitation in Large and Dense Villages of India: The Last Mile and Beyond (Bhol et. al, 2019).

The second report furnished the details and broad findings of survey following a fairly detailed assessment of sanitation infrastructure and services. It also included a comprehensive account of the stakeholder interviews. The analysis comprised a detailed account of toilets and OSS construction, details of OSS found in households and desludging of these containment systems. A cross-sectional analysis was also made based on access to other infrastructure such as water supply for supplementary use and drainage along with detailed socio-economic analysis to explore trends in type of toilets and preference for OSS across states. The broad findings and emerging trends from the analysis corroborated the gaps in sanitation infrastructure in LDVs which included results on continued lack of toilets in most of LDVs, widespread deviations in design of OSS and poor desludging services. At the same time,

[1] Urban settlements identified by Census of India that have Municipal Corporations, Municipalities, Notified Area Councils, Nagar Parishads, Town Panchayats, etc. as administrative units.

[2] Settlements with population is greater than or equal to 5000, population density is greater than or equal to 400 persons per square kilometre and more than or equal to 75 percent of male population is engaged in non-farm activities. Administratively rural but identified as urban by census.

the report revealed the improvements made during the SBM period and how perceptions of households on OSS were evident through the varying prevalence of septic tanks or pits with design, make and volume variations.

The two LDV reports not only expose the gaps in the sanitation infrastructure and services in rural areas but also highlight key research questions that emerge from their analyses. Observations based on the cross-sectional analyses help us understand the inadequacies of sanitation infrastructure and services based on access to water supply and drainage infrastructure. Socio-economic analysis undertaken in earlier reports stress on the requirement for adequate policy interventions to bridge gaps in access and services. Regarding the predominance of OSS in LDVs and their proximity to cities, the analysis demonstrates shared access to desludging services but a continued lack of treatment. This document attempts to answer some of the questions raised in the earlier reports.

This report focuses on understanding the primary drivers of choice of the onsite systems by households. It also explores the existence and nature of the sanitation value chain starting from access, to collection and transfer of waste in LDVs. It is divided into three main sections following the survey methodology – cross-sectional analysis of sanitation infrastructure and services in survey households, key takeaways from the survey and conclusion which summarises the key findings and proposes future research.

SURVEY METHODOLOGY

As mentioned earlier, following the findings from earlier research – 'Towards a New Research and Policy Paradigm: An Analysis of the Sanitation Situation in Large Dense Villages' – the states of India were broadly categorised into four groups:

- High OSS and high population share of LDVs – Kerala
- Low OSS percentage and high population share of LDVs – UP, Assam, Jammu and Kashmir, Bihar and West Bengal
- High OSS percentage and low population share of LDVs – Himachal Pradesh, Maharashtra, Uttarakhand, Andhra Pradesh, Punjab and Haryana
- Low OSS percentage and low population share of LDVs – Madhya Pradesh, Rajasthan, Odisha, Jharkhand, Odisha, Tamil Nadu, Gujarat and Chhattisgarh

In the first step, states were identified from these categories. The states identified for the survey were Himachal Pradesh, Punjab, West Bengal, Madhya Pradesh and Tamil Nadu. They were selected so to represent different parts of India. The other reason for selection of these states was to have a contrasting representation of states with varying numbers of LDVs and diverging percentages of water and sanitation infrastructure. For this purpose and subsequent district and settlement selection there was meticulous examination of Census and SBM data.

In the next step, three districts were identified from each of the aforementioned states. The key selection

5 STATES

15 DISTRICT (3 FROM EACH STATE)

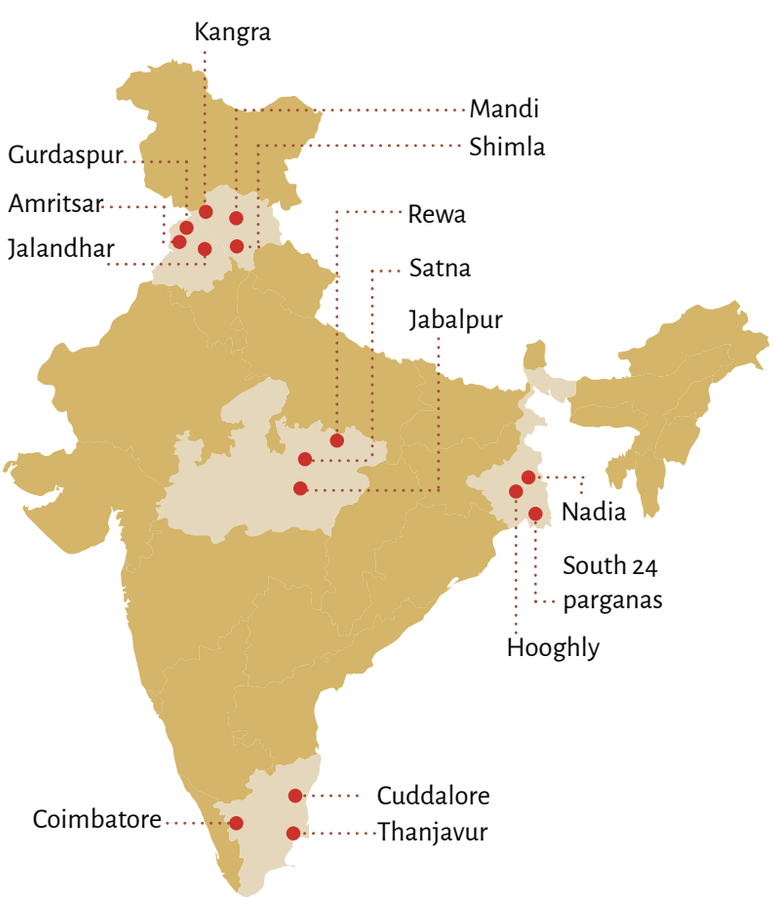
Criteria for selection: OSS type, water usage, number and population of LDVs and Development Index (HH type, assets, amenities structure)

60 LDVs (4 FROM EACH DISTRICT)

Criteria for selection: Priority to Census Towns, High prevalence of OSS, LDVs within a distance of 10-50 km from nearest city

3112 HHS TOTAL SAMPLE

Cochran Sampling Methodology used for
LDVs sampe selection



parameter for this step was the district-specific percentage of households reliant on OSS systems and the number of LDVs. Following the selection of three districts from every state, four LDVs were selected from every district. Hence, from a total of 15 districts 60 LDVs were selected as survey sites.

The selection of LDVs was done relying on the following primary selection criteria:

- Priority was given to Census Towns in comparison to other LDVs.
- The median range of population category of LDVs was selected. This was done in order to avoid selection of LDVs which may have become urbanised since the Census 2011 enumeration.
- LDVs with a high prevalence of OSS systems were selected. While priority was given to the percentage of households with septic tanks, higher percentage of pits was considered for LDVs from West Bengal on account of that state's larger reliance on pits.
- Information on distance from a Class I city was utilised while selecting LDVs. LDVs within a range of 10-50 kilometres from cities were selected in order to avoid inclusion of settlements which may have been urbanised since the Census 2011 enumeration.

Subsequently, an overall 3112 households for the survey sampling distribution were targeted commensurately across the selected 60 LDVs applying the Cochran Sampling Method. Table A1 gives a state and district-wise list of LDVs selected for the study and their respective sample sizes.

The study consisted of two essential parts:

a. Quantitative – This component of the study comprised 3112 household surveys conducted in LDVs identified in selected districts from the states of Himachal Pradesh, Punjab, West Bengal, Madhya Pradesh and Tamil Nadu.

b. Qualitative – Through this component we aimed to carry out the following tasks:

1. Key Informant Interviews (KIIs): In-depth interviews of key personnel in the same states which included:
   - ◇ Gram Panchayat members – 39
   - ◇ Masons – 13
   - ◇ Sewer cleaning truck operators – 12
   - ◇ Manual scavengers – 11
2. Focused Group Discussions (FGDs) with female participants in all of the survey states on menstrual hygiene – 5

See Table A1 in the appendix to refer to the final list of large dense villages surveyed.

CROSS-SECTIONAL ANALYSIS OF SANITATION INFRASTRUCTURE AND SERVICES IN LARGE DENSE VILLAGES

The data collected from the household survey and the KIIs is a cornucopia of information that can be pertinently analysed to explore key issues surrounding sanitation in rural India. The canvassed data provides ample opportunities for a cross-sectional analysis to comprehend the socioeconomic, infrastructural, technical and behavioural attributes behind the continued paucity of water and sanitation infrastructure and services in rural India. For this purpose a definitive framework of analyses has been adopted in this section to categorically and meticulously understand the various trends across the survey states and districts for every aspect of the sanitation value chain: toilets, containment, collection, transportation, treatment and disposal/reuse.

ACCESS TO TOILETS:

In-house toilets status across survey states:

As described in the previous section, the survey states exhibit higher access to in-house toilets compared to Census data (2011) and NARSS Survey data (2018-19). Some variations were observed while juxtaposing and comparing the state-level data compiled under all these datasets. While the Census data is slightly outdated, it has proven beneficial for the selection of the survey areas, as mentioned earlier. The NARSS data, however, is relatively recent and makes for insightful comparison with the LDV survey.

Table 1 juxtaposes and compares the data for all the LDV survey states with NARSS and Census 2011. It should be noted that the Census data provided is for the large and dense villages considered for the LDV survey conducted by CPR. On the other hand, the NARSS data presented is an aggregation of state information calculated from the larger database; hence it includes villages which may or may not coincide with the survey states of CPR. Compared to Census data the IHL percentages have improved for all the states, with the highest improvement seen in Tamil Nadu (where the IHL percentage has improved by 22 per cent) and the lowest improvement seen in Himachal Pradesh (10.1 per cent), still the but the latter's improvement is less on account of its previously high percentage of IHL. The NARSS data, however, paints a different picture. Two of the five survey states – Himachal Pradesh and Madhya Pradesh – exhibit higher percentages of IHLs compared to the survey findings, while all the states show a higher percentage of public, community and shared toilets access. The variations in IHL percentages in the aforementioned states based LDV survey, and NARSS could possibly be because of the nature of the villages surveyed in the LDV survey which as already has been mentioned are large, dense and proximity to cities.

Toilet access based on socio-economic indicators:

Socioeconomic indicators also reveal fascinating aspects in access to toilets in the survey states. Looking at access to toilets across religion and caste groups, interesting trends were observed across different survey states. Table 2 shows access to toilets across caste-religious groups for all the survey states. While at the aggregate level a decreasing trend is observed across Hindu caste groups in access to IHL, the severity of the disparity varies across states. Caste-based

Table 1 *Toilet Access in Survey States based on CPR's Large Dense Villages Survey 2018-29, NARSS 2017-18 and Census 2011*

States	Census 2011			NARSS, 2018 (Sample survey across all village categories)			CPR Large Dense Villages Survey		
	IHL %	Public and Shared %	OD%	IHL %	Public and Shared %	OD%	IHL %	Public and Shared %	OD%
Himachal Pradesh	80.30%	0.80%	19.00%	93.50%	6.20%	1.10%	90.50%	2.90%	6.50%
Punjab	77.20%	1.00%	21.80%	84.20%	15.80%	2.80%	89.00%	0.70%	10.30%
West Bengal	80.30%	1.50%	18.10%	87.80%	11.90%	5.00%	93.70%	0.80%	5.60%
Madhya Pradesh	41.70%	2.40%	55.90%	76.60%	23.10%	5.90%	60.60%	0.30%	39.10%
Tamil Nadu	63.30%	5.00%	31.70%	74.90%	10.50%	0.50%	95.10%	3.30%	1.60%
Total	**66.70%**	**2.60%**	**30.80%**	**81.80%**	**14.50%**	**3.70%**	**85.70%**	**1.60%**	**12.70%**

Table 2 *Access to Toilets across different Caste and Religious Groups*

States	Toilet Access	Caste and Religion Categories								Total
		Gen Hindu	OBC Hindu	SC/ST Hindu	Muslim	Christian	Sikh	Other Minorities	Refused to say	
Himachal Pradesh	No IHL	23	9	21	5	.	.	0	0	58
		6.7%	15.8%	10.7%	45.5%	.	.	0.0%	0.0%	94.6%
	IHL	322	48	176	6	.	.	1	2	555
		93.3%	84.2%	89.3%	54.6%	.	.	100.0%	100.0%	90.5%
Punjab	No IHL	1	2	21	1	13	25	0	4	67
		2.9%	7.1%	12.8%	11.1%	16.1%	9.2%	0.0%	22.2%	11.0%
	IHL	34	26	143	8	68	247	3	14	543
		97.1%	92.9%	87.2%	88.9%	84.0%	90.8%	100.0%	77.8%	89.0%
West Bengal	No IHL	11	3	17	10	.	.	.	0	41
		4.5%	7.3%	6.2%	11.8%	.	.	.	0.0%	6.3%
	IHL	235	38	257	75	.	.	.	2	607
		95.5%	92.7%	93.8%	88.2%	.	.	.	100.0%	93.7%
Madhya Pradesh	No IHL	20	87	122	18	.	.	0	1	248
		25.6%	33.1%	49.4%	51.4%	.	.	0.0%	33.3%	39.4%
	IHL	58	176	125	17	.	.	3	2	381
		74.4%	66.9%	50.6%	48.6%	.	.	100.0%	66.7%	60.6%
Tamil Nadu	No IHL	.	15	11	4	0	.	.	0	30
		.	4.5%	7.1%	5.7%	0.0%	.	.	0.0%	4.9%
	IHL	.	316	143	66	16	.	.	41	582
		.	95.5%	92.9%	94.3%	100.0%	.	.	100.0%	95.1%
All Survey States	No IHL	55	116	192	38	13	25	0	5	444
		7.8%	16.1%	18.5%	18.1%	13.4%	9.2%	0.0%	7.6%	14.3%
	IHL	649	604	844	172	84	247	7	61	2668
		92.2%	83.9%	81.5%	81.9%	86.6%	90.8%	100.0%	92.4%	85.7%
	Total	704	720	1036	210	97	272	7	66	3112

Table 3 *Variations in Toilet Construction over the years*

State	Within last 5 yrs (SBM period)	5-10 yrs	10-20 yrs	More than 20 yrs	Don't know	Total
Himachal Pradesh	60	161	134	143	75	573
	10%	28%	23%	25%	13%	100%
Punjab	131	189	136	43	48	547
	24%	35%	25%	8%	9%	100%
West Bengal	107	130	259	104	12	612
	17%	21%	42%	17%	2%	100%
Madhya Pradesh	197	103	51	28	4	383
	51%	27%	13%	7%	1%	100%
Tamil Nadu	131	352	52	12	55	602
	22%	58%	9%	2%	9%	100%
Total	626	935	632	330	194	2,717
	23%	34%	23%	12%	7%	100%

disparity in access to toilets is most severe in Madhya Pradesh followed by Punjab. Disparities across religions is also observed across the survey states. It is seen to be acute across Hindu and Muslim groups in Madhya Pradesh and Himachal Pradesh but less critical in Tamil Nadu and West Bengal.

Toilet construction over the years[3]:

Of the households with access to toilets, 23 per cent the toilets were constructed during SBM period, implying their construction since the inception of SBM (see Table 3). Further exploration of the number of years since the construction of toilets yields insightful information. Notwithstanding the 7 per cent of the respondents with access to toilets who couldn't recollect the year in which their toilet was constructed, it was seen that 34 per cent of the toilets were constructed in the last 5-10 years followed by 23 per cent in the last 10-20 years; finally, 23 per cent of reported toilets were constructed in the last four years as mentioned above. The interesting trend here is that most of the toilets were built during a time of a centralized programme for building toilets. Also, the data very intriguingly suggests that the highest number of toilets constructed within 10-20 years were in West Bengal, within 5-10 years in Tamil Nadu and finally within 5 years in Madhya Pradesh.

Reasons cited for not constructing toilets:

Attempts have been made in this study to elicit reasons for households not building toilets in their house. The household survey questionnaire asked households their reasons for not constructing IHLs. More specifically, households were posed a multiple response question for not building IHLs, with the following options: (i) insufficient water in premises, (ii) unavailability of land, (iii) costly to build and to maintain, (iv) did not receive subsidy from government, (v) difficult to build due to soil conditions, (vi) prefer to defecate in open, (vii) religious reasons. Interestingly, very few, an almost negligible number of households cited water, land and soil conditions or behavioural reasons based on preference for OD or religious reasons as primary reasons for not building IHLs. In fact, 53 per cent of households with no IHL cited 'costly to build and maintain' and 51 per cent cited 'did not receive subsidy from government' as the primary reason for not building toilets. When both these pecuniary reasons were cross-tabbed, it was seen that (see Table 4) 12 per cent of households with no IHL have cited both cost and lack of subsidy as deterrents in building IHLs and almost 80 per cent in total have cited either of the economic reasons as the primary deterrent.

Table 4 Economic Reasons for not building IHL

Costly to build & maintain	No Subsidy received from government		Total
	No	Yes	
No	32 (7.2 %)	175 (39.4%)	207
Yes	184 (41.4 %)	53 (11.9 %)	237
Total	216	228	444

It would also be interesting to examine to what degree economic reasons have been provided by households for not building IHLs across the consumption categories of the surveyed households. Here consumption expenditure is used as a proxy for the households' economic wellbeing and it has been done so for all subsequent analyses pertaining to assessing impact of economic factors on water and sanitation infrastructure and services. Table 5 gives a cross-tabulation of the two economic reasons provided by households for not building toilets across five consumption quintiles – poorest, second, middle, fourth and richest, and even the category of households that have not declared their consumption expenditure. It is seen that only 7 per cent of the households without toilets have not cited either of the two economic reasons for not constructing toilets. Around 53 per cent of the households without IHL are from the poorer quintiles (poorest and second quintiles) and 96 per cent of the households which have cited such economic reasons belong to these quintiles. While these numbers are revealing about the priority given to economic reasons as a deciding factor among the poorer households, they are also equally telling about the relevance of these factors for households which are relatively economically well-off. Around 36 per cent of the households without IHL are from the middle and richer quintiles, and 90 per cent of these households have cited economic reasons of cost and lack of subsidy as important deciding factors.

[3] The survey was conducted from December – January 2018-19, the survey captured information on toilets constructed during SBM period which was roughly 4 years and 4 months. Thus, they are reported as toilets in last 5 years or toilets constructed during SBM period in the report.

Table 5 *Economic Reasons for not building IHL across consumption quintiles*

Consumption Quintiles	Economic Reasons for not constructing an in-house toilet					
	Not Costly to Build and Maintain			Costly to Build and Maintain		
	Didn't receive subsidy is not a reason	Didn't receive subsidy is a reason	Total	Didn't receive subsidy is not a reason	Didn't receive subsidy is a reason	Total
Poorest	3	88	91	57	18	75
Second	8	21	29	32	8	40
Middle	4	16	20	40	8	48
Fourth	7	21	28	26	6	32
Richest	5	9	14	15	3	18
Not Declared	5	20	25	14	10	24
Total	32	175	207	184	53	237

Table 6 *Type of Toilets Constructed across Different Periods of Construction*

Toilet Facility	Number of years since the toilet has been constructed					Total
	Within last 5 yrs (SBM period)	5-10 yrs	10-20 yrs	More than 20 yrs	Don't know	
Piped Sewer	57	84	50	50	35	276
	9.1%	9.0%	7.9%	15.2%	18.0%	10.2%
Septic Tanks	346	620	304	190	139	1,599
	55.3%	66.3%	48.1%	57.6%	71.6%	58.9%
Pits (Combined)	219	222	264	83	19	807
	35.0%	23.7%	41.8%	25.2%	9.8%	29.7%
Others	4	9	14	7	1	35
	0.6%	1.0%	2.2%	2.1%	0.5%	1.3%
Total	626	935	632	330	194	2,717

TYPE OF CONTAINMENT SYSTEMS FOUND IN LARGE DENSE VILLAGES:

Following the analysis of access to in-house toilets in LDVs in the survey states, it is only pertinent to explore the types of toilets found in the surveyed households. Keeping in mind the sanitation value chain, it is imperative to not only explore the variations in toilet substructures across survey units (states and districts) but also to understand the explicit and implicit reasons for their preference. This section explores the prevalence of different OSS structures in the survey states. This assessment is imperative to understand the types of substructures used for wastewater containment in rural areas to develop a greater comprehension and establish policies for better wastewater management services. Towards this end the first puzzle that needs to be deciphered is: what fraction of the population residing in LDVs relies on on-site containment structures?

Prevalence of different types of containment systems in toilets over the years:

Based on the survey data the most prevalent substructures are septic tanks (with and without soak pits), which are followed by pits (single and twin leach-pits) and then toilets connected to piped sewers. However, there are two interesting trends, evident from Table 6, that need to be underscored here. One, in every reported year of construction the septic tank category exhibits the highest percentage, including construction within the last four years when the centralized programme has been promoting twin leach-pits. Two, pit construction has shown an increasing trend for the toilets constructed within the last 5 years compared to the toilets constructed in the last 5-10 years. Delving deeper to unravel state-specific trends it is observed that Himachal Pradesh, Punjab and Madhya Pradesh have consistently shown a higher preference for septic tanks with a slight shift in

preference for pits for toilets constructed within the last 4 years. However, interestingly, a sharp shift towards pits is noticed in the recently constructed toilets in Tamil Nadu, with the percentage share jumping from 21 per cent for toilets constructed 5-10 years ago to 60 per cent for toilets constructed within the last 5 years. In West Bengal there has been a consistently high preference for both single and twin-leach pits over the years.

Type of containment systems in toilets built within the last 5 years[4]:

While empirical evidences substantiate the preference for septic tanks in LDVs, it remains unclear whether septic tanks were still the preferred choice of containment system for households when the government was promoting the construction of twin-leach pits in rural areas under SBM. Towards this end Table 7 sheds some light on the kind of containment structures constructed during SBM period across the survey sites. While we have seen that the maximum number of new toilet[5] constructions (contrasted to old toilets) occurred in Madhya Pradesh, it is also interesting to note that 80 per cent of those toilets were constructed with septic tanks as the preferred OSS. Madhya Pradesh was followed by Himachal Pradesh and Punjab in terms of high preference for septic tanks as the OSS. The two states where pits were the preferred OSS were West Bengal and Tamil Nadu, with West Bengal having a larger percentage share from its respective total of new toilet constructions. It is also very interesting to note that new toilet constructions occurred across all consumption quintiles (from poorest to richest), based on Monthly Per Capita Expenditure (MPCE) of households, with septic tanks being a preferred choice in all of the categories. Madhya Pradesh records the highest number of constructions

[4] The survey was conducted from December – January 2018-19, the survey captured information on toilets constructed during SBM period which was roughly 4 years and 4 months. Thus, they are reported as toilets in last 5 years or toilets constructed during SBM period in the report.

[5] New toilets are toilets built during the SBM period (in last 5 years) and old toilets are toiles that were built earlier than that.

Table 7 Toilets Constructed within the Last Five Years across States and across Consumption Quintiles

Consumption Quintiles	Toilet Type	Survey States					Total
		HP	Punjab	WB	MP	TN	
Poorest	Piped Sewer	.	13	10	.	.	23
	Septic Tanks	2	12	1	74	1	90
	Pits (Combined)	.	4	14	14	17	49
	Others	.	.	.	.	.	.
	Total	2	29	25	88	18	162
Second	Piped Sewer	.	3	4	.	.	7
	Septic Tanks	2	17	1	28	6	54
	Pits (Combined)	3	2	9	5	7	26
	Others	.	1	.	.	.	1
	Total	5	23	14	33	13	88
Middle	Piped Sewer	.	4	2	1	.	7
	Septic Tanks	8	21	1	23	9	62
	Pits (Combined)	2	1	26	2	11	42
	Others	.	1	.	.	.	1
	Total	10	27	29	26	20	112
Fourth	Piped Sewer	.	3	4	.	.	7
	Septic Tanks	12	16	3	16	16	63
	Pits (Combined)	5	.	21	4	7	37
	Others	.	.	1	.	.	1
	Total	17	19	29	20	23	108
Richest	Piped Sewer	1	1	1	.	.	3
	Septic Tanks	12	3	1	9	1	26
	Pits (Combined)	4	.	8	3	3	18
	Others	.	.	.	.	.	.
	Total	17	4	10	12	4	47
Total MPCE declared		51	102	107	179	78	517
MPCE not declared	Piped Sewer	0	10	.	0	0	10
	Septic Tanks	8	16	.	8	19	51
	Pits (Combined)	1	3	.	9	34	47
	Others	0	0	.	1	0	1
Total MPCE not declared		9	29	.	18	53	109
Total New Toilets Built		60	131	107	197	131	626

from the poorer quintiles (poorest and second) with a high preference for septic tanks, while for the middle to the richest quintiles Himachal and Tamil Nadu record a higher number of toilet constructions. Out of the total 626 new toilets, 32 per cent (198 toilets) were constructed in households which had Below Poverty Line (BPL) cards and 66 per cent of these had septic tanks.

Cross-checking whether a toilet was constructed using some scheme or programme, interesting information can be unravelled regarding toilets constructed in recent years. Table 8 provides information on the different schemes or programmes or agencies that funded the construction of toilets across different states and the kind of toilets constructed during the SBM period. It is noticed that 21.6 per cent of the new toilet constructions are said to have been constructed under SBM-G. Out of these toilets 61.5 per cent toilets are connected to pits and 59 per cent are connected to single pits (lined, unlined and leach). Around 14 per cent of the new toilets are claimed to have been constructed by Panchayats. Now, these toilets may or may not have been constructed under SBM. However, the most interesting finding here is that the majority of the new toilets constructed (63 per cent) were reportedly private constructions. For these private constructions, septic tanks are clearly the most preferred choice of containment structures, with a 64 per cent share. It is unclear, though, whether these households availed subsidies. Table 9 provides some insight on this matter. It is seen that for the new toilets with septic tanks and pits that were reportedly built under SBM or by Panchayats, the construction of the septic tanks purportedly cost an average of INR 12,026 and INR 14,600 respectively, while the average amount reported for private construction is around INR 17,300.

Table 8 *Scheme-led and Private Toilet Constructions during SBM period*

State	SBM				Panchayat				Private Construction				Other Programmes and Schemes	Total New Toilets
	Piped Sewer	Septic Tanks	Pits	Total	Piped Sewer	Septic Tanks	Pits	Total	Piped Sewer	Septic Tanks	Pits	Total		
Himachal Pradesh	.	.	2	2	.	4	5	9	1	39	8	48	1	60
Punjab	3	2	.	5	.	11	1	12	30	70	9	109	4	131
West Bengal	7	.	25	32	1	.	12	13	13	7	41	61	0	107
Madhya Pradesh	.	40	3	43	.	27	17	44	.	90	17	107	2	197
Tamil Nadu	.	.	53	53	.	6	3	9	.	46	22	68	1	131
Total	10	42	83	135	1	48	38	87	44	252	97	393	8	626
Percentages	(7.4%)	(31%)	(61%)	[21.6%]	(1.1%)	(55.2%)	(43.7%)	[13.9%]	(11.2%)	(64.1%)	(24.7%)	[62.8%]		

Note: The figures in parenthesis () give percentage share of toilets within the categories - SBM, Panchayat and Private construction. The figures in square brackets [] give percentage share of the aggregate number of toilets from every category from the total number of new toilets constructed (626)

Table 9 *Cost of Construction of Scheme-led and Private Constructions*

Programme or Institution	Parameters	Toilets constructed within the last 4 years			
		Piped Sewer	Septic Tanks	Pits	Others
SBM	frequency	10	42	83	1
	mean OSS cost	NA	12026	6736	NA
Panchayat	frequency	1	48	38	1
	mean OSS cost	NA	14600	7470	NA
Private Construction	frequency	44	252	97	1
	mean OSS cost	12200	17302	7157	NA
Others	frequency	2	4	1	1
	mean OSS cost	NA	14500	NA	8000

Table 10 *Preference for Septic tanks vs. Pits across Consumption Quintiles*

Type of OSS	Poorest	Second	Middle	Fourth	Richest	Not Declared	Total
Septic Tanks	210(60.0%)	196(58.0%)	248(59.0%)	331(65.7%)	252(78.0%)	362(76.9%)	1599(66.5%)
Pits	140(40.0%)	142(42.0%)	172(41.0%)	173(34.3%)	71(22.0%)	109(23.1%)	807(33.5%)

Table 11 *Preference pattern for Septic Tanks and Pits across all Caste and Religion Groups (includes distribution, median cost of construction and median volume of the substructure)*

Caste/ Religion Categories	Parameters	Septic Tanks						Pits					
		Economic Categories Based on MPCE						Economic Categories Based on MPCE					
		Poorest	Second	Middle	Fourth	Richest	Not Declared	Poorest	Second	Middle	Fourth	Richest	Not Declared
General Hindu	Freq	22	30	49	60	106	63	32	43	60	61	31	22
	Median OSS Cost in Rs	18000	20000	20000	20000	25000	25000	8000	7000	7000	7000	7000	6000
	Median OSS Vol in Litres	11000	8500	14000	18000	23000	18000	2900	3000	2800	3500	3600	5150
OBC Hindu	Freq	71	53	61	105	48	125	21	15	32	30	7	33
	Median OSS Cost in Rs	15000	15000	15000	15000	20000	15000	6000	6500	6000	6000	6000	6000
	Median OSS Vol in Litres	4000	7000	5000	6000	7000	5000	2600	2800	2500	2500	1800	2000
SC/ST Hindu	freq	76	64	71	95	62	73	67	71	59	64	28	34
	Median OSS Cost in Rs	12000	15000	18000	18000	20000	20000	6000	7000	6000	7000	8000	7000
	Median OSS Vol in Litres	5000	6500	7000	8000	14000	7000	2800	2800	2400	2800	3750	2400
Muslim	freq	9	9	15	12	7	34	18	11	14	15	4	9
	Median OSS Cost in Rs	16500	12000	16500	15000	15000	15000	8000	7000	7000	7000	12000	6000
	Median OSS Vol in Litres	7000	5000	7000	7000	7000	7000	3900	3600	3300	2800	3450	2600
Christian	freq	10	12	9	13	4	13	.	1	2	.		2
	Median OSS Cost in Rs	12500	10000	9500	12000	15000	12500	.	10000	4000	.		.
	Median OSS Vol in Litres	4000	4000	5000	4000	5000	4000	.	2200	1300	.		2000
Sikh	freq	18	27	33	37	19	39	1	.	4	1	.	4
	Median OSS Cost in Rs	10000	15000	15000	15000	15000	15000	.	.	7000	5000	.	.
	Median OSS Vol in Litres	4500	5000	5000	5000	5000	7000	3900	.	2900	2800	.	3000
Other Minorities	freq	2	.	2	1	.	.	.	.	.	.	.	.
	Median OSS Cost in Rs	19000	.	16500	15000	.	.	.	.	.	.	.	.
	Median OSS Vol in Litres	14000	.	9500	7000	.	.	.	.	.	.	.	.
Refused to Say	freq	2	1	8	8	6	15	1	1	1	2	1	5
	Median OSS Cost in Rs	12000	.	18000	15000	15000	15000	10000	.	6000	12000	3000	10000
	Median OSS Vol in Litres	4000	4000	6000	7000	4500	7000	8300	1800	1800	4700	3400	2400

Preference for septic Tanks and pits across consumption categories:

The analysis undertaken in the previous section corroborates the correlation between kinds of supplementary water sources and types of toilet facilities. It was seen that households with access to tap water had a higher likelihood of building septic tanks; this reduced for households relying on ground water source and then further declined for surface water source-reliant households. Similar trends were also seen for distance from the main supplementary water source. One of the distinctive findings from the state statistics on OSS systems was that most of the states had a majority of households with toilets connected to septic tanks, with the highest percentage of preference seen in Punjab (72 per cent) followed by Himachal Pradesh (69 per cent). However, the exceptional case was West Bengal which had a majority of households relying on pit systems (70 per cent) followed by Tamil Nadu (27 per cent). What is more interesting is that a very clear trend is noticed for both kinds of on-site systems when gauged across the consumption quintiles. Table 10 shows that the percentage share of septic tanks improves from the poorest to the richest quintile; conversely, there is a decline in the percentage share of pits from the richest to the poorest quintiles.

Preference for Septic Tanks and Pits across Social Groups:

While Table 10 above reveals a very simple trend – the preference for septic tanks or pits by households across consumption quintiles – exploring the nuances of the socioeconomic characteristics of households can unfurl more significant behaviour patterns. For instance, Table 11 gives an interesting insight on the effects of caste and class intersections on access to the two broad on-site systems. The table shows a trend for the General Hindu category in terms of access to septic tanks, based on the class (consumption class). It is only in this category that we notice a steep rise in the number of households with septic tanks as we move from the poorest to the richest category. It is also seen that there is an increasing trend in the cost incurred to build the septic tanks and their capacities. Contrastingly, while such trends are also observed for other caste and religion categories, the degree of increase isn't too high. This is probably because of the concentration of lower caste groups (OBC and SC/ST) in the poorer and middle quintiles. It is also noticed that for the other caste and religion groups there is little variation in the sizes of the septic tanks or the cost of constructing them. This sort of evidence, though revealing, is not very strange. Rather, it corroborates the notion of purity that exists amongst the Hindu upper castes. For pits, however, the practice is quite standardised. There is little variation regarding the volume of pits and cost of construction across the consumption quintiles for different consumption groups. However, there may be a pattern in desludging behaviour across these cross-sections, which is explored in the next section.

Explicit Reasons provided for Preference of Septic Tanks and Pits:

Having discussed some of the implicit reasons, it is imperative to analyse the direct responses regarding the reasons for constructing on-site systems. While it is intuitively understood that the majority of households build OSS systems due to the unavailability of sewerage networks, the exact economic, technical and behavioural reasons for constructing septic tanks or pits is a seldom researched topic. These on-site substructures have become even more significant in recent times with burgeoning access to toilets and the pressing need to address faecal sludge management. Taking cognizance of the undeniable over-reliance on such systems, the survey has sought to elicit information on the economic, behavioural and technical reasons for building them. This information has been analysed at the state level for septic tanks and pits.

Each of the three broad reasons include specific reasons. For example, the larger set of behavioural reasons includes behaviour-specific reasons such as general awareness of the benefits of septic tanks or advised by masons, etc. Table 12 provides key insights on how respondents ranked or prioritized their economic, behavioural and technical reasons for building septic tanks. It is noticed that 45 per cent of the households have cited economic reasons as the primary basis for constructing septic tanks. This is followed by behavioural reasons, prioritized by 42 per cent of the respondents with septic tanks. Only 12 per cent of the households have cited technical reasons as most vital for their decision to build septic tanks. Interestingly, the patterns in the reasoning for building septic tanks are different for the different survey states. West Bengal very few septic tanks so it can be left out of this analysis. It is seen that a majority of households in Himachal Pradesh have cited behavioural reasons as the primary deciding factor for construction of septic tanks. While in Punjab, Madhya Pradesh and Tamil Nadu, households have largely cited economic reasons as deciding factors. When we look at the exact preference patterns we notice that a major share of households in

Punjab and Tamil Nadu give the highest preference to economic reasons followed by behavioural and, finally, technical reasons. Contrastingly, in Himachal Pradesh and Madhya Pradesh a larger share of households report prioritizing of behavioural reasons followed by technical and, finally, economic reasons.

Table 13 is similar to Table 15 above but shows households which have pits. It is seen that 45 per cent of total households with pits have prioritized economic reasons, 40 per cent have cited behavioural reasons as primary, and only 15 per cent of the households have cited technical reasons. Perhaps the most interesting statistics of the pit latrine data is that 27 per cent of such toilets were constructed within the last 4 years and 55 per cent of the new constructions were reportedly subsidised under SBM or by the Panchayats; the rest were private constructions. While a majority of pits are found in West Bengal (more than 50 per cent of the total respondents here have pits), Tamil Nadu too has a fairly large number of households with pits. For both West Bengal and Tamil Nadu economic reasons are prioritized.

Table 12 *Explicit Economic, Behavioural and Technical Reasons Preference Pattern for Building Septic Tanks*

State	Econ>Tech>Beh	Econ>Beh>Tech	Tech>Econ>Beh	Beh>Econ>Tech	Beh>Tech>Econ	Total
Himachal Pradesh	39	71	37	126	146	419
	9.31	16.95	8.83	30.07	**34.84**	100
Punjab	48	152	49	49	71	369
	13.01	**41.19**	13.28	13.28	19.24	100
West Bengal	10	14	7	3	9	43
	23.26	**32.56**	16.28	6.98	20.93	100
Madhya Pradesh	75	71	32	38	100	316
	23.73	22.47	10.13	12.03	**31.65**	100
Tamil Nadu	75	154	60	83	67	439
	17.08	**35.08**	13.67	18.91	15.26	100
Total	247	**462**	185	299	393	1,586
	15.57	**29.13**	11.66	18.85	24.78	100

Table 13 *Explicit Economic, Behavioural and Technical Reasons Preference Pattern for Building Pits*

State	Econ>Tech>Beh	Econ>Beh>Tech	Tech>Econ>Beh	Beh>Econ>Tech	Beh>Tech>Econ	Total
Himachal Pradesh	5	7	7	36	34	89
	5.62	7.87	7.87	**40.45**	38.2	100
Punjab	9	9	8	8	7	41
	21.95	**21.95**	19.51	19.51	17.07	100
West Bengal	76	157	67	78	74	452
	16.81	**34.73**	14.82	17.26	16.37	100
Madhya Pradesh	6	11	12	3	28	60
	10	18.33	20	5	**46.67**	100
Tamil Nadu	24	60	24	30	25	163
	14.72	**36.81**	14.72	18.4	15.34	100
Total	120	244	118	155	168	805
	14.91	**30.31**	14.66	19.25	20.87	100

DESLUDGING BEHAVIOUR AND PRACTICES IN LDVS:

Particulars of Desludging Reported for different types of Septic tanks and Pits:

The analysis so far corroborates the higher prevalence of on-site systems in LDVs which have also been found to have better access to tap water. Besides this, correlations have also been explored with socioeconomic characteristics of households: consumption expenditure of households considered as proxy for income, as well as caste and religion categories for social stratification of the sample households. However, access to on-site systems is far from the end of the sanitation puzzle. Without proper desludging, these structures act as mere containment units. While the design and construct of these structures, as prescribed by BIS or CPHEEO or even the latest SBM-G technical guidelines, are paramount to the proper functioning of these structures for treatment of wastewater, large aberrations are noticed across geographies. Table 14 shows the septic tank makes and wastewater outlets of households that have reported desludging and Table 15 shows the same for pits.

It has also been noted that 70 per cent of the septic tanks that reported being desludged are from Census Towns while the rest are from other LDVs. Similarly, for pits that have reportedly been desludged, 61 per cent are from Census Towns and the rest are from other villages.

Among households with septic tanks, only 25 per cent of them have reported desludging their tanks. Again, only 15 per cent of the total sample households with pits have reported availing desludging services. While the abysmally low numbers of desludging speaks volumes of the existing gaps in sanitation services and/or household level negligence, it is pertinent to understand which households, with what kind of OSS designs, are actually availing desludging services. From the above tables we again notice interesting trends. It is observed that households with single-chambered septic tanks, the simplest design and arguably inadequate for serving the purpose of providing primary treatment of waste, report the highest levels of desludging (75 per cent). Also very interestingly, 86 per cent of the households with single-chambered septic tanks that have reported availing desludging have no wastewater outlet. Though at an aggregate level 70 per cent of the septic tanks with no outlet have reportedly been desludged, 19 per cent of septic tanks with wastewater outlets to open drains and open land have reported desludging. Similarly, 84 per cent of pits that reported being desludged are single pits and, at an aggregate level (for both single and twin pits), the majority of pits getting desludged have no outlets.

Desludging Behaviour and Cost across Social Groups and Type of Waste Water Outlets:

Besides infrastructural factors such as water supply described above, social factors too contribute to the decision to build pits or septic tanks. It was observed in Table 11 in the previous section how for the General Hindu category household there is a very strong relation between septic tank size and monthly per capita expenditure. Now looking at desludging of on-site systems – septic tanks and pits separately – we notice interesting patterns across caste and religion groups (see Table 16). First, there is the clear variation in cost reported for desludging septic tanks and the corresponding figure for pits. This variation can be directly attributed to the capacity variations of these substructures: pits are clearly smaller than septic tanks. Second, from the caste and religion categories it is understood that highest levels of desludging have been reported by the OBC Hindu households (almost 40 per cent of them have reported desludging) followed by Muslim households (36 per cent) and then SC/ST households (23 per cent). However, General Hindu households and Sikh households have reported only 10 and 6 per cent.

This desludging behaviour can be partly explained by infrastructure variations and partly by caste- and religion-specific practices and trends (see Figure 1, 2 and 3). The reason why a large section of OBC Hindu, SC/ST Hindu and Muslim households have reported desludging is because a larger section of these groups have no outlets from their septic tanks which are already of a smaller size. On the other hand, while a sizeable section of General Hindu Households have septic tanks, only 10 per cent have desludged their tanks for two probable reasons: one, they generally have much larger septic tanks (18,000 litres median volume compared to 5000 litres for OBC and 7000 litres for SC/ST hindu categories); and two, almost 70 per cent of General Hindu households have their large septic tanks connected to soak pits, thus reducing the need for frequent desludging. The latter reason has been induced by the larger plot sizes of General Hindu households. For Sikh households too, which is a sizeable cohort in the sample survey where households have reported high percentage of on-site systems, we see very few households reporting desludging.

Table 14 *Desludging reported for Septic tanks of Different Structures and Waste Water Outlets*

Septic Tank Structure	Waste Water Outlet				Total
	To Soak Pits	To Drains	To Open Land	No Outlet	
Three Chambered	9	2	2	4	17
	52.9%	11.8%	11.8%	23.5%	100%
Two Chambered	20	33	8	20	81
	24.7%	40.7%	9.9%	24.7%	100%
Single Chambered	13	16	12	246	287
	4.5%	5.6%	4.2%	85.7%	100%
Total	42	51	22	270	385
	10.9%	13.2%	5.7%	70.1%	100%

Table 15 *Desludging reported for Pits of Different Structures and Waste Water Outlets*

Pit Design	To Drains	To Open Land	No Outlet	Total
Twin-pits	3	1	15	19
	15.79%	5.26%	78.95%	100%
Single Pits	5	17	81	103
	4.85%	16.5%	78.64%	100%
Others	0	0	1	1
	0%	0%	100%	100%
Total	8	18	97	123
	6.5%	14.63%	78.86%	100%

Table 16 *Desludging Services Availed for Septic tanks and Pits across Caste and Religious Groups*

Caste Religion Groups	Septic Tanks				Pits			
	Freq	Median OSS Vol in litres	Median OSS Cost in Rs	Median Amount for Desludging	Freq	Median OSS Vol in litres	Median OSS Cost in Rs	Median Amount for Desludging
Gen Hindu	33	14000	20000	2000	38	2800	7000	1200
OBC Hindu	186	4000	13500	2500	12	2500	7000	1500
SC/ST Hindu	103	6000	15000	2000	49	2600	7000	1200
Muslim	29	7000	15000	2500	18	2900	7000	2000
Christian	13	5000	15000	2000	1	1300	3000	1500
Sikh	7	5000	15000	1500	.	.	.	.
Other Minorities	1	23000	30000	5000	.	.	.	.
Refused to Say	26	5500	15000	2500	2	2700	3000	1500

Figure 1 *Box-plots of OSS volumes across caste and religion groups*

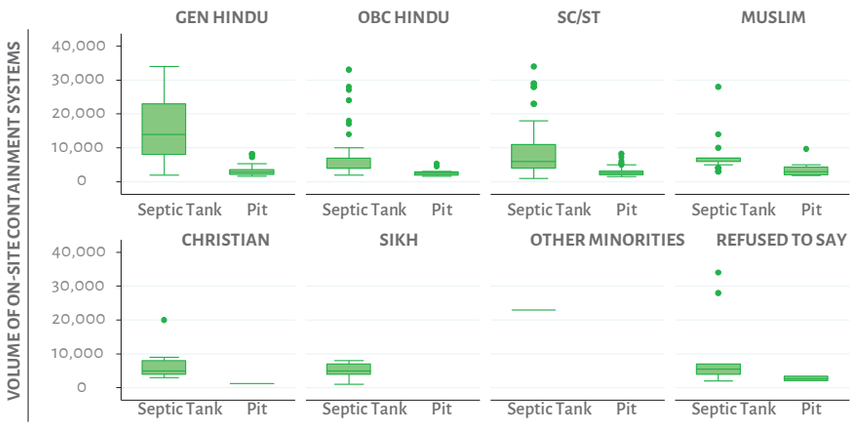


Figure 2 *Distribution of septic tank volumes across caste and religion groups for households that report desludging and those that don't*

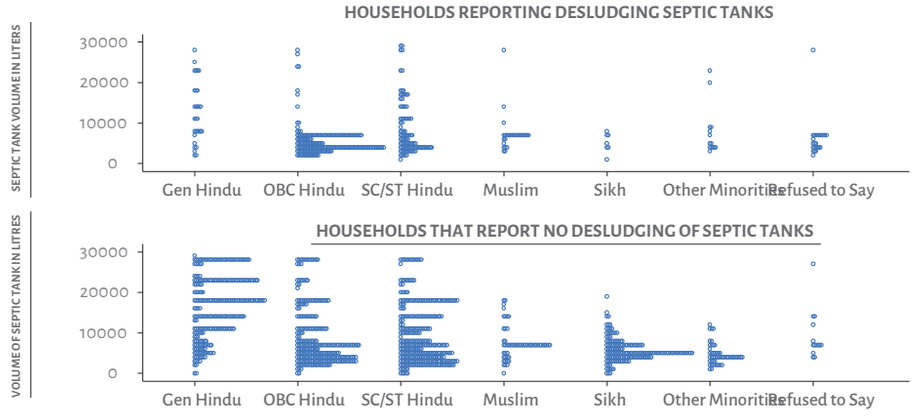
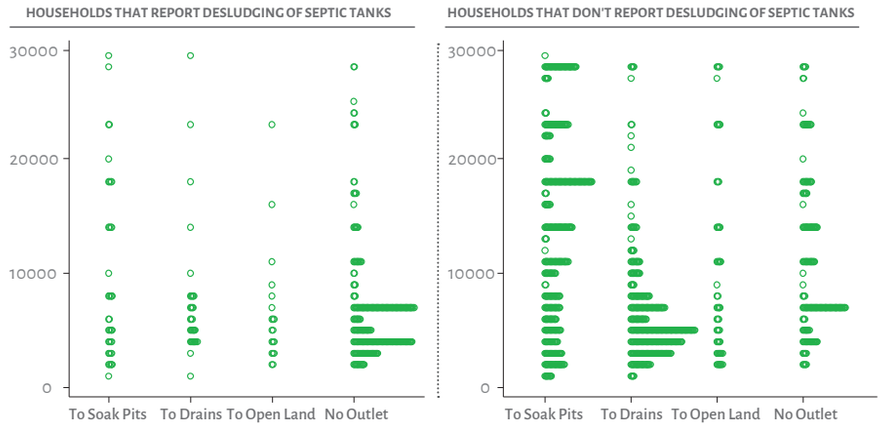


Figure 3 *Distribution of septic tanks volumes across reported waste water outlets for households that report desludging and those that don't*



WHAT ARE THE KEY TAKEAWAYS FROM THE SURVEY?

The survey of the LDVs has yielded interesting revelations. Both the household survey and the KIIs have provided a plethora of information which prove key insights on sanitation in LDVs. While some revelations – such as the predominance of on-site systems – were earlier intuitively understood as normal given the absence of larger sewerage infrastructure, these aspects can now be studied in detail with the available information. The findings not only corroborate some of the earlier studies, which had tried to find correlations between the prevalence of on-site systems and economic and geographical conditions, but also provide evidence of the peculiarities in practices around the construction and maintenance of specific OSS systems. It has also been found that some of these peculiarities and practices are influenced by personal, social, technical and institutional factors. The broader takeaways from this research are the preference patterns for the construction and upkeep of these on-site containment structures which, given their individual and yet quasi-public nature, have significant environmental ramifications. Hence, this research attempts to highlight some of the idiosyncrasies pertaining to OSS systems in LDVs. This section attempts to narrow down the findings from the survey and contextualise them with different components of the sanitation value chain – access to toilets, containment of waste, collection and transport of waste and, finally, treatment.

WHAT ARE THE KEY DRIVERS DETERMINING PREDOMINANT ON-SITE SANITATION SYSTEMS AT VILLAGE LEVEL?

In Focus: Variations in prevalence of on-site sanitation systems at large dense village level

While there are substantial evidences of household characteristics affecting their choice of on-site sanitation systems, an analysis of the data aggregated at the village level, also, corroborates clustering of factors that influence for either septic tanks or for pits. The aggregation of influence for choosing between the two containments systems can be intuitively attributed to demographic and spatial factors like population of the village and distance from nearby city and other factors like general urbanisation level of district and infrastructure availability in the region in terms of motorable roads and piped water supply. These factors can be assumed to collectively influence the demand for sanitation services and the availability of the same. This in turn incentivises households' decision to build septic tank or pit.

What are the correlations between on-site sanitation system choices and village level characteristics?

The variations in preference for on-site systems, whether a household builds a septic tank or a pit, is seen to be caused by a variety of factors. Though these factors have seen to have a great impact on the household choice, they are also significant at the village level. It has been noticed that there is a neighbourhood effect in terms of households building toilets by seeing their neighbours building toilets and consequently building similar on-site containment systems as their neighbours. This is also motivated by the knowledge of the masons in the locality who build toilets. During the key informants interview masons reported that they usually build similar on-site containment systems unless they are specifically asked to customise the design and make based on the household size and monetary and space constraints of the household. But more or less at the village level preferences do seem to manifest in a collective way influenced either by the neighbourhood effect, skill of the local mason and most importantly the local hydrogeological conditions. Having noticed this trend a simple correlation matrix has been made based on the household data clustered at the LDV level to see the preference for septic tanks or pits. Table 17 presents the findings of the correlation matrix for the preference for septic tanks or pits based on different parameters – demographic, levels of urbanisation, proximity to Class I cities and National Highways, economic, social and infrastructural and other signalling factors. Only the significant correlation coefficients have been shown for both septic tanks and pits.

It is fascinating to note that for which ever factors the correlation coefficient is positive for septic tanks the corresponding correlation coefficient for pits is negative. This underscores the previously mentioned hypothesis of collective preference for septic tanks or pits at the village level. For example, villages in more urbanised districts are seen to have a positive correlation for septic tanks but a negative correlation for pits symbolising a larger preference for septic tanks in more urbanised districts. Distance from Class I cities has a positive correlation with septic tanks. Economic factors are seen to have a positive correlation on septic tanks but a negative correlation with pits signifying that economically better-off households are more likely to have septic tanks than pits. The correlation coefficients are positive for septic tanks with respective to tap-water to premise and water source within dwelling/plot, but its negative for pits. Other signalling

factors have also been included in the analysis and they show that households in LDVs prefer septic tanks over pits when water is supplied by the Panchayat or PHEO and there is a community arrangement for the same and when there is waste management facility in the village. This shows that households prefer better containment units when they have better access to water and sanitation services in their village.

Is there an influence of proximity to Class I cities on on-site sanitation system choices?

Distance from Class I city was one of the selection parameters for LDVs for the survey and, thus, is treated as one of the first analysis parameters. The household

KEY INSIGHTS

Villages in more urbanised districts are seen to have a positive correlation for septic tanks but a negative correlation for pits symbolising a larger preference for septic tanks in more urbanised districts.

Economic factors such as MPCE, pucca dwelling structure and ownership of two-wheeler are seen to have a positive correlation on septic tanks but a negative correlation with pits signifying that economically better-off households are more likely to have septic tanks than pits.The correlation coefficients are positive for septic tanks with respective to tap-water to premise and water source within dwelling/plot, but its negative for pits.

Table 17 *Correlation of septic tanks and pits percentages at LDV level with demographic, spatial, socio-economic, infrastructral and other signalling factors*

Parameters	Variables	Septic Tank	Pits
Demography	Population		
Urbanisation	District Urbanisation	0.3145*	-0.2996*
Proximity	Distance from nearest Class I city	0.3324*	
	Distance from nearest Highway		
Economic	Median MPCE	0.4215*	
	Pucca Dwelling	0.4397*	-0.2605*
	Two-wheeler	0.3491*	
	LPG connection	0.6800*	-0.3739*
Social	Hindu General		
	Hindu OBC		
	Hindu SC/ST	-0.3250*	0.2581*
	Muslim		
	Sikh		-0.2771*
	Other Minorities		
	Refused to Say	0.3008*	
Infrastructure	Tap-water Source	0.6096*	-0.4280*
	Ground Water Source	-0.3300*	
	Surface Water Source	-0.6261*	0.6828*
	Water Source Within Dwelling/Plot	0.4702*	
	Water Source Near	-0.3224*	
	Water Source Away	-0.5522*	0.4049*
	Water Litres per capita per day	0.3569*	-0.2953*
	Underground or Covered Drainage	-0.4921*	0.3736*
	Open Drainage	0.3067*	-0.4119*
	No Drainage		
	Motorable Road	0.4176*	
Other Signaling Factors	Water supplied by panchayat	0.3983*	-0.4702*
	Water supplied by private agency		
	Water supplied through community arrangement	0.2850*	
	Water availed from natural sources	-0.5842*	0.6525*
	Solid Waste Management Facility Available	0.4442*	

*** Correlation is significant. Blank cells represent non-significant correlations, hence not mentioned.**

Figure 4 *Share of sample households based on distance from earest city*

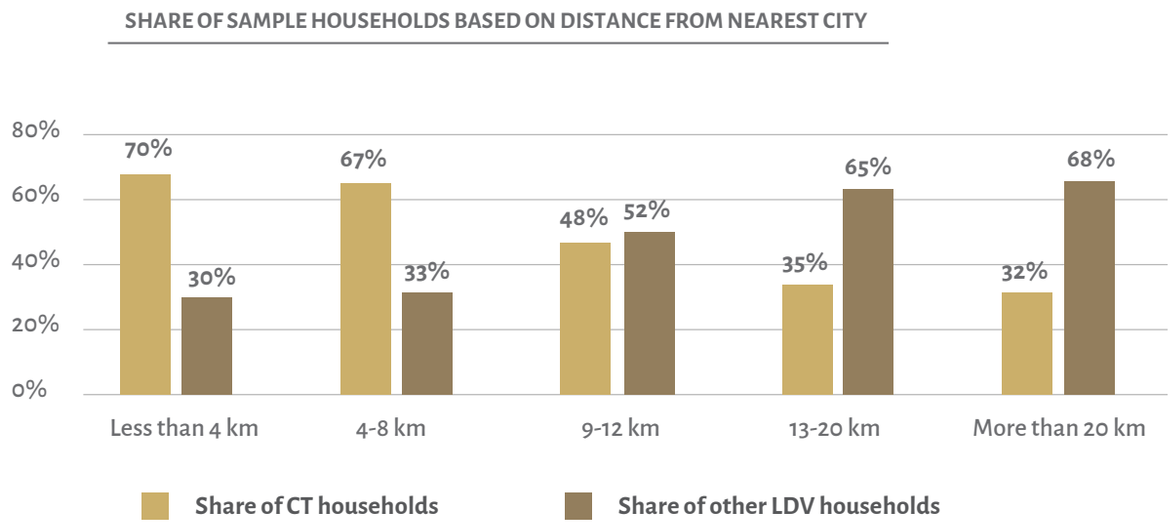
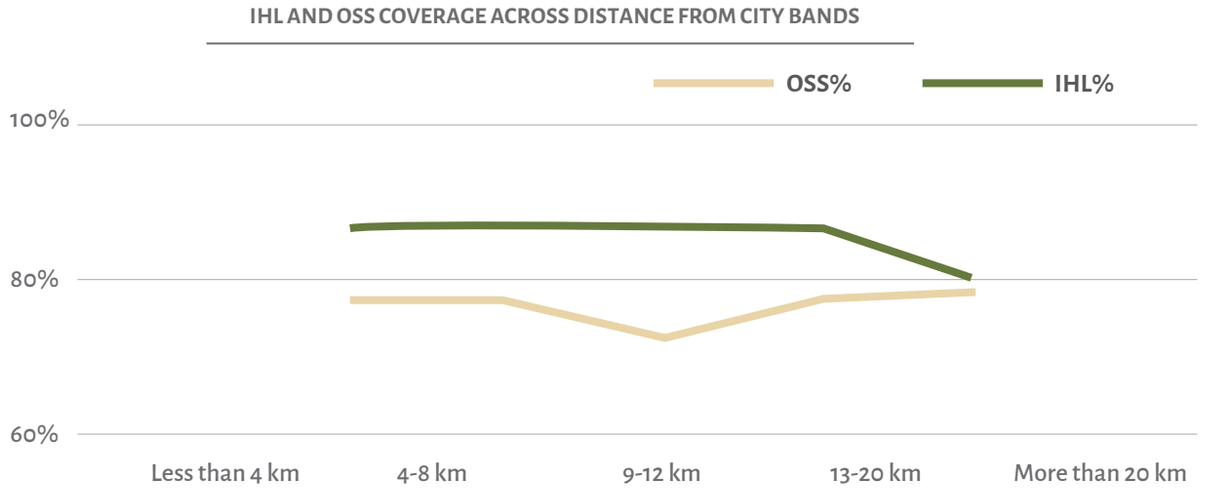


Figure 5 *IHL and OSS coverage across distance bands from nearest city*



distribution across distance bands from nearest cities reported by households is shown in figure 4. It is seen that share of households in CTs decreases as we move from the nearest city band of less than 4 kilometres to the distance band of more than 20 kilometres. Concurrently, the share of households from other LDVs increases as we move further from nearest cities. This is partly explained by the sample site selection and mostly by the general location of CTs near large cities. This finding leads to the discovery of telling trends in OSS preference upon further analysis.

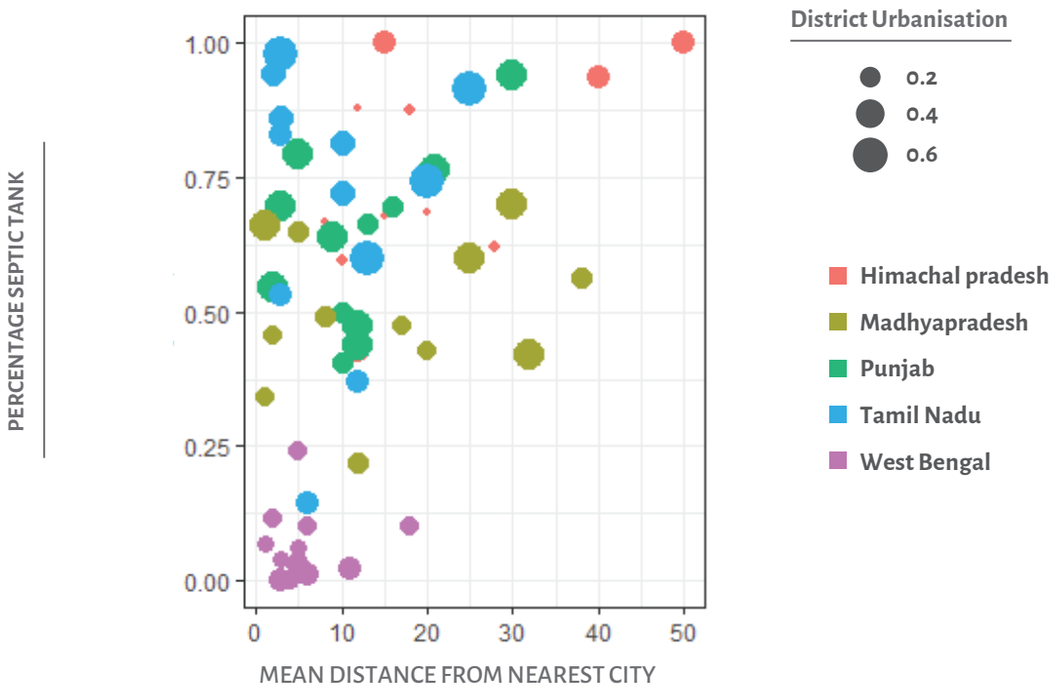
Analysis of share of on-site sanitation systems present in all LDVs (both CTs and other LDVs) based on distance from nearest city bands shows that IHL coverage decreases as we move from less than 4 km distance band to more than 20 km band (see Figure 5). It gradually converges with OSS percentage. This means that LDVs which are not close to cities and are remotely located demonstrate a lesser IHL coverage. Concurrently, farther the distance from cities lesser are the sewerage and drainage coverage, hence, households that build toilets connect them to on-site containment units.

KEY INSIGHTS

Larger share of new toilets construction was seen in other LDVs (56 per cent) compared to CTs.

67 per cent of new toilet construction using SBM subsidy directly or with the support from Panchayat were built in other LDVs.

Figure 6 *Septic tank percentage in LDVs based on distance from nearest city and urbanisation level of district*



What is the influence of urbanisation on on-site sanitation system choices?

It was noticed in Table 17 that urbanisation of the district had a positive correlation with septic tank percentage of LDV. There are some state level variations particularly because of the methodology used for of LDV sites for the survey where distance from nearest city was also one of the criteria. For example, most of the LDVs in West Bengal were within 10 kilometres from their respective nearest city, but they have a higher prevalence of pits. Figure 6 shows the septic tank coverage in LDVs based on their distance from nearest cities and urbanisation levels of their districts. It is seen that most of LDVs in Punjab and Tamil Nadu and some in Madhya Pradesh that are proximate to nearest cities and are in highly urbanised districts have higher percentages of septic tanks. The only exception here are some LDVs in Himachal Pradesh which despite their remoteness have higher percentage of septic tanks which may be attributed to their districts high urbanisation levels.

WHAT KIND OF TOILETS AND ON-SITE CONTAINMENT SYSTEMS HAVE BEEN BUILT?

In Focus: The direct and indirect influence of SBM-Gramin on toilets and on-site sanitation systems coverage in study areas

The survey states exhibit a higher access to in-house toilets compared to Census data (2011) and NARSS Survey data (2018-19), essentially because the survey is representative of the identified large dense villages (1,58,948 settlements). With the exception of Madhya Pradesh all other states showed an increase in IHL coverage (Bhol et al, 2019). Some variations were observed while juxtaposing and comparing the state-level data compiled under all these datasets. While the Census data is slightly outdated, it has proven beneficial for the selection of the survey areas as mentioned earlier. The NARSS data, however, is fairly recent and makes for insightful comparison with the LDV survey.

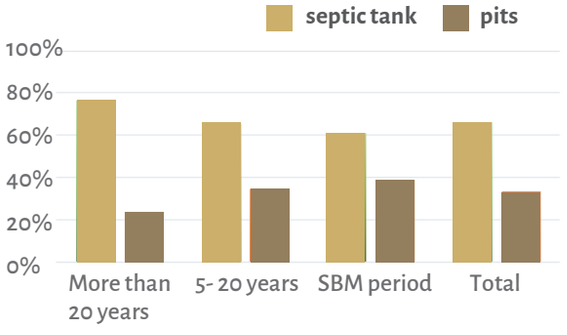
Following the analysis of access to in-house toilets in LDVs in the survey states, it is relevant to explore the types of toilets found in the surveyed households. Keeping in mind the sanitation value chain, it is imperative to not only explore the variations in toilet substructures across survey units (states and districts) but also to understand the explicit and implicit reasons for their preference. This section explores the prevalence of different OSS structures in the survey states. This assessment is the first step to understand the types of substructures used for wastewater containment in rural areas to assess demand for sanitation infrastructure and services and prescribe policies interventions for better wastewater management services. Towards this end the first

puzzle that needs to be deciphered is: how has SBM – Gramin impacted LDVs' existing reliance on on-site containment structures?

How does toilet construction over the years reflect preference for OSS?

The first report on LDVs speak volumes on the predominance of on-site sanitation systems in rural areas (Dasgupta et. al., 2017). The progress made in construction of new toilets under the flagship sanitation programme has further increased the reliance on on-site sanitation systems as had been seen in the white paper from CPR's survey in LDVs (Bhol et.al, 2019). Subsequent analysis of the distribution of the different kinds of on-site containment systems built over the years compare the construction of septic tanks to that of pits. The analysis reveals that septic tanks are clearly the largely preferred choice. However, pit construction has risen over the years. The survey revealed that 23 per cent of toilets constructed have been built in the last 5 years during the SBM period. Out of these 90 per cent of toilets built are connected to on-site containment structures. The analysis also reveals that the number of pit constructions have increased over the years (see Figure 7) signalling the increasing acceptance of pits as on-site sanitation systems over the years. But this increased acceptance is also because of the fact that largely poorer households have built toilets in the recent years (discussed in details later sub-section).

Figure 7 *Preference for OSS over the years*



KEY INSIGHTS

The survey revealed that 23 per cent of toilets constructed have been built in the last 5 years, during the SBM period. Out of these 90 per cent of toilets built are connected to on-site containment structures.

12.32 per cent of households which had toilets have reported upgrading their old insanitary toilets to sanitary toilets connected to OSS.

The SBM – Gramin has had a significant contribution in burgeoning the number of toilets in rural India. SBM – Gramin guidelines promoted the construction of twin-pits following three primary reasons – (i) the cost of constructing twin pits are lower than septic tanks, (ii) the absence of sewerage networks and treatment facilities in rural areas makes twin-pits ideal for toilet waste and, (iii) twin leaching containment units would allow rural households to use dried waste as compost. CPR's LDV study, however, found that septic tanks have largely been preferred over pits even though pit construction has increased over the years including the last five years of SBM implementation.

For all the toilets constructed over the years connected to OSS, however, 84 per cent are privately built by households (See Figure 8). But this is does not undermine the effects of SBM on the overall construction of toilets. Out of the total new toilet constructions in the last 5 years, 22 per cent of households have reported constructing toilets by directly availing SBM subsidy while 15 per cent of households have reported toilet construction by Panchayat. 12.32 per cent of households which had toilets have reported upgrading their old insanitary toilets to sanitary toilets connected to OSS.

Figure 8 *Whether toilets were constructed independently or with government support*

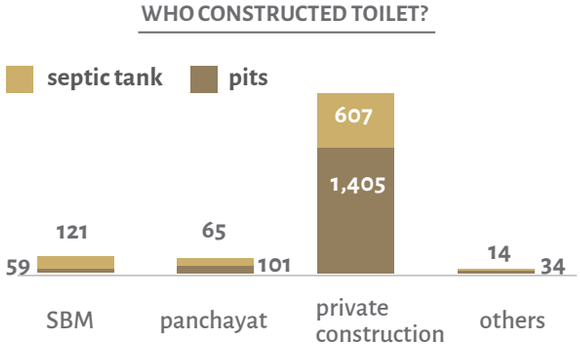
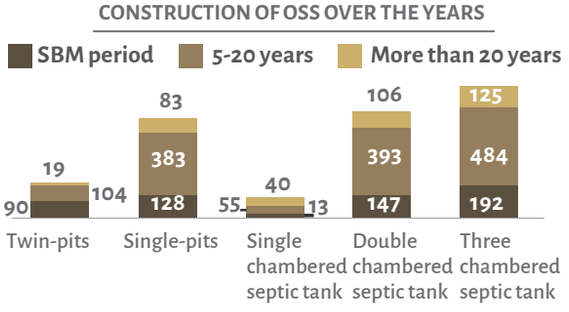


Figure 9 *Preference pattern for OSS types over the years*



The variations in preferences for septic tanks and pits is not the result of a simple dichotomous choice between the two technologies. Over the years there have been variations in the choice of septic tanks and pits constructed by households. It is seen that three chambered septic tanks, double chambered septic tanks and single pits have been the most preferred choices of on-site containment systems (see Figure 9).

How impactful has the Swachh Bharat Mission – Gramin been towards influencing households' choice of OSS?

These choice patterns have also varied based on the financial support received by households to build toilets. For households which have toilets connected to different kind of on-site sanitation systems, single pits have been preferred among pits and three chambered septic tanks are most preferred followed by double chambered septic tanks for all private constructions (see Figure 10). But for households that have received subsidy under SBM directly or indirectly through Panchayats pits have been the preferred choice. Toilets which were constructed by availing SBM subsidy directly by the household demonstrate interesting trends in the choice of containment unit built for them. Figure 11 gives the distribution of containment units built for toilets which were constructed using SBM subsidy. It validates the effects of SBM's push for twin-pits as majority of these toilets are connected to twin-pits (47 per cent). But households have still constructed other containment units. The second biggest share is that of three chambered septic tanks followed by single pits and then double chambered septic tanks. This corroborates the fact that the choice of containment unit is a household choice after all and it could be influenced by a range of socio-economic, spatial or regional, technical and behavioural reasons.

KEY INSIGHTS

For all the toilets constructed over the years connected to OSS, 84 per cent are privately built by households.

Out of the total new toilet constructions in the last 5 years, 22 per cent of households have reported constructing toilets by directly availing SBM subsidy while 15 per cent of households have reported toilet construction by Panchayat.

There is clear evidence of usage of SBM subsidy to construct septic tanks (33 per cent) despite the governments push for construction of twin-pits.

67 per cent of the toilets built using SBM subsidy are connected to pits and 70 per cent of these pits are twin-pits. 47 per cent of the new constructions are twin-pits.

How has SBM – Gramin benefitted the poor households in LDVs?t

Toilet construction, both old and new, have happened for households irrespective of their economic classes. However, it was found that largely poorer households have built toilets in the last 5 years. Utilising the monthly per capita expenditure, the sampled households were distributed across 5 quintiles – poorest to richest. A breakdown of toilet constructions in CTs and other LDVs demonstrates that in both kinds of LDVs relatively poorer households have constructed toilets in the last 5 years when the medians of the MPCE are compared (see Figure 12).

KEY INSIGHTS

Poorer households have built a larger share new toilets in both Census Towns and other Large Dense Villages during the SBM period.

Figure 10 *Share of OSS types built with or without subsidies*

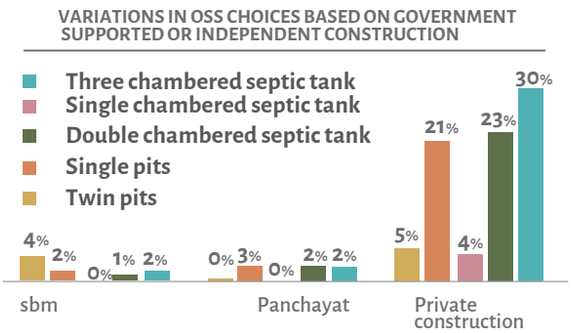


Figure 11 *Choice of containment units by households availing SBM subsidy*

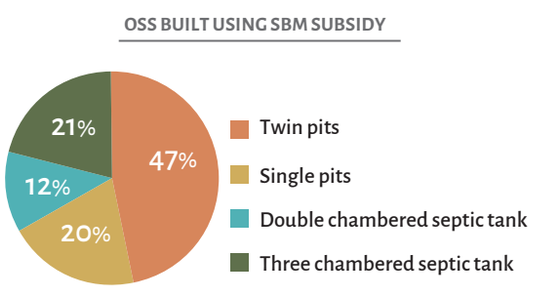


Figure 12 *MPCE of households with old and new toilets in CTs and other LDVs*

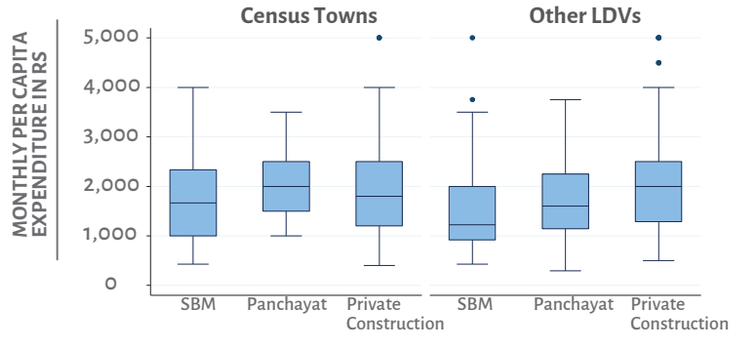


Figure 13 *MPCE of households with new toilets constructed independently or with subsidy*

KEY INSIGHTS

Around 40 per cent of the toilets were constructed by the poorest and poor (second) quintiles during the SBM period, and more than 60 per cent of these constructions were connected to septic tanks in LDVs.

It was also observed that despite the lower median MPCE of households with new toilet constructions people from the middle and richer quintiles have also reported construction of new toilets. However, when the information on whether toilets were constructed independently or with subsidy support from government, variations in MPCEs of households were seen. It is evident that the relatively richer households have built their toilets independently (as private constructions) in both CTs and other LDVs (see Figure 13). Contrastingly, poorer households have built toilets with support from Panchayat or by directly availing SBM subsidy. The construction over the years also show variations in prevalence for septic

Table 18 *Details of OSS construction over the years (freqency, cost of OSS, MPCE of household and OSS volume)*

OSS Type	Parameters	More than 20 yrs	5-20 yrs	SBM period
Septic tanks	Frequency	329	924	346
	Median OSS cost in Rs	20000	15000	15000
	Median MPCE in Rs	2500	2333.333	1750
	Median OSS Volume in litres	11000	7000	5000
Pits	Frequency	102	486	219
	Median OSS cost in Rs	7000	7000	6000
	Median MPCE in Rs	2000	2000	2000
	Median OSS Volume in litres	3000	2800	2600

Figure 14 *Improvements in IHL coverage during SBM period across socio-religious groups*

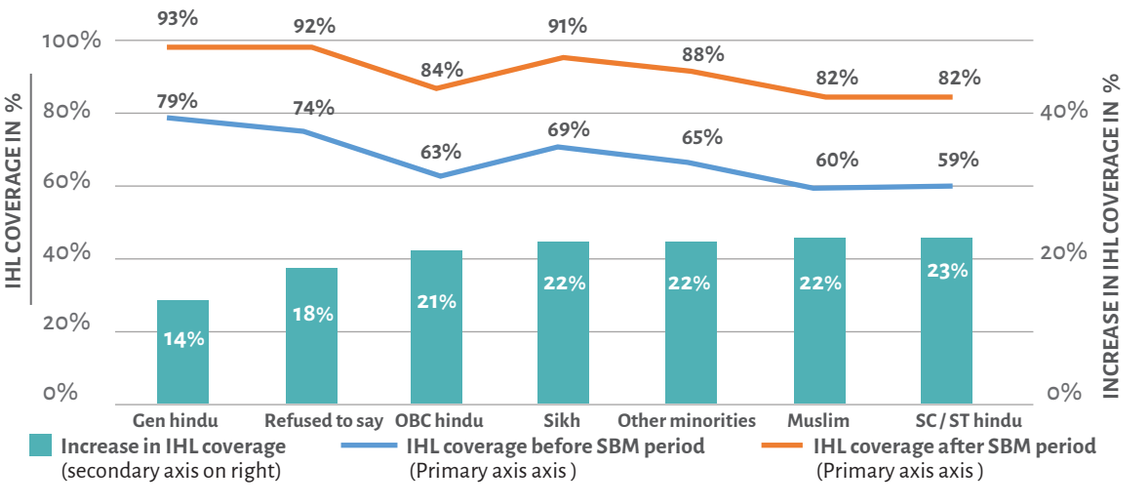


Figure 15 *Share of new toilets and OSS constructions across socio-religious groups*

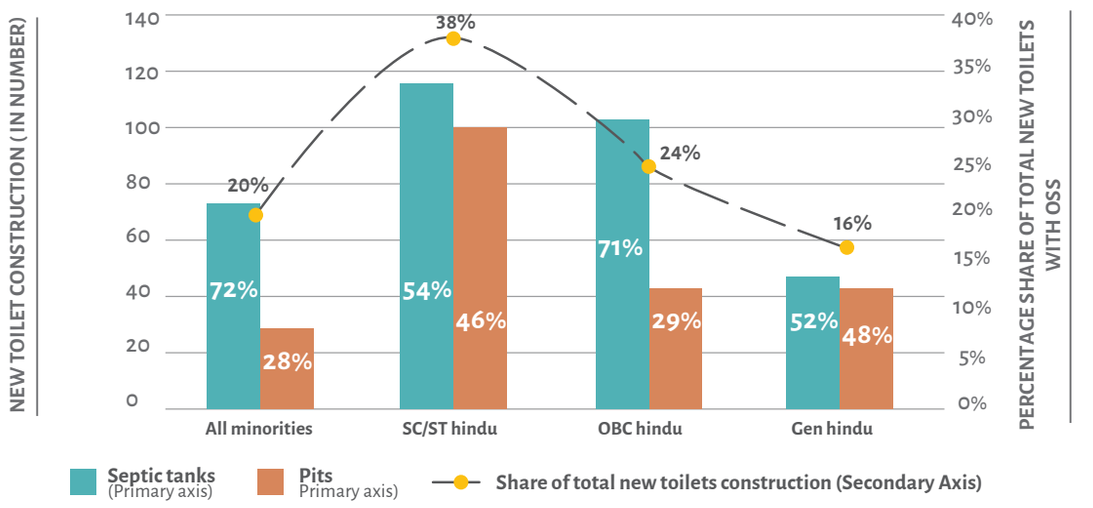
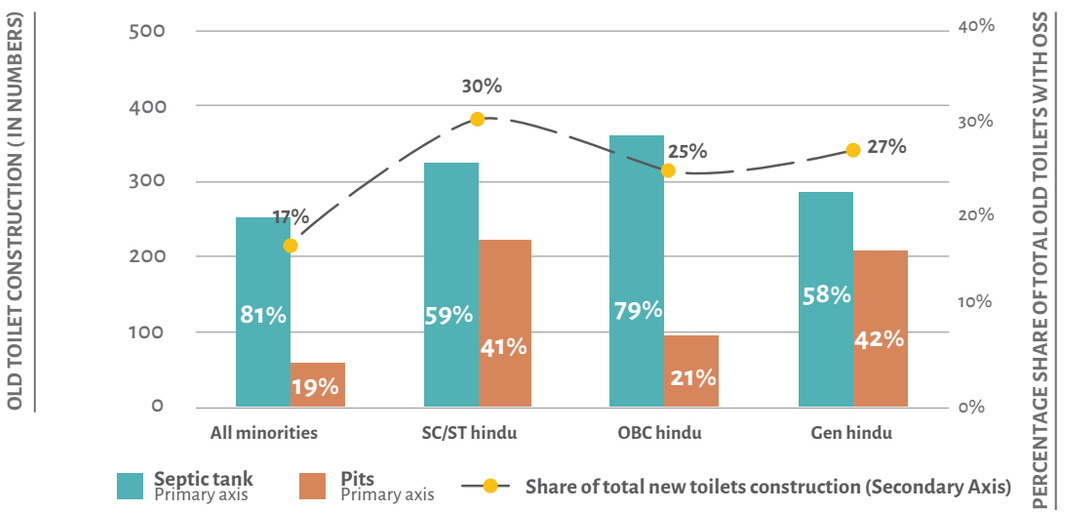


Figure 16 *Share of old toilets and OSS constructions across socio-religious groups*



tanks or pits and their volumes (Table 18).

How have different communities chosen between on-site sanitation systems in SBM period?

As discussed earlier, 23 per cent of households covered under the survey built new in-house toilets in the last 5 years. Table 2 in the previous section had shown the IHL coverage of households across social and religious groups. In this section, we discuss the specific improvements in the toilet coverage in the last 4 years across different socio-religious groups (see Figure 14). It is observed that least improvement in IHL coverage has occurred in general Hindu households with 14 per cent improvement. But this is on account of the fact that general Hindu households already had almost 70 per cent IHL coverage to begin with. The highest improvement in IHL coverage is seen in Hindu SC/ST households with 23 per cent improvement bringing their current IHL coverage to 80 per cent.

KEY INSIGHTS

Maximum increase in IHL coverage during the SBM period has happened in SC/ST Hindu households (23 per cent) which brought up their IHL coverage from 60 per cent to 80 per cent.

The least share of new toilet construction was 14 per cent that happened in general Hindu households, bringing up their IHL coverage from 79 to 93 per cent.

The new toilet constructions also reveal the preference for OSS across the socio-religious groups. Figure 15 shows the share of new toilet constructions across the socio-religious groups and what kind of OSS have been built along with the new toilets. It is observed that the from the 23 per cent of new toilet constructions during the SBM period highest share of construction has been in Hindu SC/ST households which account for 38 per cent of the new constructions. Followed by Hindu OBC households with 24 per cent, other minorities (all religious minorities) with 20 per cent and, finally general Hindu households with 16 per cent. From these new toilet constructions, septic tanks have been the preferred choice of OSS for households across all socio-religious groups. However, share of pit constructions from respective new constructions for socio-religious groups are seen to be highest among general Hindu households (at 48 per cent) followed by Hindu SC/ST households (at 46 per cent). Figure 16 shows the septic tank and pits share across socio-religious groups for old toilets

KEY INSIGHTS

For new toilets constructed it is seen that highest share of toilet construction has been in SC/ST Hindu households 38 per cent of total constructions (236/626 toilets) reported.

The share of toilet construction has been significantly high in SC/ST and OBC households in the last 5 years with them cumulatively accounting for 62 per cent of total new constructions.

Highest amount of pit construction has happened in SC/ST Hindu household (46 per cent of total new constructions).

Septic tanks have largely been preferred by all communities.

How have state actors reacted to SBM-Gramin?

In the interview of stakeholders, Gram Panchayat members from 39 LDVs were interviewed to elicit their evaluation of sanitation in their respective villages. Since Panchayat members are the elected representatives it can be fairly assumed that they have a higher social status and, hence, a significant influence over the people in the village. 36 per cent of GP members interviewed reported change in preference patterns for OSS after SBM. However, 95 per cent of the GP members reported that septic tanks were still the predominant systems for newly constructed toilets and 67 per cent believe that septic tanks are better OSS. 67 per cent of GP members also reported construction on pits for newly constructed toilets, almost 50 per cent of which were twin-pits.

KEY INSIGHTS

36 per cent of GP members interviewed reported change in preference patterns for OSS after SBM. However, 95 per cent of the GP members reported that septic tanks were still the predominant systems for newly constructed toilets and 67 per cent believe that septic tanks are better OSS. 67 per cent of GP members also reported construction on pits for newly constructed toilets, almost 50 per cent of which were twin-pits.

90 per cent of the GP members interviewed reported that open defecation was still practiced in the village despite new toilet construction.

WHY DO HOUSEHOLDS CHOOSE ONE TYPE OF OSS OVER ANOTHER?

In Focus: The decision making of households has primarily been driven by economic and behavioural factors

Though largely households reported economic reasons – affordability and prioritisation of other house construction work – for their choice of OSS, the prioritisation of economic reasons has declined over the years. The reason being the subsidisation of toilet construction. Contrastingly, the behavioural reason has been prioritised more in the recent years hinting at a signalling effect of SBM–Gramin since larger number of new constructions have happened independently.

Analysis of these priorities (reasons) – economic, technical and behavioural – over the years specified by households which have opted for septic tanks or pits yields interesting trends. It is seen that sanitation programme has altered the preferences from septic tanks to pits gradually over the years for all households which prioritised any of the three reasons. This means the toilet construction programme has efficiently managed to alter perceptions about OSS technology. Concurrently, pits construction have burgeoned not only because of their affordability (which is explained by new constructions in poorer households) but also technical and behavioural reasons.

Considering the construction of OSS, the prioritisation of all reasons have risen over the years in favour of pits and have declined for septic tanks. Though this phenomenon has arisen because of larger construction of pits, analysis shows that the toilet construction programme has augmented all economic, technical and behavioural reasons for pit preference. Despite this septic tanks have remained as the preferred choice of OSS in LDVs.

Interviews of key informants too demonstrate the continued perception of septic tanks as more reliable OSS. Despite change in preference pattern reported by GP members and masons interviewed due to SBM, 67 per cent of GP members and more than 90 per cent of masons reported septic tanks as better OSS technology. This explains the influencing effect of socially eminent members and service providers towards the continued predominance of septic tanks in LDVs.

How have the perception of Households towards On-site Sanitation Systems changed over the years?

The last section presented the broad trends in the construction of septic tanks and pits and throws some light on the variation in their makes. While plenty of inferences can be made about the primary decision making factors behind the choice of containment units, as have been suggested in the end of last section, this section will attempt to articulate some of the explicit reasons provided by households. The survey designed by CPR included direct questions about economic, technical and behavioural reasons for the construction of septic tanks or pits (see Table 19). These specific reasons inform the trends in decision making factors that have led to the preference for septic tanks over pits or vice-versa.

Figure 17 depicts the trends in preference for septic tanks over pits or the other way round based on the

Table 19 *Reasons for constructing septic tank or pit*

Economic Reasons	Technical Reasons	Behavioural Reasons
• Best Option given Budget Constraints • More priority given to other expenses during house construction	• Structure considered durable • Structure considered better suited for local topography and soil conditions • Structure considered to be better suited for local rainfall conditions • Structure considered to be better suited for ground water table (flood proof) • Problems faced in previously existing containment system • Ease of maintenance • No odour or flies	• Advised by friends/neighbours • Advised by mason • Advised by Govt. Official • General awareness on the benefits of Septic tanks/Pits • Others

aforementioned reasons cited by the households. The information was collected in form of ranking of economic, technical and behavioural reasons cited by households to build a septic tank or a pit. This was done to elicit the prioritisation of decision making factors by households for their choice of OSS. It is noticed that over the years there has been an increasing trend for pits construction compared to septic tanks for

KEY INSIGHTS

Though largely people reported economic reasons for their choice of OSS, the prioritisation of economic reasons has declined over the years. The reason being the subsidisation of toilet construction. Contrastingly, the behavioural reason has been prioritised more in the recent years.

An analysis of these priorities over the years specified by households which have opted septic tanks or pits yields interesting trends. It is seen that sanitation programmes have altered the preferences from septic tanks to pits gradually over the years for all households which prioritised any of the three reasons. This means the toilet construction programme has altered perceptions about OSS technology.

Considering the construction of OSS, the prioritisation of all reasons have risen over the years in favour of pits and have declined for septic tanks. Though this phenomenon has arisen because of larger construction of pits, it shows that the toilet construction programme has augmented all economic, technical and behavioural reasons for pit preference.
Not only has SBM made toilets affordable for the households in large dense villages with the subsidy amount but it has also stimulated changes in perceptions about pits.

Figure 17 *Preference patterns for OSS based on prioritised decision making factors*

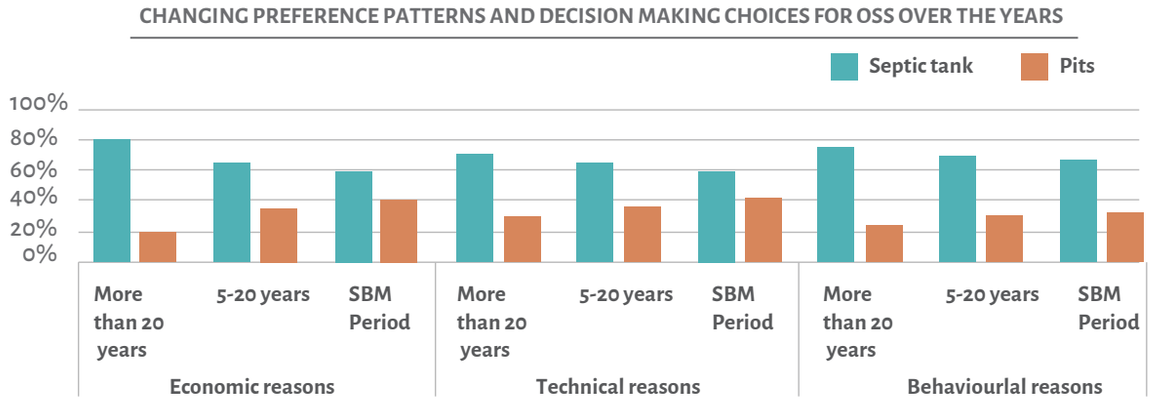


Figure 18 *Volume variation of OSS across years of toilet construction*

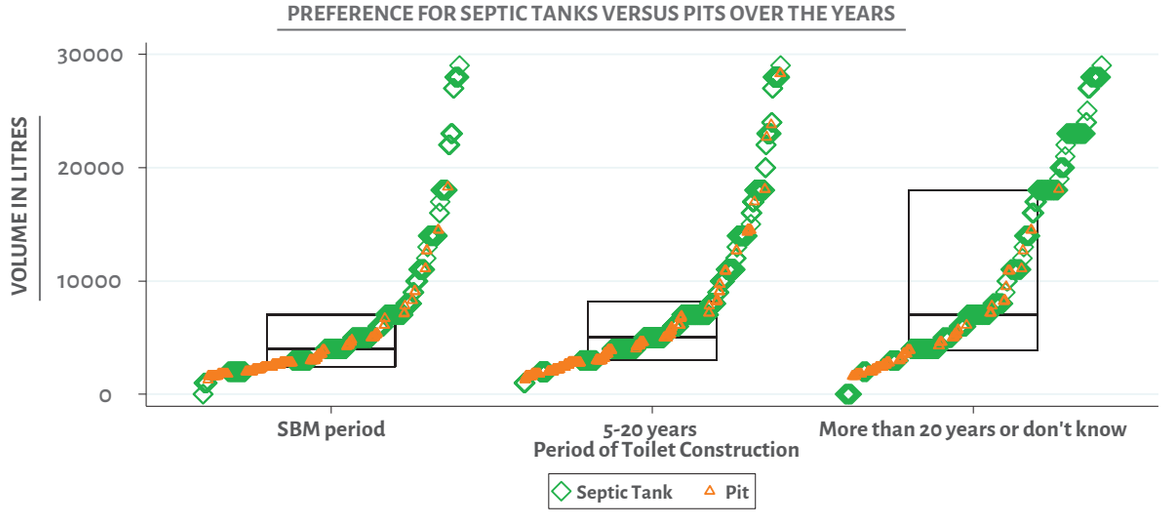


Figure 19 *MPCE variation across households from different socio-religious groups based on year of toilet construction*

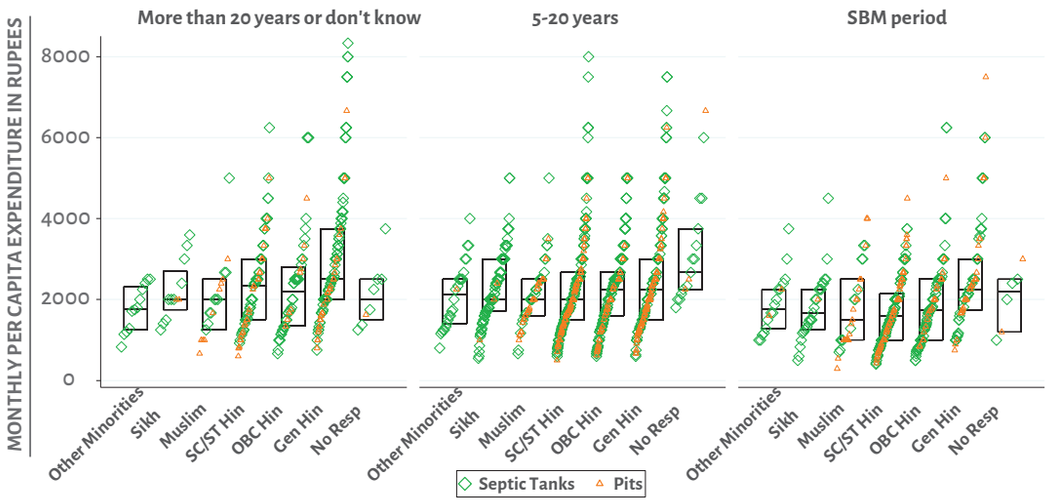
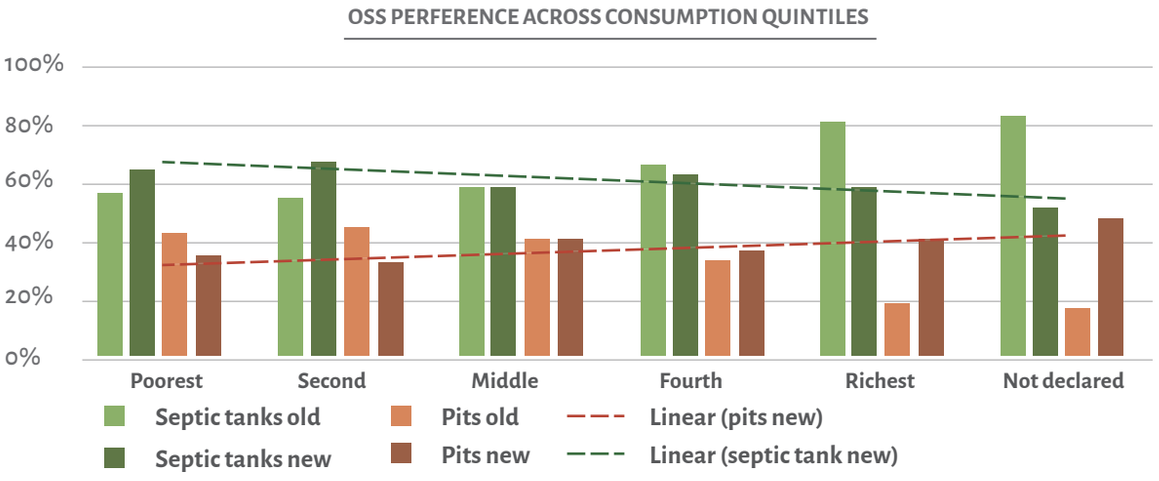


Figure 20 *MPCE distribution for household with different types of OSS for new and old toilets*

Figure 21 *OSS preference in old and new toilets across consumption quintiles*



all the reasons cited as priority. This trend could be attributed to a variety of things. Firstly, larger share of richer households had constructed toilets prior to the inception of SBM. This is evidenced in Table 21 where over the years MPCE of households constructing toilets has declined. Secondly, space constraint might have been another reason why households' choice has shifted from septic tanks to pits. Table 21 also depicts how the volume of containment systems has shrunk over time and OSS built in the last five years are of lesser volume than older OSS. Thirdly, the reduction in the volume of containment units also suggests that construction of smaller OSS is because of an increase in desludging services. After all, CPR's LDV survey is based on villages proximate to cities and highways. Finally, and most importantly, it is the effect of SBM on household's choices and mason's technical know-how. Not only has SBM made toilets affordable for the rural households with the subsidy amount but it has also stimulated changes in perceptions about pits.

Table 18 reveals the trends in toilet construction over the years and how there has been a gradual reduction in the volume of the containment units (see Figure 18). It also gives an insight on who has constructed the toilets over the years. While a simple reading of Table 18 suggests that the poorer households built their toilets in the last five years, Figure 19 gives the caste and religion break-up of the sampled population to reveal further trends.

KEY INSIGHTS

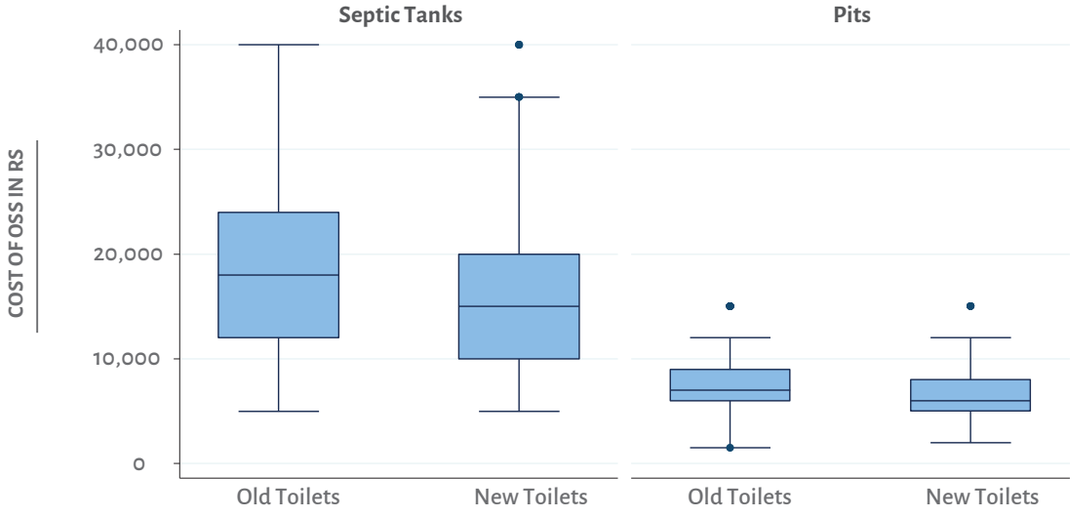
Out of the total 626 new toilets, 32 per cent (198 toilets) were constructed in households which had Below Poverty Line (BPL) cards and 66 per cent of these households had septic tanks.

How have the changed perceptions affected choice of OSS across economic classes?

Noticeable trends are observed in preference for septic tanks or pits as OSS across different economic classes. Using MPCE as a proxy for income and hence economic well-being, it is observed that median MPCE of households with toilets with OSS when analysed over the years are the lower for households new toilets during SBM period compared to old toilets (Figure 20). This corroborates previously mentioned claim that larger number of constructions have happened in poorer households. However, it is seen that pits construction have happened not only in households with lower MPCE but also in households with higher MPCE. It is seen to be more prominent in new toilets section of the plot. The spread of the distribution in the

Upon further investigation of the construction of septic tanks and pits across different consumption quintiles it is seen than there is a gradual decline in preference for septic tanks for new toilet constructions as we move from the poorest to the richest quintile and households that did not declare their consumption expenditures (Figure 21). Concurrently, there is an increase in preference for pits with the sharpest jump seen in

Figure 22 *Cost of OSS (septic tanks and pits) for old and new toilets*



KEY INSIGHTS *Though a larger share of poor households have built new toilets, bringing down the median mpce of households with new toilets below that of old toilets, households from all quintiles have built septic tanks.*

richest and not declared categories of households.

These altered perceptions have manifestly changed not only the preference for specific types of OSS but also the design and make of such substructures. With toilets being made affordable for poorer households, cost of construction reported has declined over the years and so has the volume of containment units (Figure 22).

The cost of constructing toilets reported by households have also declined in the last 5 years, thus, signifying lowering of costs by availability of subsidy and increased construction of toilets by masons.

The reduction in OSS cost reported has been justifiably so considering the large number of constructions in poorer households.

The median OSS cost of septic tanks is Rs 15,000 for new toilets compared to the corresponding figure for old toilets – Rs 18,000. The median cost for pits also has come down from Rs 7000 for old toilets to Rs 6,000 for new toilets.

KEY INSIGHTS *The increasing preference for pits can be attributed to the direct or indirect effect of SBM as seen in Madhya Pradesh and Tamil Nadu and specific state effects where pit construction is normally high like West Bengal.*

HAVE THERE BEEN DEVIATIONS FROM THE IDEAL DESIGN OF OSS?

In Focus: Variations in design and make of on-site sanitation systems based on their year of construction, socio-economic and infrastructural factors of households

This sub-section includes analysis that delves deep into the variations in design and make of OSS that have been observed in previous sections and reports.

What kind of deviations have been seen in OSS construction?

It is observed that though households largely prefer septic tanks to pits, they also demonstrate higher deviations from design in context of waste water outlet to soak pits. Figure 23 gives the distribution of old and new toilets distributed across type of OSS and their waste water outlets. 33 to 42 per cent of old and new septic tanks discharge waste water into open land and drains, compared to 23 to 30 per cent of such deviations in pits.

Variations in sizes of containment units are also seen based on their waste water outlets and year of construction (see Figure 24).

KEY INSIGHTS *"Deviations in construction of OSS over the years shows how there are variations not only in number of chambers or pits for septic tanks and pits resp. but also in size and waste water outlets of OSS constructed.*

Deviations in design of septic tanks are more than the same for pits."

Figure 23 *Waste water outlet for old and new OSS*

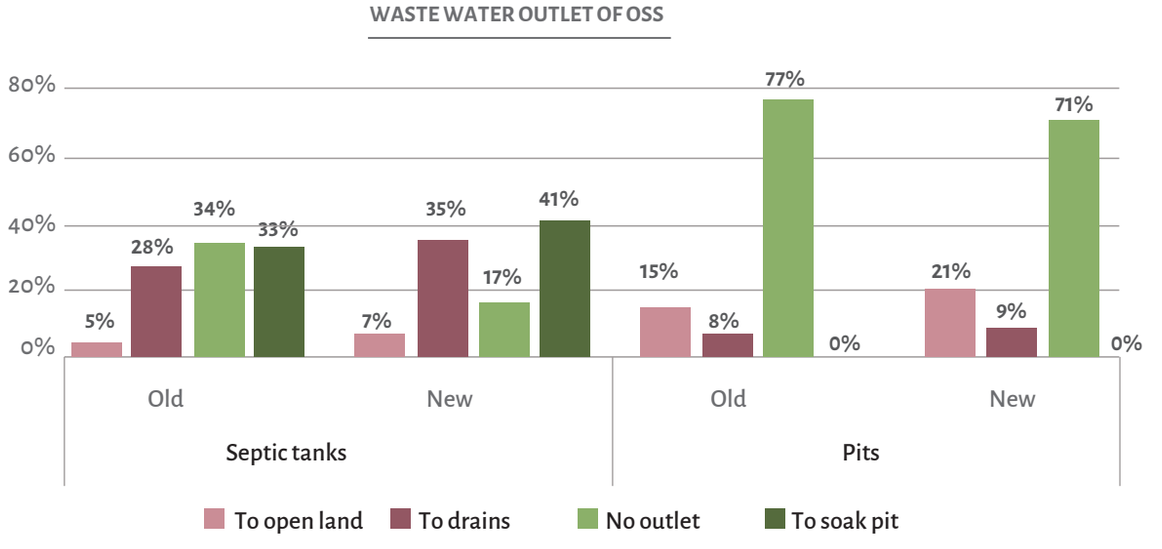


Table 20 *Choice of waste water outlet for septic tanks based on economic, technical and behavioural reasons across states*

State	Economic Reason				Technical Reason				Behavioural Reason			
	To Open Land	To Drains	No Outlet	Soak Pits	To Open Land	To Drains	No Outlet	Soak Pits	To Open Land	To Drains	No Outlet	Soak Pits
Himachal Pradesh	7 (7.29%)	4 (4.17%)	15 (15.63%)	70 (72.92%)	8 (5.3%)	7 (4.64%)	32 (21.19%)	104 (68.87%)	10 (7.09%)	4 (2.84%)	29 (20.57%)	98 (69.5%)
Punjab	7 (3.57%)	170 (86.73%)	2 (1.02%)	17 (8.67%)	1 (1.05%)	85 (89.47%)	0 (0%)	9 (9.47%)	2 (2.94%)	63 (92.65%)	0 (0%)	3 (4.41%)
West Bengal	2 (9.09%)	0 (0%)	3 (13.64%)	17 (77.27%)	1 (11.11%)	0 (0%)	0 (0%)	8 (88.89%)	0 (0%)	0 (0%)	2 (22.22%)	7 (77.78%)
Madhya Pradesh	15 (10.27%)	48 (32.88%)	0(0%)	83 (56.85%)	10 (14.29%)	23 (32.86%)	1 (1.43%)	36 (51.43%)	10 (10.1%)	31 (31.31%)	3 (3.03%)	55 (55.56%)
Tamil Nadu	4 (1.99%)	1 (0.5%)	191 (95.02%)	5 (2.49%)	4 (3.1%)	1 (0.78%)	120 (93.02%)	4 (3.1%)	1 (1.69%)	0 (0%)	53 (89.83%)	5 (8.47%)
Total	35 (5.3%)	223 (33.74%)	211 (31.92%)	192 (29.05%)	24 (5.29%)	116 (25.55%)	153 (33.7%)	161 (35.46%)	23 (6.12%)	98 (26.06%)	87 (23.14%)	168 (44.68%)

Table 21 *Multinomial logit model predicting relative risk ratio differences between households with septic tanks connected to soak pits and septic tanks with other waste water outlets*

Parameters	To Open Land	To Drains	No Outlet	Soak Pits
Volume of Septic Tank (in increments of 1000 litres)	-0.009***	-0.014***	-0.009***	0
Monthly Per Capita Expenditure (in increments of Rs 1000)	0.166	-0.507***	0.291***	0
Water for supplementary use in litres per capita per day (in increments of 10 litres)	-0.01	0.009	-0.053***	0
Distance from Nearest Class I city (in increments of 1 kilometre)	-0.008	-0.014	-0.016**	0
Open and Kutcha Drainage (relative to no drains)	-1.361***	2.773***	-1.093***	0
Underground and/or Covered Drainage (relative to no drains)	-1.708**	2.670***	-2.423***	0
Tap water to premise (relative to ground water source)	-0.299	0.079	1.424***	0
Non-motorable road (relative to motorable road)	1.165**	0.111	-1.968***	0
No road (relative to motorable road)	-0.044	-1.221***	-2.218***	0
Double Chambered Septic tank (relative to single chambered septic tank)	0.174	1.214**	1.097*	0
Three Chambered Septic Tank (relative to single chambered septic tank)	0.088	-0.264	1.399**	0
Semi-pucca House (relative to kutcha house)	0.61	1.471***	2.094***	0
Pucca House (relative to kutcha house)	0.844*	1.414***	1.182**	0
Constant	-1.593*	-1.600**	-1.509*	0
* p<0.05, ** p<0.01, *** p<0.001				

drains are 2.773 and 2.670 times respectively more likely to deviate from construction of soak pits and connect waste water outlets to drains. Contrastingly, households are less likely by 1.093 and 2.423 times respectively to not have outlets and prefer soak pits when they have access to drains. It is to be noted that this model predicts the relative risk ratios compared to not only the base or reference for each parameter such as no drains in the case of drainage parameter which is a categorical variable but also relative to the base of dependent variable category of septic tanks with soak pits. For continuous variables such as volume of septic tank, monthly per capita expenditure of the household and water consumption are measured in increments of 1000 litres, Rs 1000 and 10 litres per capita per day respectively. From these variables the most influential factor is monthly per capita expenditure of the household which influences a preference for construction of soak pits over connection to drains by 50 per cent for every Rs 1000 increase.

There are state level influences that act as confounding factors in the model described above such as monthly per capita expenditure's influence on deviation from soak pits to no outlets is shown positive because of the richer households in Tamil Nadu that haven't built soak pits for their septic tanks. Irrespective of such results, this kinds of analysis holds key to understanding deviations from prescribed design of containment systems (BIS, 2002; MoDWS, 2016) and desludging behaviour of households.

The multinomial logit helps explain some reasons for the deviation from the ideal design of septic tanks which is three chambered and connected to a soak pit in large and dense villages. Suffice it to say that deviations from the ideal design is one of the primary reasons for irregular desludging of the septic tanks. But similar logic could not be extended to pits based on waste water outlets since more than 70 per cent of households with pits have no outlets. The size and kind of waste water outlets of the containment structures influence the demand for desludging services – mechanised and manual. It is unfortunate that these deviations sustain the practice of manual scavenging in large and dense and villages as has been mentioned in the report on Sanitation in Large and Dense Villages of India: The Last Mile and Beyond (2019).

What impact do these deviations have on desludging behaviour of households?

Deviations from ideal design of septic tanks and pits in terms of volume based on household size and waste water outlets impact the filling of the containment unit and, hence, impact the desludging behaviour of households. The household survey reveals that only 17 per cent of total surveyed houses have reported desludging. Figure 24 and 25 give the percentage of different types of septic tanks and pits (respectively) distributed across different waste water outlets and how many of those households have actually reported desludging their OSS. It is observed that only 18 per cent of desludging is reported for septic tanks with no outlets while 16 per cent desludging is reported for pits with no outlets. Thus, effectively very few households have reported emptying their containment units which are mostly the ones which have no outlets.

In addition to this it is also seen that most of desludging of OSS have been reported in households with smaller containment units (Figure 26). The median volumes of septic tanks and pits in households that have reported emptying them are 5000 and 2800 litres only.

KEY INSIGHTS

"Only 21.53 percent of households surveyed have reported desludging their OSS.

Mostly OSS connected to no outlets have reported desludging their OSS."

Figure 24 Volume variations for OSS based on waste water outlets and year of construction

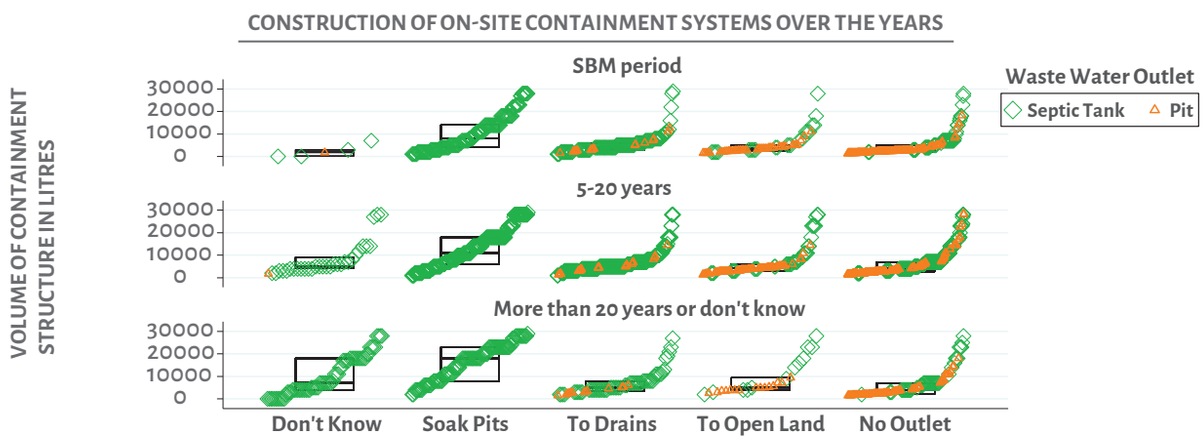


Figure 25 *Desludging of septic tanks based on their waste water outlets*

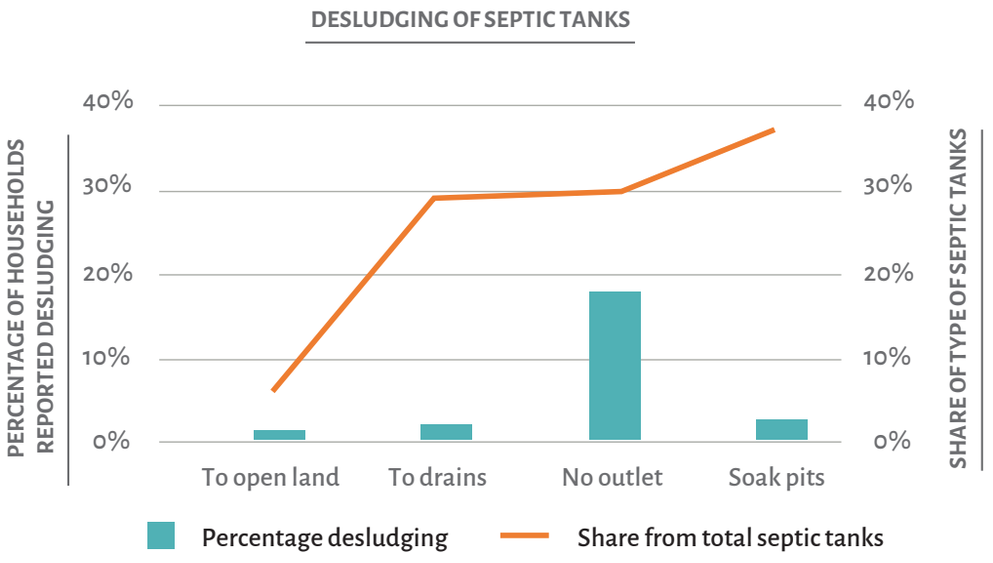


Figure 26 *Desludging of pits based on their waste water outlets*

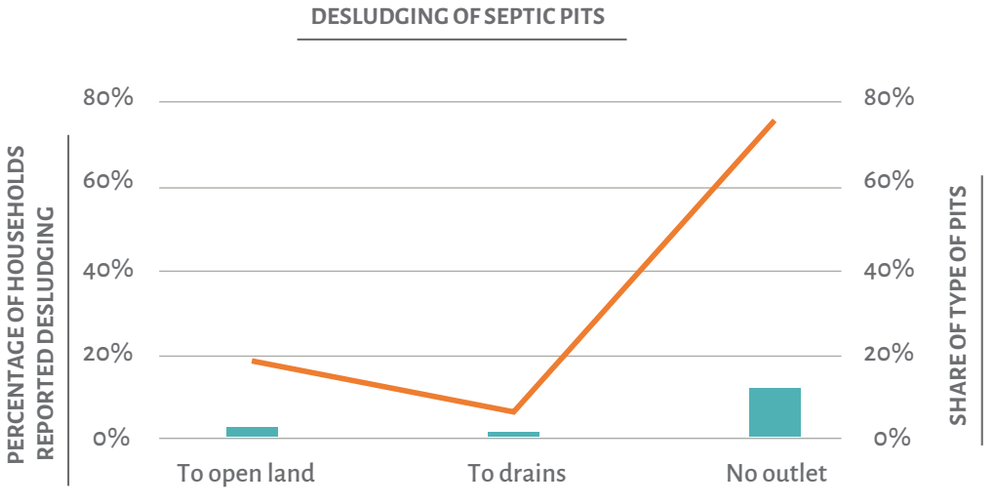
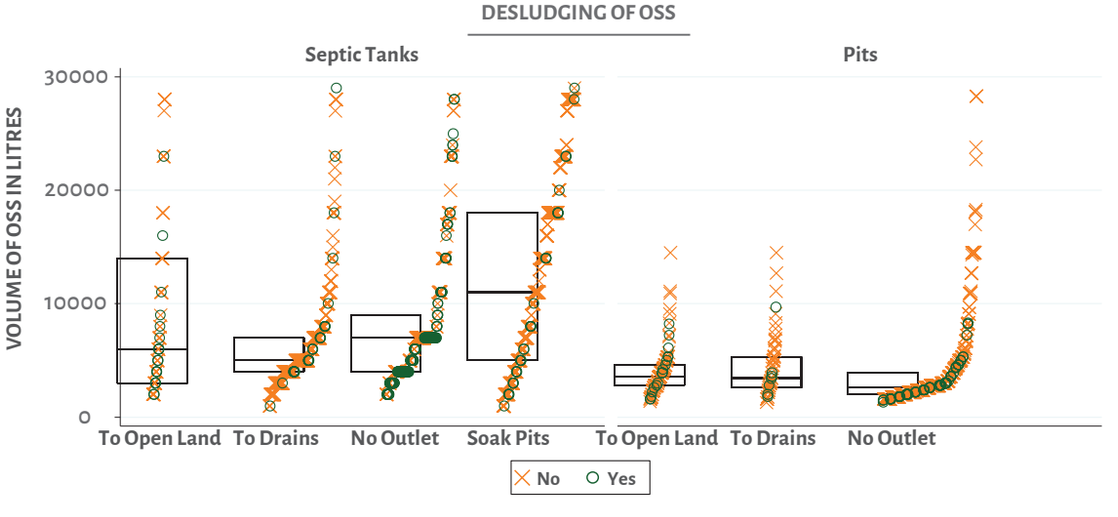


Figure 27*Desludging of OSS based on their volumes and waste water outlets*



What are the perceived reasons for deviation?

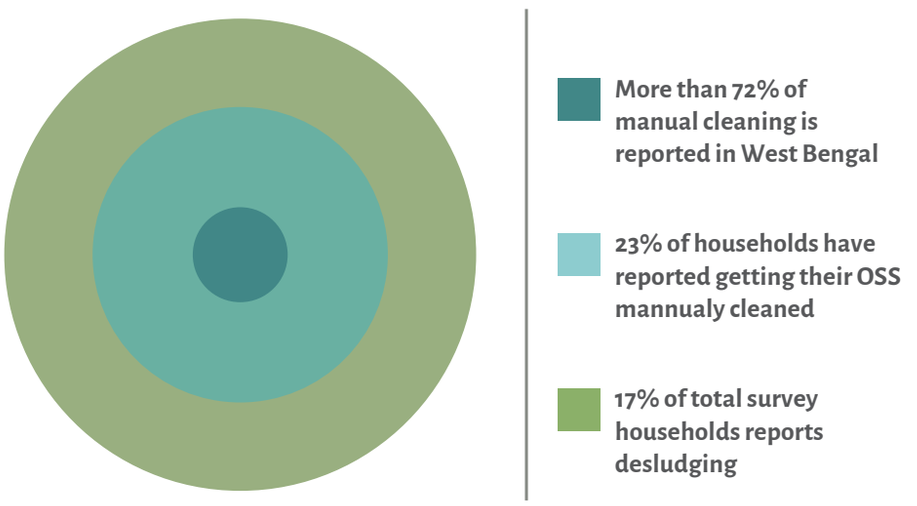
Further exploration of the LDV dataset is quite telling about the reasons provided by households for preferring septic tanks or pits as their containment units. Utilising the information on revealed preference for septic tanks and pits the particulars of economic, technical and behavioural reasons (Table 19 and Figure 17) were explored in the earlier study (Bhol 2019). However, the same information has been used here to understand the prioritization of economic, technical or behavioural reasons for variations in the design of the septic tanks constructed by households. Table 20 distributes the households with septic tanks across different waste water outlets based on the citation of economic or technical or behavioural reason as priority which making the decision for construction. Certain state level trends emerge which highlight choice of waste water outlet for septic tanks. Himachal Pradesh followed by Madhya Pradesh have most number of septic tanks connected to soak pits. But higher number of households from Himachal Pradesh have prioritized technical and then behavioral reasons for building septic tanks while in Madhya Pradesh higher number of households have cited economic reasons as their priority. For septic tanks with no outlets around 80 per cent of households are from Tamil Nadu where they have largely attributed economic reasons as the biggest decision making factor followed by technical reasons. For Punjab, however, waste water outlets to drains is a rampant practice covering over 88 per cent of total septic tanks in Punjab and 72 per cent of septic tanks connected to drains from the total number of septic tanks connected to drains figure. More than 53 per cent of these households from Punjab have cited economic reasons as their priority.

The benefits of this analysis though are limited only to understanding region specific trends. For a detailed understanding of the deviations from the ideal design for septic tanks with soak pits based on different factors an econometric analysis is imperative. Table 21 shows the results of a multinomial logistic regression applied to households across all states with septic tanks. The dependent variable is waste water outlets

What have been the responses of service operators in LDVs?

Only 5 out of 12 truck operators interviewed reported of being hired by the Panchayat and only two operators have been formally licensed for conducting desludging business. With the exception of one operator who provides desludging service with an open cart connected to motorised vehicle, the rest operate by use of trucks or tractors. They have reported that provide services in 3 to 80 villages and commute from a minimum of 1 km to as far as 50 km to provide services. On an average they service 30

Figure 28 *Evidence of manual cleaning of OSS from LDV survey*



households every month with the highest number of monthly services reported in West Bengal on account of the highly populated LDVs there. With the exception of one operator, all the rest dispose the septage in open land or in drains. The charges have varied from Rs 800 to Rs 2500 per trip and is based on the distance commuted by the service operator. 3 out of 12 operators (all from Tamil Nadu) have reported that manual handling of waste is required at some point between collections from household and final dumping. With the exception of three operators who did not reveal their caste, the rest of the interviewed operators reported that were Dalits.

What evidences were found on the perpetuation of manual cleaning of OSS?

As mentioned earlier, the survey reveals that only 17 per cent of surveyed households (21 percent of households with OSS) have availed desludging services. 24 per cent of the households availing desludging their OSS have reported availing manual cleaning. Out of this the maximum amount of manual cleaning is reported in West Bengal (see Figure 27). An average of Rs 1500 has been paid by households for manual cleaning of their OSS.

Besides the household survey, interviews of identified manual cleaners were conducted in 11 villages. All 9 manual cleaners reported having a regular demand of desludging. 9 out of 11 manual cleaners reported working along with other people while cleaning OSS and 4 out of them said other members in their family also manually cleaned OSS. While all of them reported of being contacted by households, 3 of them reported of being contacted by truck operators and 2 reported of being contacted by the Panchayat. They all reported of cleaning different types of OSS in their own villages and nearby villages within a radius of 2–10 kilometres. Except for 2 interviewed manual cleaners the rest reported being Dalits- *Dumars* in Madhya Pradesh, *Mazhabi Sikh* in Punjab and *Thottis* in Tamil Nadu.

CONCLUSION

The findings of the survey underscore the relevance of OSS systems in LDVs in terms of their predominance given the absence of networked sewerage systems in rural areas. The fact that the survey covered only LDVs which are proximate to cities (with 90 per cent of surveyed households within 25 kilometres from cities), also, highlights the case of rural-urban contiguity manifested in terms of the prevalence of OSS. The 60 LDVs survey throws up a positive correlation between septic tank coverage and urbanisation, distance from cities, economic factors, tap-water supply, waste usage and approach road. Interviews of gram panchayat members and masons corroborate these findings while also providing insights on the preference patterns for OSS choices of households. The research highlights the magnitude of OSS prevalence and variations in choice patterns for them. It also showed that there was limited experience and nascent maintenance services with only 17 per cent of households reporting desludging their OSS and 33 per cent of households reporting directly discharging their toilet waste into drains and open land. Further, it was seen that there are deviations from the ideal design of chambered septic tanks with soak pits and twin-pits which also seem to impact the regular desludging. This points at the urgent need to improve sanitation services in LDVs to ascertain safe treatment and disposal of waste.

Further, gauging the improvements made in toilet construction during the SBM period, we find, IHL coverage has improved from 65 per cent to 85 per cent in LDVs augmenting OSS coverage to 77 per cent. SBM's impact has been both direct and indirect since 35 per cent of new toilet constructions are reported of being built with government's support and almost one-fourth of the toilets reported in LDVs were built during the SBM period. The last 5 years have accounted for more significant share of toilet construction in poor households with IHL coverage for Below Poverty Line households visibly augmented by 28 per cent. Across socio-religious groups, the SBM period has been impactful as well since the survey findings highlight IHL coverage improvement for SC/ST Hindu, other religious minorities and OBC Hindu households by 23, 22 and 20 per cent respectively. Another impact of SBM has been in terms of increasing the acceptance of pits though septic tanks remain the widely preferred choice. To this end, the affordability of toilets and behavioural impact of SBM are key attributes.

This report has furthered the research on sanitation in LDVs by answering some of the questions raised as future research areas in the previous study. Learnings from the key takeaways in this report, though helpful, emphasise on some critical research in the way forward. One, taking cognizance of the improvements in toilet construction during SBM period, there is an urgency to upgrade sanitation services in LDVs. Understanding that the impact has been substantial enough, what steps need to be taken to complement the development of sustainable FSM methods for rural areas? Two, deviations in OSS design and combinations of socio-economic-infrastructural factors are seen to influence desludging behaviour. To this end, it is imperative to understand how can desludging of OSS be regularised in rural areas? Three, the proximity of surveyed villages to cities attests rural-urban continuum not just in terms of territorial contiguity but also in terms of sanitation infrastructure. But there is an inadequacy of treatment facilities in urban areas of India both in terms of their numbers and treatment capacities. So the pertinent research along these lines are – what necessary institutional and infrastructural upgrades are required to match the desludging and waste treatment demand in LDVs? And how can such demand and supply gaps in sanitation infrastructure and services be addressed through integrated planning?

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APPENDIX

Table A1 *Final List of Large and Dense Villages Surveyed*

State	District Name	Village No.	Village Name	LDV Type	Census Population	Household Sample Size planned	Actual Household Sample Surveyed
Himachal Pradesh	Shimla	1	Jhakhri	CT	4655	100	101
		2	Kumharsain	Vill	1545	35	35
		3	Meheli	Vill	1523	35	35
		4	Shogi	Vill	1256	30	30
	Mandi	5	Dehar	Vill	1738	35	37
		6	Jarol	Vill	2136	45	47
		7	Karsog	Vill	1907	50	50
		8	Salaper	Vill	2850	70	72
	Kangra	9	Bhapoo	Vill	2400	35	37
		10	Gangath	Vill	4194	63	66
		11	Indora	CT	4534	70	70
		12	Kandrori	Vill	1959	32	33
Madhya Pradesh	Jabalpur	13	Baghraji	Vill	5375	50	57
		14	Bargi	CT	6916	50	53
15 Gandhigram Vill					6817	50	50
		16	Kundam	CT	4856	50	53
	Satna	17	Majhgawan	CT	8290	50	55
		18	Rahikawara	Vill	7845	50	50
		19	Singhpur	Vill	5965	45	48
		20	Sonwari	Vill	8105	55	57
	Rewa	21	Garh	Vill	5229	45	47
		22	Nowbasata	CT	4358	45	47
		23	Raipur	Vill	6415	55	57
		24	Tiwani	Vill	6779	55	55
Punjab	Jalandhar	25	Apra	CT	6258	55	55
		26	Birk	Vill	5264	55	55
		27	Chomon	CT	3704	35	36
		28	Dhin	CT	5961	55	55
	Amritsar	29	Baba Bakala	CT	8946	53	55
		30	Chogawan	CT	5416	32	33
		31	Nag	Vill	9352	64	64
		32	Sathiala	Vill	9358	52	53
	Gurdaspur	33	Behrampur	CT	5432	45	47
		34	Fateh Nangal	CT	7721	65	65
		35	Harchowal	Vill	5291	45	46
		36	Kala Afgana	Vill	4944	45	46

State	District Name	Village No.	Village Name	LDV Type	Census Population	Household Sample Size planned	Actual Household Sample Surveyed
Tamil Nadu	Cuddalore	37	Manjakuzhi	Vill	5949	46	46
		38	Pallippadai	CT	6369	46	49
		39	Periyakurichi	CT	7599	62	64
		40	Silambimangalam	Vill	5695	46	49
	Coimbatore	41	Arasur	CT	11510	70	70
		42	Chinnathadagam	CT	8407	50	50
		43	Chinniam palayam	CT	8232	45	45
		44	Kattampatti	Vill	5859	35	35
	Thanjavur	45	Chakkarapalli	CT	6227	43	43
		46	Kabisthalam	Vill	6630	51	52
		47	Natchiarkoil	CT	7505	57	59
		48	Thirunariyur	Vill	6786	50	50
West Bengal	South Twenty-four Parganas	49	Ghatak Pukur	Vill	5048	40	44
		50	Kanganbaria	CT	6657	60	65
		51	Ramkrishnapur	CT	5971	50	51
		52	Uttarparanij	CT	6810	50	53
	Nadia	53	Belgharia	CT	5858	45	50
		54	Gangni	CT	5532	40	43
		55	Punglia	CT	6857	50	54
		56	Silinda	Vill	7741	65	68
	Hugli	57	Baksa	CT	6432	60	74
		58	Bargachhia	CT	4566	40	41
		59	Kalachhara	Vill	4225	40	41
		60	Ramanathpur	CT	6811	60	64

Scaling City Institutions for India: Sanitation

Sanitation programme at the Centre for Policy Research (CPR) is a multi-disciplinary research, outreach and policy support initiative. The programme seeks to improve the understanding of the reasons for poor sanitation, and to examine how these might be related to technology and service delivery models, institutions, governance and financial issues, and socio-economic dimensions. Based on research findings, it seeks to support national, state and city authorities develop policies and programmes for intervention with the goal of increasing access to inclusive, safe and sustainable sanitation. Initiated in 2013, the programme is primarily funded by the Bill and Melinda Gates Foundation (BMGF).

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