REPORT

SOLID AND LIQUID WASTE MANAGEMENT IN DHENKANAL DISTRICT: SITUATION ASSESSMENT REPORT

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SCI-FI SCALING CITY INSTITUTIONS FOR INDIA WATER SANITATION

REPORT

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Acknowledgement

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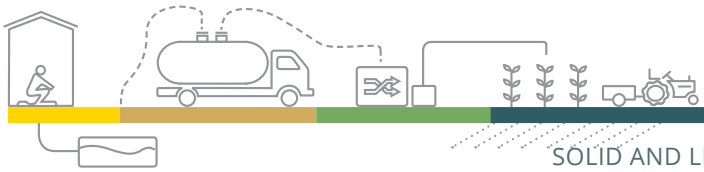


INTRODUCTION

Sanitation, or the safe management of solid and liquid wastes, along with the practice of hygiene, is critical to public health and contributes to reduced infant and maternal mortality rates, improved nutrition and education outcomes, increased productivity, and the physical and mental well-being of individuals[1]. Accordingly, Sustainable Development Goal 6 underlines the global target to ensure availability and sustainable management of water and sanitation for all. As per the UN, around 4.2 billion people still lack safely managed sanitation globally (2017).

With nearly 70% of India's population residing in rural areas, instituting and sustaining rural sanitation systems, is as crucial today as it was in the wake of independence when the country was primarily rural. Yet, the efforts to improve rural sanitation beginning in the 1950s culminated into a structured and streamlined programme only during the International Drinking Water Supply and Sanitation Decade of the 1980s with the launch of the Central Rural Sanitation Programme in 1986. Since then, nationwide programmes have followed at each other's heels for increasing access to improved sanitation, albeit understood to be comprising individual toilet facilities among rural households.

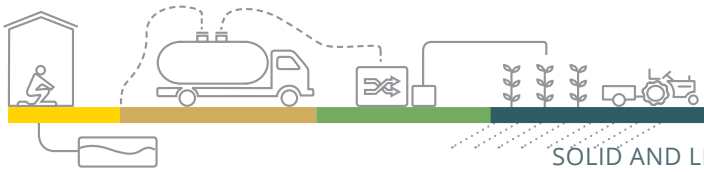
The Swachh Bharat Mission – Gramin (SBM-G), launched on 2nd Oct 2014 and the latest of such programmes, sought to accelerate the penetration of toilets in rural areas, which had stood at 31% in 2011 as per the Census of India. The programme aimed to tackle the issue of open defecation through a mission mode drive to construct subsidised toilet facilities. At the end of the first phase of SBM, districts and states across the country had declared themselves Open-Defecation Free (ODF) through the construction of about 103 million rural toilets during 2014-19[2]. Recognizing that access to toilets is the first step to safe sanitation outcomes, the recently launched SBM-G Phase II, targets ODF sustainability and Solid and Liquid Waste Management (SLWM), including Faecal Sludge Management (FSM). Besides strategies like trenching and co-treatment for FSM, the guidelines mention planning new Faecal Sludge Treatment Plants (FSTPs) in districts.

As per Census 2011, Odisha is one of the top states in terms of rural population share with almost 83% of the population residing in rural areas. Census reported the toilet access for rural Odisha to be 14%. The state, with one of the lowest reported access levels to a toilet among rural households at baseline, had declared all of its 30 districts open-defecation free[3] by 2019. Since 2014, 6.9 million toilets have been built in rural Odisha. Driven by a forward-thinking approach, the Hon'ble Chief Minister of Odisha proclaimed the message of 'Swachh Odisha, Sustha Odisha' in 2018 for furthering the state's achievement, leveraging the gains the state had been making under SBM-G. Odisha has already been successfully addressing these issues through institutionalization of FSM in urban areas, emerging as a sanitation exemplar over the last few years. The state has been one of the first to demonstrate FSM systems

1 Various studies have shown evidence including UNICEF-Evidence Paper: The Impact of WASH on Key Health & Social Outcomes, 2016; World Bank-Flagship Report: Economic Impacts of Inadequate Sanitation in India, 2011.

2 Source: http://sbm.gov.in/sbm (India Ministry of Drinking Water and Sanitation, 'Swachh Bharat Mission-Gramin')

3 SBM-G MIS. Retrieved from https://sbm.gov.in/sbmReport/State.aspx (last accessed on July 31, 2020)



in smaller towns viz. Dhenkanal and Angul, scaling up further to its nine Atal Mission for Rejuvenation and Urban Transformation (AMRUT) cities, and a massive ongoing scaling-up effort to cover all its urban areas.

As a first step toward the goal of clean and sanitized villages, the state has recently issued its Rural Sanitation Policy, 2020, that guides and enables sanitation interventions in rural areas over a ten-year horizon. In operationalizing the Policy and in line with the objectives of SBM-G Phase II, the district of Dhenkanal in the state, with support from UNICEF and the Centre for Policy Research (CPR), is undertaking a one-of-its-kind project to firstly, formalize urban-rural convergence and coordination mechanisms for utilizing urban FSM system to also cater to peripheral rural areas; secondly, to pilot a greenfield SLWM system for a cluster of Gram Panchayats in the district and lastly, to demonstrate a district-wide approach to sanitation planning.

To better understand the prevailing SLWM landscape in the district and guide interventions, the Project undertook a desk review of the Dhenkanal district followed by a primary data collection through a survey of 1000 households and interviews with over 30 key stakeholders at the GP-level during August-September 2020.[4]

STRUCTURE OF THE REPORT

The report is divided into two parts.

Desk Review (Part A) collates and analyses data from various secondary sources. In this, the first section introduces the district through its demographic characteristics as well as a geophysical and economic profile. The second section presents trends from an analysis of sanitation-related secondary data.

Primary data analysis (Part B) consists of the findings from the survey conducted across the rural Dhenkanal district. It starts with the socio-economic profile of the respondents, then delves into the details of the existing toilet access and usage, infrastructure for blackwater management, desludging behaviour, access to drinking water, disposal of graywater and lastly, management of solid waste. The section also highlights the perception of people and willingness to pay with respect to solid and liquid waste management.

Finally, the conclusion section highlights the key issues and challenges that need to be addressed for SLWM in the district.

4 The district-level survey data has been disaggregated using the categories of 'Plug-in' and 'Greenfield'. Under the survey design, 'Plug-in' has been defined as rural areas within a 30 km distance from the Dhenkanal municipality. 'Greenfield' refers to those rural areas lying outside of this zone in the district.

PART A: DESK REVIEW

The present section collates and analyses data from secondary sources, including

- Census of India (2011),
- Swachh Bharat Mission MIS,
- Records from the Faecal Sludge Treatment Plant (January 2019 – February 2020), and
- Central Groundwater Board District Profile
- National Rural Drinking Water Programme (NRDWP) MIS

to evaluate the existing sanitation service levels in the district.

1. PROFILE OF DHENKANAL DISTRICT

Dhenkanal is one of the 30 districts in Odisha and is spread over 4452 square kilometres in the central part of the state (Figure 1). As per Census of India 2011, the district has a total population of nearly 12 lakhs amounting to 2.7 lakh households residing in 3 statutory towns, two census towns, and 1208 villages. The district population grew at a decadal rate of 11.8% during 2001-11 (Table 1). Overall, the district has been ranked 15th among all the districts of Odisha in terms of size and 19th in terms of population.

FIGURE 1: LOCATION OF THE DISTRICT AND POPULATION IN DIFFERENT BLOCKS OF THE DISTRICT

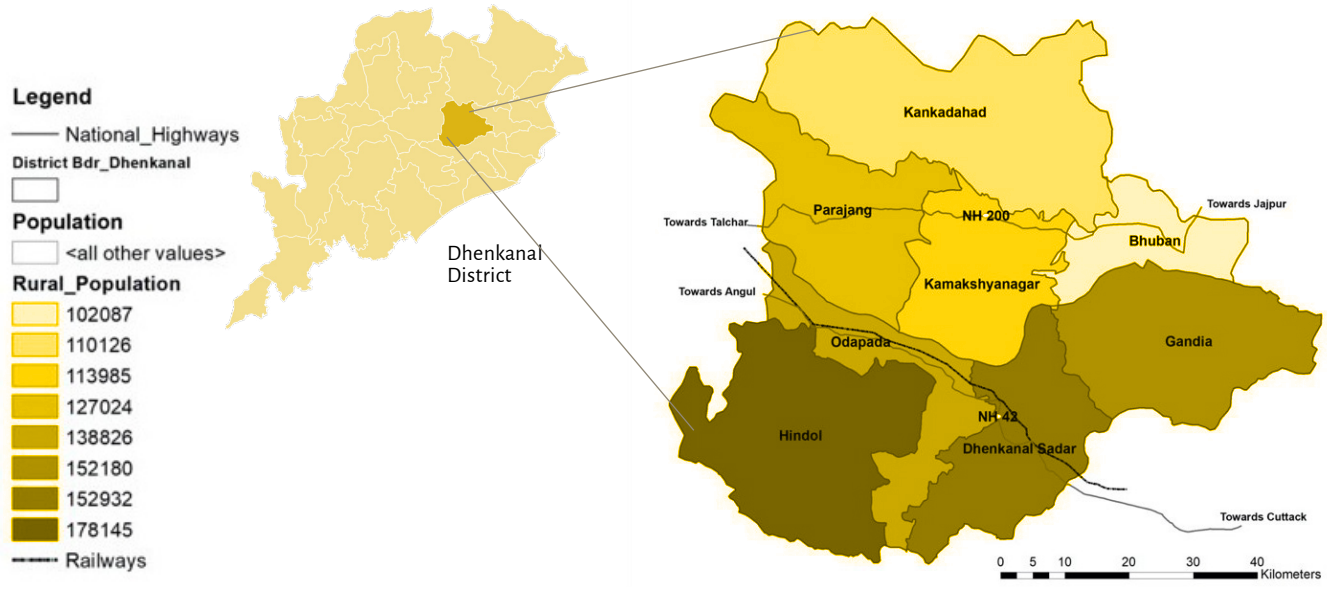
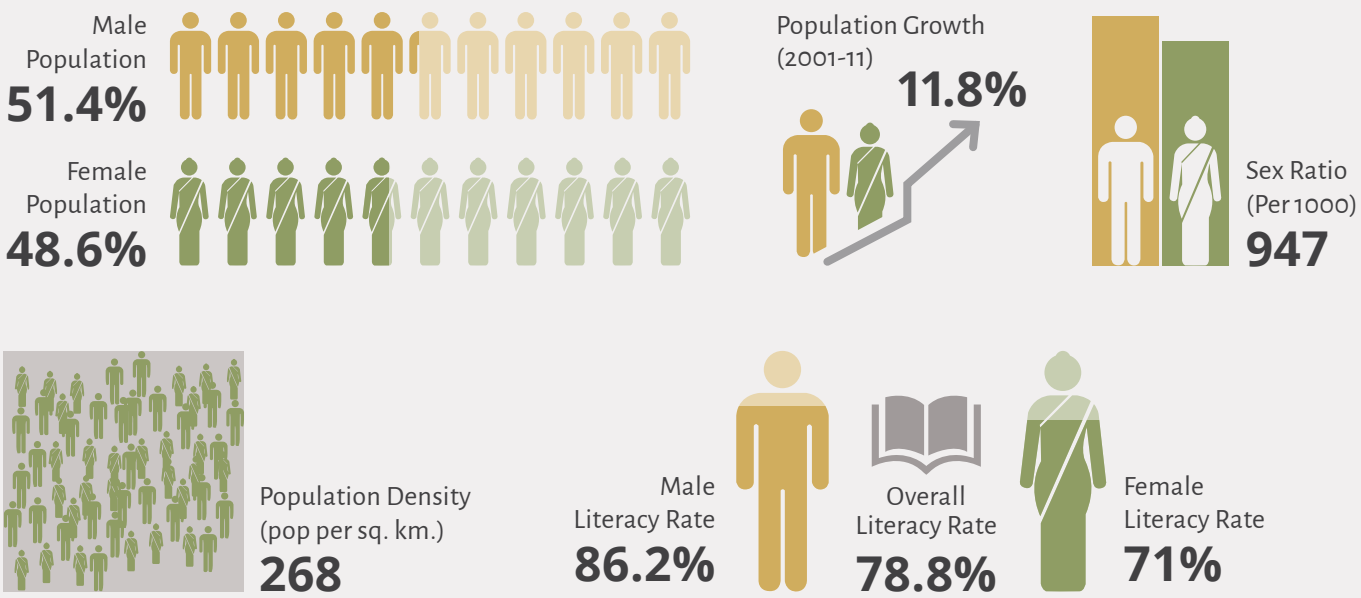


FIGURE 2: BRIEF DEMOGRAPHIC PROFILE OF THE DISTRICT



a. Administrative and Demographic Profile

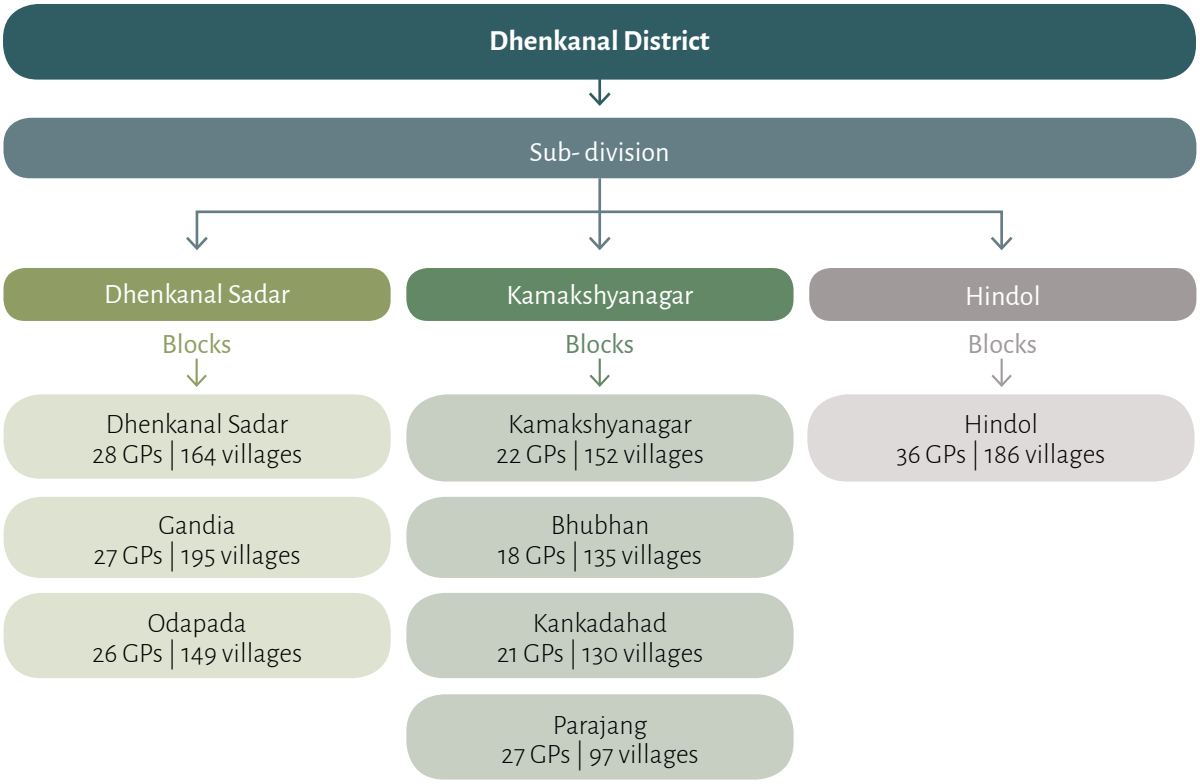
The district is divided into different units for carrying out various government activities. For administrative purpose, the district is split into three sub-divisions; for revenue administration, the district is divided into eight tehsils; for carrying out development activities, the district is divided into eight community development blocks (Figure 2). The Panchayati Raj & Drinking Water Department (PR&DWD), Government of Odisha (GoO) governs the rural areas of the district, while the urban areas are governed by the Housing & Urban Development Department (H&UD), GoO.

Following the enactment of the Orissa Grama Panchayat Act, 1948, the state introduced a three-tier system of Panchayati Raj Institutions (PRIs) at the district, block, and village levels for rural governance[5]. The PRIs had been further empowered in their role through the 73rd amendment of the Constitution of India in 1992 which repositioned Gram Panchayats (GPs) as Institutions of Self -Government. Therefore at the local level, GPs with support from their committees, such as Gram Panchayat Water and Sanitation Committee and Gaon Kalyan Samiti is responsible for water and sanitation service delivery. On the urban front, the H&UD Department is further organized into three directorates - Directorate of Municipal Administration, Directorate of Town Planning and Chief Engineer, Public Health Engineering Organization (Urban)[6]. Additionally, the Odisha Water Supply & Sewerage Board (OWSSB), set up in 1991, is the state-level nodal agency for implementation of urban sanitation projects. At the local-level, ULBs assume the responsibility for service delivery. In 2014, Hindol was constituted as the 4th statutory town in Dhenkanal bringing up the count of urban local bodies (ULBs) in the state to 114. At present, the number of villages and Gram Panchayats (GPs) has also increased to 1237 and 212 respectively.

5 https://odishapanchayat.gov.in/English/department.asp

6 http://www.urbanodisha.gov.in/About.aspx

FIGURE 3: ADMINISTRATIVE STRUCTURE OF THE DISTRICT (NUMBER OF VILLAGES AND GPs FROM CENSUS OF INDIA 2011)



Among its eight blocks, only Bhuban, Kamakhsyanagar, and Sadar have an 'administratively' urban population due to the presence of ULBs. With 90.5% of its population living in rural areas, the district is predominantly rural (Table 2). However, a significant proportion of the rural population is concentrated in large dense villages[7]. Overall, the district has 205 LDVs, including two Census Towns – one each in Odapada and Parajang blocks. Sadar and Bhuban have the highest percentage of LDV in the district while Kankadahad has the lowest share of LDVs among all the villages. 61% of the rural population in Bhuban lives in LDVs, while only 5.3% of the rural population in Kankadahad lives in LDVs. A higher proportion of the rural population residing in LDVs suggests that the nature of infrastructure needed will be different from the other villages - affecting the demand for various services like water supply, sanitation-related services, solid waste collection, among others.

Scheduled caste population in the district is 19.62% of the total population and ST population is 13.59% of the total population. Kankadahad district has the most substantial proportion of ST population, and Hindol has the highest percentage of SC population. Most of the tribal villages are in Kankadahad block while the highest number of SC villages are in Kamakshyanagar block.

7 Large Dense Villages, a classification coined by an earlier CPR study, refers to census villages with a population of more than 1000 and a population density of more than 400 people per square kilometers.

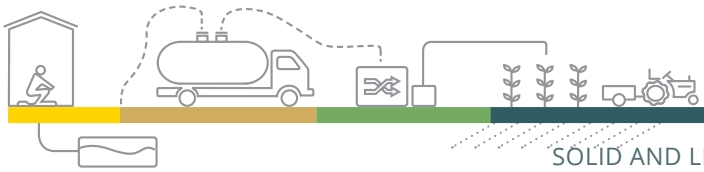


TABLE 1: BLOCK-WISE RURAL AND URBAN POPULATION

Block Name	Total Population	% Rural Population	% Urban Population	% LDV Population (of rural pop.)
Bhuban	124287	82.1	17.9	61.7%
Gandia	152180	100.0	0.0	46.7%
Hindol	178145	100.0	0.0	26.9%
Kamakshyanagar	130795	87.1	12.9	32.7%
Kankadahad	110126	100.0	0.0	5.3%
Odapada	143482	96.8	3.2	49.9%
Parajang	133450	95.2	4.8	38.9%
Sadar	220346	69.4	30.6	49.0%
Total	1192779	91.1	8.9	39.0%

SOURCE: CENSUS OF INDIA 2011

TABLE 2: BLOCK-WISE SC AND ST POPULATION AND `NUMBER OF SC-DOMINATED AND TRIBAL VILLAGES (POP. WITHIN CATEGORY > 50%)

Block Name	% SC Population	% ST Population	SC-dominated Villages	Tribal Villages
Bhuban	20.2	8.6	12	16
Gandia	17.2	16.6	14	24
Hindol	23.4	7.0	15	10
Kamakshyanagar	21.9	14.3	21	26
Kankadahad	12.4	42.6	1	67
Odapada	22.6	8.1	10	6
Parajang	19.1	9.1	5	8
Sadar	18.6	11	13	15
Total	19.6	13.6	91	172

SOURCE: CENSUS OF INDIA 2011

b. Economic Profile

Dhenkanal is predominantly a rural economy with cultivation, forest produce and mining as the major economic activities. Cultivation is the main economic activity followed by forest produce and mining. A large section of tribal population is dependent on the forest produce like timber, bamboo, kendu leaves, lac, honey, for their livelihood. Mining is the main industrial activity in the district. Some of the minerals which are commercially exploited are chromite, fire clay, and quartz. Along with mining, industrial activity related to metal fabrication, textile, fly ash brick is also carried out in the district.

The work participation rate (WPR) of the district, defined as the percentage of total workers (main and marginal) to the total population, lags compared to the Odisha in terms of overall WPR (Table 4). The difference is more pronounced in the case of female WPR than male WPR. The difference between WPR for the whole district and the state is 5.2%, but in the case of female WPR the difference increases to 11%, but for male WPR the difference is only 0.5%. Gender-wise WPR at the block level also presents a similar trend. Low WPR across the district with a higher share of marginal workers means the economic conditions of the majority of the population may be precarious.

The overall share of agricultural and non-agricultural workers also varies in different blocks. Majority of workers in Odapada and Sadar are engaged in non-agricultural work. In all the other blocks, majority of workers are involved in the agricultural sector whereas Bhuban and Hindol have almost equal proportion workers engaged in both sectors while Kankadahad, Kamakshyanagar Parajang have a much higher proportion of workers engaged in the agricultural sector. Higher share of workers in the non-agricultural sector points towards urbanisation of the rural areas (Table 5). Although 90.5% of the population in Dhenkanal lives in rural areas, but only 55% of total population work in agriculture which points to increasing importance of non-agricultural sector in the rural areas. In such LDVs, home to 16% of the total population, more than 50% of total workers are engaged in the non-agricultural sector. In some of the blocks like Odapada, which is adjacent to Sadar, almost 83% of the total population live in settlements where agriculture is not the main activity. This indicates that there is a sizeable proportion of population who are living in urban-like settlements but do not have the necessary infrastructure and amenities necessary for such settlements.

TABLE 3: WORK PARTICIPATION RATE (WPR) IN THE DISTRICT

Block Name	% Overall			% Male			% Female		
	Total	Main	Marginal	Total	Main	Marginal	Total	Main	Marginal
Bhuban	32.6	21.9	10.7	54.6	39.8	14.9	9.2	2.9	6.3
Gandia	36.3	22.6	13.7	55.9	40.0	16.0	15.9	4.6	11.4
Hindol	36.5	21.7	14.7	56.7	37.5	19.2	15.4	5.3	10.1
Kamakshyanagar	36.8	24.2	12.7	55.0	40.9	14.1	17.6	6.4	11.2
Kankadahad	48.9	22.3	26.6	58.5	36.7	21.8	39.2	7.8	31.5
Odapada	35.5	26.1	9.4	56.4	44.5	11.9	12.4	5.8	6.6
Parajang	35.2	20.5	14.7	54.6	35.0	19.6	15.0	5.4	9.6
Sadar	33.9	25.4	8.5	54.0	43.4	10.6	12.5	6.1	3.3
Total	36.5	23.3	13.3	55.6	40	15.6	16.4	5.5	10.8

SOURCE: CENSUS OF INDIA 2011

TABLE 4: SHARE OF AGRICULTURE IN OCCUPATION

Block Name	% Non-Agricultural	% Agricultural
Bhuban	31.4	50.7
Gandia	19.4	80.6
Hindol	44.2	55.8
Kamakshyanagar	20.3	66.9
Kankadahad	10.1	89.9
Odapada	83.3	16.7
Parajang	27.5	72.5
Sadar	37.6	31.8
Total	35.5	55.5

SOURCE: CENSUS OF INDIA 2011

c. Physical Profile

The district of Dhenkanal rests atop unconfined aquifers in southeast parts of northeast and largely unconsolidated aquifers in other parts, with red lateritic, sandy loam and alluvial as the primary soils in the overall region[8]. The river Brahmani, the second-longest river in the state, cuts through the district near the middle and controls the drainage of the district along with its tributaries, of which the most important include Ramiala Nadi, Nigre Nadi, and Purajhor Nadi[9] The district is a part of the agro-climatic zone, Mid Central Table Land, which experiences a hot and moist/sub-humid climate.

The Central Ground Water Board (CGWB) considers all the blocks in the Dhenkanal district, like the majority of blocks in the state, at a 'Safe' level of groundwater development[10]. Although the quantum water extraction has been increasing over the years, the abundance of the state's water endowment is reflected in both the pre-monsoon and post-monsoon depths to water table that vary between 2-10 mbgl and less than 2 to 5 mbgl in the former and latter setting respectively. The trend also holds true for Dhenkanal district with only about 3% of all monitoring wells reporting groundwater dipping below 10 mbgl during any of the monitoring periods (Figure 2)[11]. The average annual minimum and maximum depth to water in the district are 1.33 and 8.17 mbgl respectively. During monsoon, 61% of all monitoring wells report a depth to water table of less than 2 mbgl.

Located near the coastal belt of the state, about three-fourths of the district's land area falls in the Very High Damage Risk Zone and the remaining in the High Damage Risk Zone with respect to cyclones[12] (Figure 3). Cyclone Fani (2019), wreaking havoc in several parts of the country, had affected 652 villages across all the blocks in the district[13]. In addition to cyclones, the district also suffers from a moderate risk to earthquakes.

8 http://www.dowrodisha.gov.in/DIP/2015-20/DHENKANAL.pdf

9 http:// cgwb.gov.in/District_Profile/Orissa/Dhenkanal.pdf

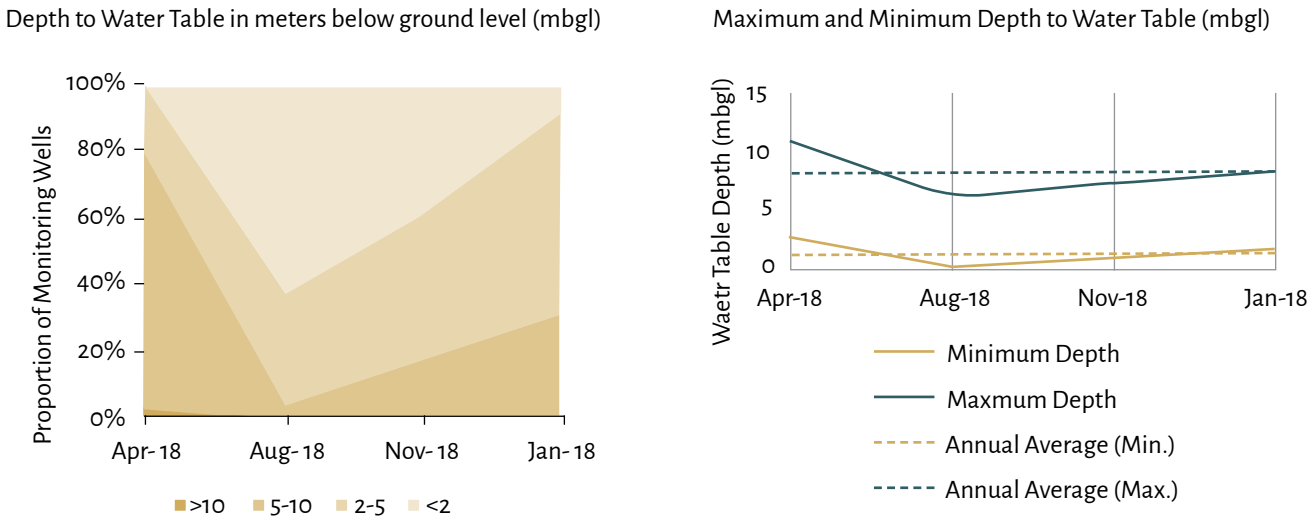
10 http:// cgwb.gov.in/GW-Assessment/GWRA-2017-National-Compilation.pdf

11 http:// cgwb.gov.in/Regions/GW-year-Books/GWYB-2015-16/GWYB%20SER%202015-16.pdf

12 State Disaster Management Plan 2019

13 http:// ncrmp.gov.in/wp-content/uploads/2018/09/psc/Fani2019.pdf

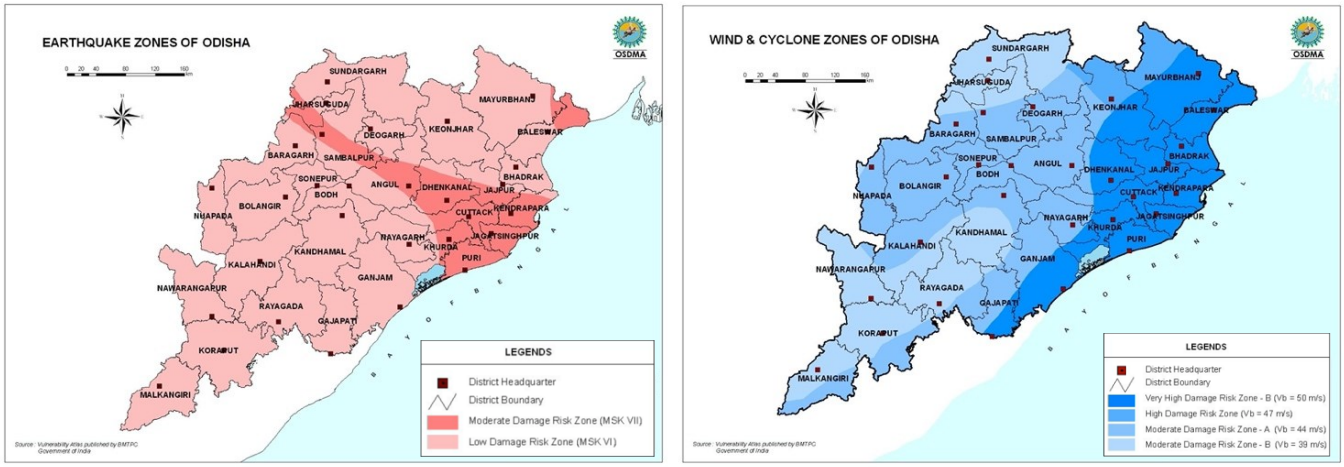
FIGURE 4: DEPTH TO WATER TABLE (IN METERS BELOW GROUND LEVEL) IN DHENKANAL



2. SANITATION SERVICES IN THE DISTRICT

Rural sanitation in India has historically reported low service levels. Building on related schemes of the past, the Government of India launched the Swachh Bharat Mission – Gramin (SBM-G) in 2014 to eliminate open defecation in all rural areas of the country through a nationwide subsidised toilet construction drive. Over its five years of implementation, SBM-G has effected an unprecedented increase in the access to toilet facilities in the state of Odisha at large as well as the Dhenkanal district. The following sections present the trends in access as reported by Census of India 2011 and the gains since made that have allowed the state and the district to declare all its area' Open Defecation Free (ODF)'.

FIGURE 5: STATE HAZARD MAPS (SOURCE: ODISHA STATE DISASTER MANAGEMENT. Retrieved from https://www.osdma.org/state-hazard-map/#gsc.tab=0



a. Access to Toilet Facility (Census of India 2011)

According to the Census of India 2011, only 18.3% households in rural Dhenkanal had individual household toilets and 80% households were practising open defecation. Sadar, which is the most urbanised block, had the highest percentage of households with toilet at about 35% and 25% of households in the block owned a septic tank. The preference for septic tank is high across the blocks wherein the majority of reported toilets are connected to septic tanks (Table 6).

or administratively rural areas classified as urban in nature by Census, have higher access to toilets of all three categories (Table 7). The trend is applicable in relation to the type of toilet facilities as well wherein urban-like rural settlements had a higher percentage of households with septic tanks. As the access and nature of toilets changes the kind of services needed for proper maintenance of toilets will also change.

TABLE 5: BLOCK-WISE DIFFERENT TYPES OF SANITATION SYSTEMS

Block Name	% Sewer	% Septic	% Ventilated Improved Pit	% Open Pit	% Others	% No Toilet
Bhuban	0.7	11.5	2.7	1.2	1.7	82.1
Gandia	0.8	6.7	2.9	1.4	1.9	86.2
Hindol	0.5	6.6	3.3	1.6	4.1	83.9
Kamakshyanagar	1.0	10.3	4.3	0.9	2.0	81.5
Kankadahad	0.3	4.2	1.1	0.7	1.2	92.6
Odapada	1.5	10.1	2.7	0.6	2.8	82.3
Parajang	1.0	5.2	1.8	0.7	1.5	89.8
Sadar	1.4	25	4	1.2	3.4	65.1
Total	0.9	10.9	3.0	1.1	2.5	81.5

SOURCE: CENSUS OF INDIA 2011

Access to toilet and the type of toilet available depend on various factors like the nature of settlement, availability of water inside the household premises, social composition of the village, among other factors. As noted above, 'urban'-like preferences are manifest in settlements with 'urban' like characteristics. Large Dense Villages refers to census villages with more than 1000 population and with more than 400 people per sq.km. Data shows that LDVs have higher access to toilets compared to other villages and Census Towns,

Social composition of the block also seems to have an impact on the access to toilets. Kankadahad which have the highest percentage of tribal population also has the lowest access of toilets among households. At a broad level, the data shows that a higher percentage of tribal population in the village is negatively related to access to toilet facilities (Figure 4a). This means that higher the percentage of tribal population in a village, the lesser is the percentage of households with toilets. A similar relation exists between the percentage of SC households

TABLE 6: PERCENTAGE OF HOUSEHOLDS WITHOUT INDIVIDUAL TOILET FACILITIES IN DIFFERENT SETTLEMENT TYPES

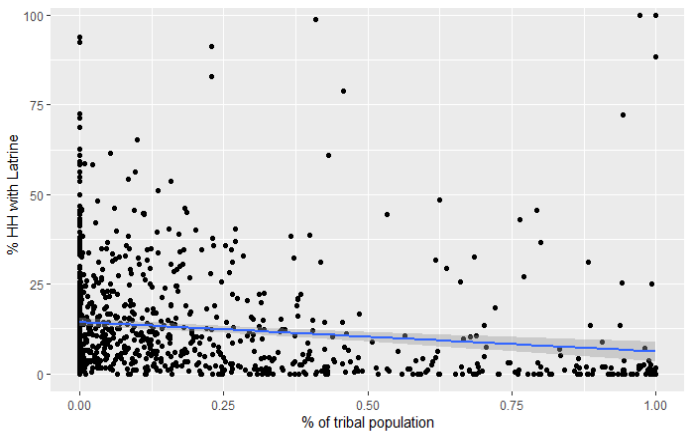
Block Name	Percentage of households with no toilet			Urban
	Village	LDV	CT	
Bhuban	88.4	84.1	NA	64.7
Gandia	89.3	82.6	NA	NA
Hindol	85.5	79.3	NA	NA
Kamakshyanagar	88	83.8	NA	47.4
Kankadahad	93	84.1	NA	NA
Odapada	83.2	82	72.7	NA
Parajang	91.8	88.3	69.1	NA
Sadar	82.2	80.5	NA	25.4
Total	87.7	82.7	70.9	37.1

SOURCE: CENSUS OF INDIA 2011

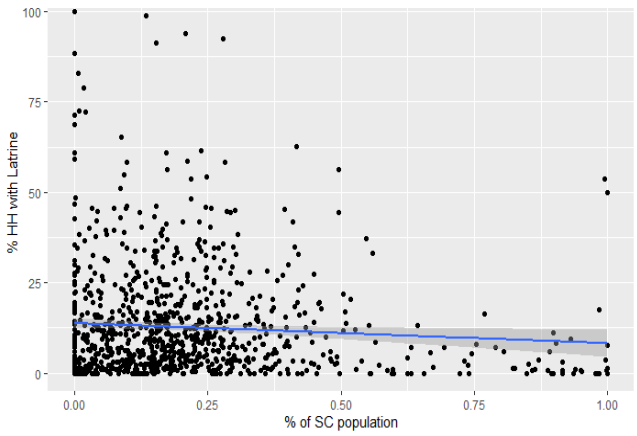
and percentage of households with access to a toilet facility, but the slope in this case is lower indicating a weaker relationship (Figure 4b). On running a regression model for estimating the effect of various factors on the access to toilet, however, it is found that the share of tribal population or SC population do not show a significant relationship with the access to toilets (Annex I). Similarly, ownership of assets do not show a significant relation with access to toilet. On the other hand, literacy level and location of water source inside the premise have a strongly positive and significant relation with the access to toilet. This clearly shows that the access to toilets depend on education and availability of water rather than the social or economic status of the household.

FIGURE 6: RELATIONSHIP BETWEEN ACCESS TO TOILET AND (A) PROPORTION OF TRIBAL POPULATION AND (B) PROPORTION OF SC POPULATION

(a) Access to Toilet vs. ST Population



(b) Access to Toilet vs. SC Population



b. Progress under Swachh Bharat Mission

Under SBM-G, the state of Odisha augmented access to a toilet facility from 15% to a reported 100% in all its rural areas through the construction of 68,80,489 toilets. Resultingly, all of the 30 districts in the state, including Dhenkanal, have declared themselves ODF. Together, these account for 6,801 Gram Panchayats and 46,785 villages. The Dhenkanal district has constructed 2,42,890 individual toilet facilities in the same period (Figure 5). The detailed SBM-G MIS data obtained for the district, for 52% of the total beneficiaries, provides a breakdown of the type of on-site sanitation system constructed alongside the toilet for management of faecal waste on-site. As per this data, 56.3% of the toilets are connected to a single pit, 43.7% to twin pits, and 0.1% to septic tanks. The trend is an interesting contrast to the high preponderance of septic tanks reported during the Census before the implementation of SBM-G. At the block-level within the district, the construction of toilets has been staggered non-uniformly in the five years of the SBM-G. For all blocks barring Dhenkanal (Sadar), the highest number of toilets were constructed in the last leg of the programme whereas Dhenkanal Sadar most benefitted from the programme in the second year. Interestingly, the temporal trend in toilet construction is also reflected in the share of single pits among toilets constructed under SBM-G (Figure 6).

The data shows that with an increasing share of toilets constructed in 2018-19, or the last year of the programme, the proportion of toilets with single pits decline. The two parameters show a strong and steep linear relationship (excluding Dhenkanal Sadar as an outlier). Overall, the Gandia and Odapada blocks have the highest prevalence of single pits at 90% and 99% respectively. Northern blocks, i.e. Kankadahad, Parajang, Bhuban, and Kamakshyanagar, report a relatively lower proportion of single pits. Still, lowest proportion of single pits, reported in Kamakshyanagar, is still significant at 25%.

FIGURE 7: (A) YEAR-WISE PROGRESS OF SBM-G IN ODISHA AND DHENKANAL DISTRICT
(B) TYPES OF ON-SITE SANITATION SYSTEMS CONSTRUCTED UNDER SBM-G IN DHENKANAL

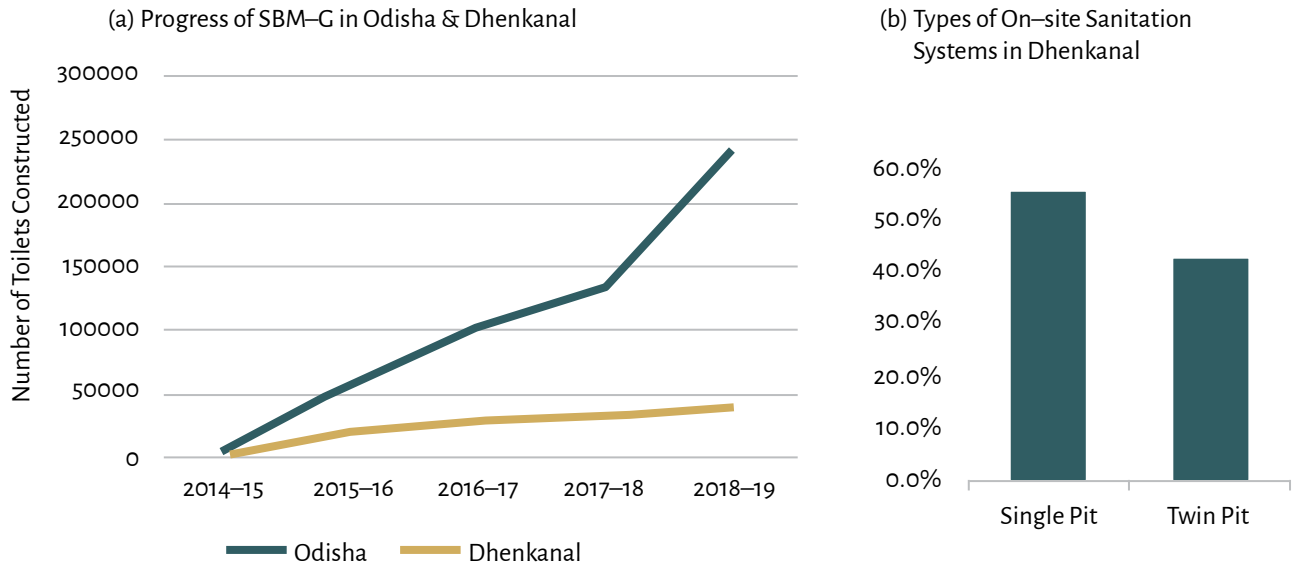
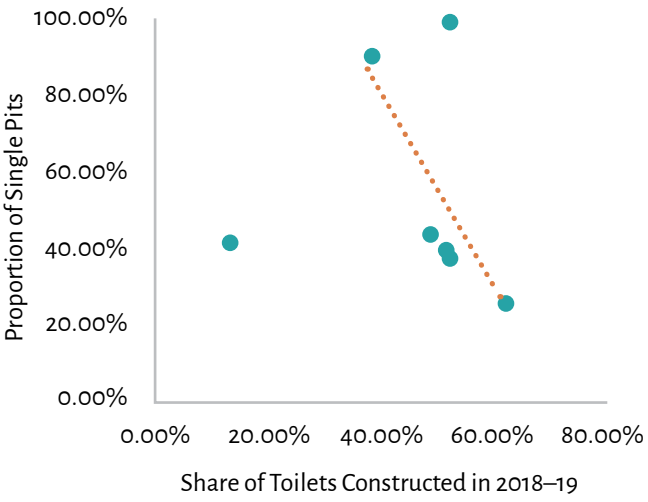
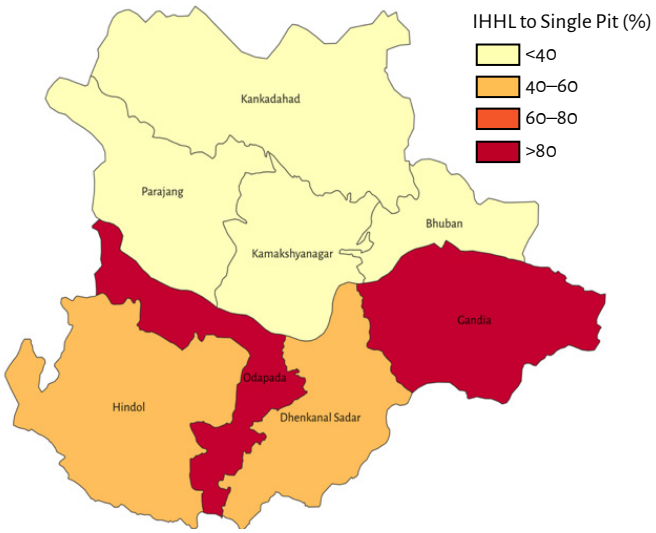


FIGURE 8: (A) RELATION BETWEEN THE TYPE OF OSS SYSTEMS AND PERIOD OF TOILET CONSTRUCTION (B) PREVALENCE OF SINGLE PITS ACROSS BLOCKS

(a) Relation between Type of OSS System & Period of Toilet Construction



(b) Prevalence of Single Pits across Blocks



C. Water Supply

According to Census 2011, around 87% of the district population had been dependent on groundwater while only 6.3% was dependent on piped water. Tubewells, uncovered wells and handpumps have been the most common type of water sources. Sadar, which is the most urbanised block, has the highest percentage of tap water and a lower proportion of households dependent on handpumps and tubewells (Table 8).

Most of the households did not report any water source inside the premise and therefore are required to travel to the source for fetching water – which as seen earlier, directly impacts the access to a toilet facility. There is ample evidence to suggest that the burden of fetching the water from outside is disproportionately on female members of the household. In urban settlements, around 55% of households have water source inside the premise, but it is still a very low number. Census towns are better than the rural areas, but they also have only 33% of households with water source inside the premises. The LDV and non-LDV villages are not very different in relation to access, but as LDV are denser settlements, the water-related issues are more acute.

Since then, strides have been made to increase the access to piped water supply in rural areas through programmes like the National Rural Drinking Water Programme (NRDWP), now followed by the Jal Jeevan Mission. The programme's MIS data, as of April 2019, shows that nearly 42% of the district's population, comprising 16.37% of the total number of habitations, has access to piped water supply (Table 10). The number of public taps as of April 2020, stands at 951 in the district. The service level is slightly lower than the state-level average of 46%. Compared to the 557 habitations with a piped water supply, more than six times or 3,677 habitations have access to a handpump/tubewell/other spot sources[14].

14 https://nrdwp.gov.in

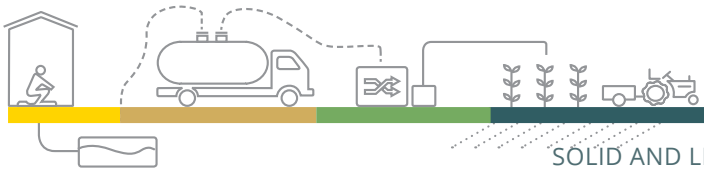


TABLE 7: PERCENTAGE OF HOUSEHOLDS WITH DIFFERENT WATER SOURCES

Block Name	% Piped Water				% Groundwater		% Surface Water			% Others
	Tapwater Treated	Tapwater Untreated	Covered Well	Uncov-ered Well	Hand-pump	Tubewell	Pond	Spring	River	
Bhuban	6.5	3.0	1.1	51.6	6.4	22.8	0.4	1.1	6.5	0.7
Gandia	1.8	1.1	1.9	74.8	2.7	11.3	0.5	4.0	0.8	1.0
Hindol	2.7	1.1	1.3	43.2	19.2	29.2	0.3	1.3	1.7	0.2
Kamakshyanagar	3.9	1.9	2.3	42.3	16.9	25.0	0.4	1.4	5.1	1.0
Kankadahad	0.7	0.9	0.9	38.8	26.2	22.3	1.0	5.3	3.7	0.1
Odapada	3.5	3.8	1.8	42.2	14.7	24.1	0.3	3.4	5.6	0.6
Parajang	4.4	2.5	1.2	32.1	15.6	33.1	1.6	2.1	7.0	0.6
Sadar	8.7	2.0	8.1	58.1	4.3	16.1	0.1	0.6	1.2	0.8
Total	4.3	2.0	2.7	49.0	12.5	22.6	0.5	2.2	3.6	0.6

SOURCE: CENSUS OF INDIA 2011

TABLE 8: PERCENTAGE OF HOUSEHOLD BY LOCATION OF WATER SOURCE

Block Name	% Water within premises	% Water Near	% Water Away
Bhuban	21.5	36.8	41.7
Gandia	25.5	29.5	45.0
Hindol	10.8	39.0	50.2
Kamakshyanagar	18.5	34.9	46.6
Kankadahad	11.0	34.1	54.8
Odapada	17.8	38.4	43.8
Parajang	8.9	35.6	55.4
Sadar	34.5	29.6	35.9
Total	19.6	34.5	45.9

SOURCE: CENSUS OF INDIA 2011

Regardless of whether water is supplied through a spot source or piped infrastructure, however, the district is overwhelmingly dependent on groundwater and surface water contributes to less than 0.5% of the total number of water supply schemes (Figure 8). Nonetheless, 36% of all the delivery points monitored under the scheme exhibited contamination of water. More than half of all the tests points in the Sadar block reported contamination with Hindol and Gandia close behind at 48% and 47% respectively. Monitoring of source quality monitoring reveals that in the Odapada block, as many as 76% of all sources contain an excessive amount of iron. Iron is a major contaminant state-wide and affects 44% of water sources across the district[15] .

FIGURE 9: SOURCE FOR WATER SUPPLY UNDER THE NATIONAL RURAL DRINKING WATER PROGRAMME

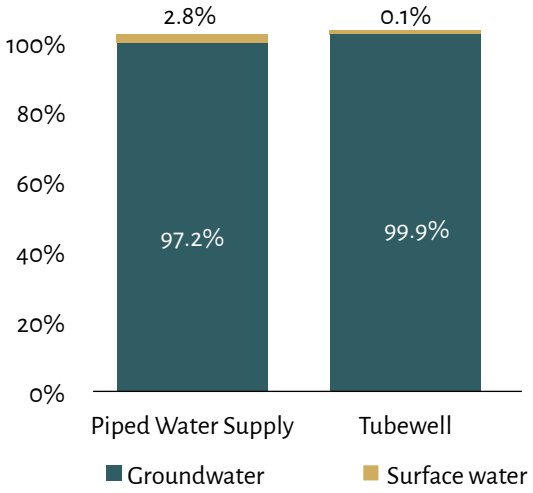


TABLE 9: STATUS OF WATER SUPPLY IN DISTRICT FOLLOWING THE NATIONAL RURAL DRINKING WATER PROGRAMME

Population & Habitation (out of total 3,622) Having Piped Water Supply Water		
Number of Habitations	Total	587
	Fully Covered	587
	Partially Covered and/or Quality Affected	0
% of Habitation	Total	16.37
	Fully Covered	16.37
	Partially Covered and/or Quality Affected	0
Population(Lakhs)	Total	4.47
	Fully Covered	4.47
	Partially Covered and/or Quality Affected	0
% of Population	Total	41.77
	Fully Covered	41.77
	Partially Covered and/or Quality Affected	0
Population & Habitation Coverage Achieved in 2019-2020	Number of Habitation	196
	% of Habitation	5.47
	Population(Lakhs)	1.76
	% of Population	16.45

SOURCE: NRDWP MIS DATA (AS ON 01/04/2019)

15 http://cgwb.gov.in/District_Profile/Orissa/Dhenkanal.pdf

d. Drainage

According to Census 2011, only a small percentage of households have access to drainage facility (Table 11). Except for the blocks which have some urban population, in all other blocks, more than 90% of households do not have access to any drainage facility. Where accessible, drainage typically takes the form of open drains. The levels of access to drainage are not very different across census towns, LDVs and villages.

TABLE 10: PERCENTAGE OF HOUSEHOLDS WITH DIFFERENT TYPES OF DRAINAGE

Block Name	% Open Drain	% Closed Drain	% No Drain
Bhuban	10.0	0.9	89.0
Gandia	5.0	0.6	94.3
Hindol	4.6	0.7	94.6
Kamakshyanagar	10.4	1.1	88.5
Kankadahad	3.2	0.4	96.4
Odapada	5.8	2.5	91.8
Parajang	10.1	1.4	88.5
Sadar	18.5	3.6	77.8
Total	9.0	1.6	89.4

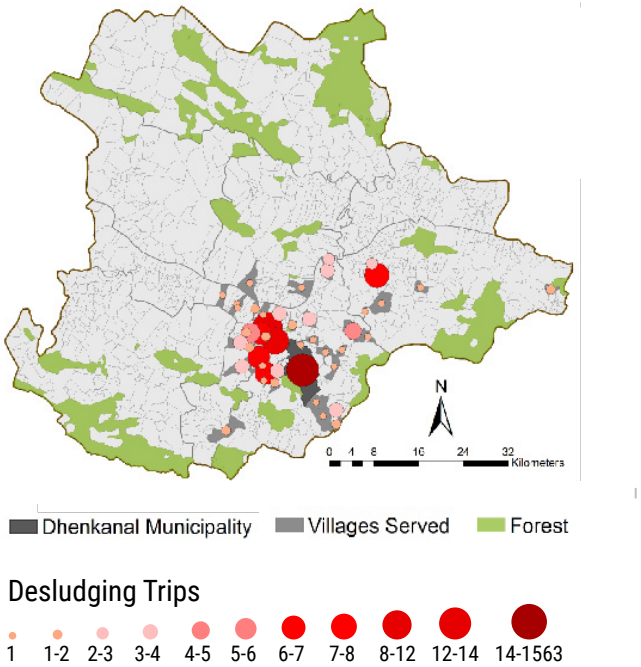
SOURCE: CENSUS OF INDIA 2011

e. Desludging Services

The increase in access to a toilet facility will inevitably spur the demand for desludging services upon their usage in both urban and rural areas. The municipality of Dhenkanal commissioned an FSTP, with a treatment capacity of 27 kilolitres per day (KLD) in October 2018. Since commencing operations, the FSTP has been serving rural households within a 20 kilometres (km) radius in addition to those within the municipal boundaries (Figure 9). Although households comprise the bulk of the demand at a little over 98%, commercial and institutional rural establishments too have requested and received desludging services through the urban facility.

Overall, the FSTP operator fulfils nearly 75% of all requests within a week of their receipt and the service level, measured through time taken to deliver the service, does not significantly vary between rural and urban areas. Compared to urban households, rural households

FIGURE 10: DESLUDGING REQUESTS SERVED IN RURAL AREAS SURROUNDING THE FSTP IN DHENKANAL MUNICIPALITY



require a lesser number of trips per OSS system. While a single trip is sufficient for only 38% of OSS systems in urban areas, the proportion is more than double at 85% in rural areas (Figure 10).

Multiple trips are predominantly required by septic tanks located in urban areas. On the other hand, not only is the share of septic tanks desludged compared to the total number of OSS systems desludged is lower in rural areas (Figure 11), but also the average number of trips that a septic tank requires for desludging. Interestingly, the average age of sludge from septic tanks is similar between urban and rural households – about four years and going as high as 24 years. Meanwhile, that of sludge from leaching pits in rural areas is 1.5 times as much as that from pits desludged in urban areas on average.

The amount that rural households have paid for desludging through the FSTP operator varies between INR 1,500 to INR 3,500 for a single trip; between INR 4,000 to INR 6,000 for two trips; INR 6,000 for three trips (only one case); and up to INR 10,000 for more than three trips.

FIGURE 11: NUMBER OF TRIPS AVAILED FOR DESLUDGING A HOUSEHOLD OSS SYSTEM IN URBAN AND RURAL AREAS

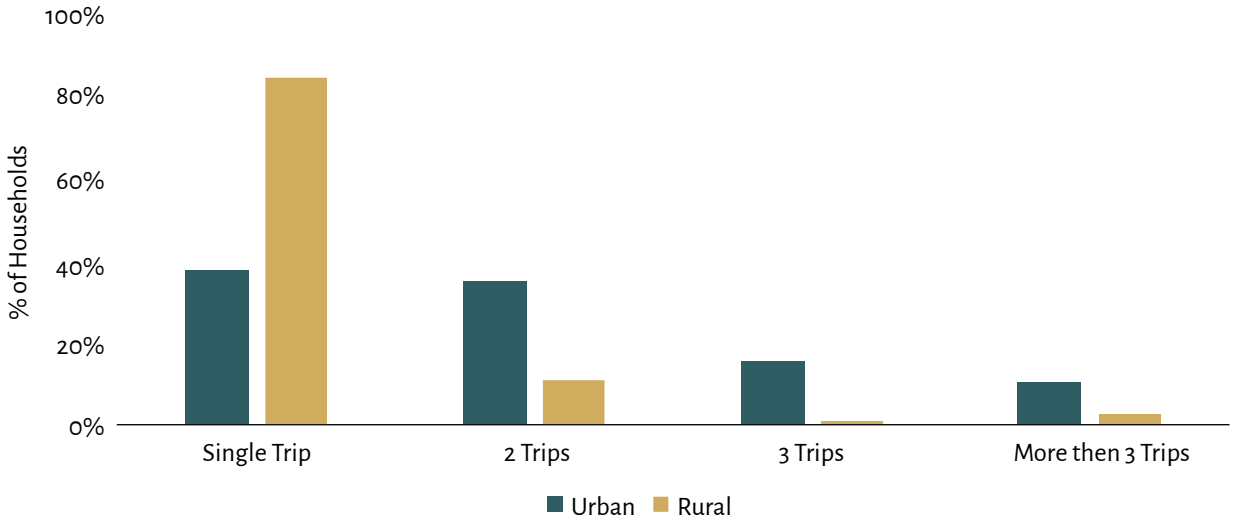
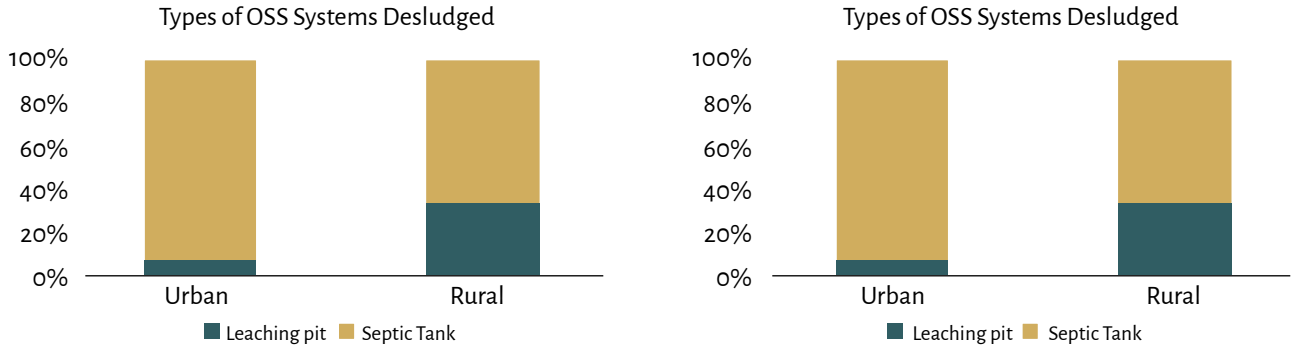


FIGURE 12: TYPES OF OSS SYSTEMS DESLUDGED IN URBAN AND RURAL AREAS



PART B: PRIMARY DATA ANALYSIS

METHODOLOGY OF THE SURVEY

We conducted a survey of 1000 households across the Dhenkanal district. This sample size translates to a margin of error (MoE) of 4.07% at a confidence level of 99%, or alternatively, an MoE of 3.09% at a confidence level of 95% (Cochran Sampling Method). Given, 30 observations is typically considered adequate for performing simple statistical analysis, the 1000 households were distributed across 33 GPs (33 x 30 = 990 households) so as to have 30 households (HHs) in each GP.

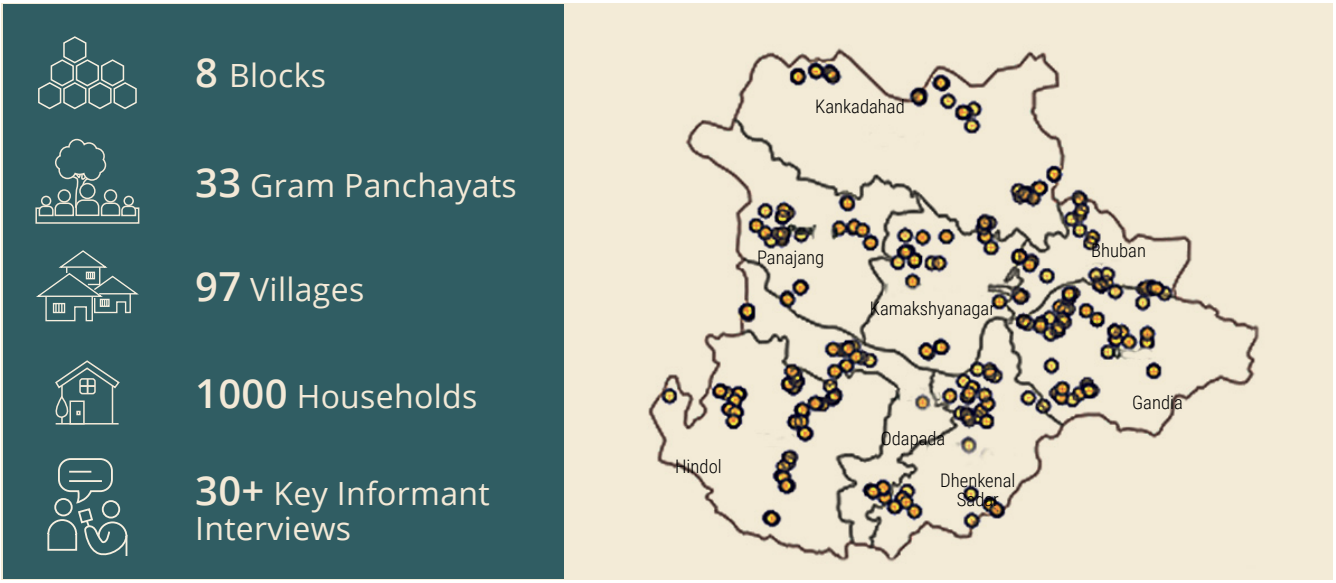
To identify 1000 households across 33 GPs for conducting the survey, we employed a multistage stratified sampling design with random selection of the units at each stage (similar to National Sample Survey, India Human Development Survey, National Annual Rural Sanitation Survey)[16]. Here, the GP served as the First Stage Unit (FSUs), villages within the GPs served as the Second Stage Units (SSUs), and households were the Ultimate Stage Units (USUs).

For selection of GPs, we first stratified all the GPs in the district based on the proportion of ST population into two strata. Based on the population share of the two strata, we proportionately divided the 33 GPs between them. Accordingly, we allocated one GP from the sample to the 'predominantly tribal GPs' stratum (more than 50% of population is ST), while the rest went to the 'non-tribal GPs'. For selecting 32 GPs and 1 GP in each of the stratum, we employed the Probability Proportionate to Size (PPS) method.

With 33 GPs selected in the manner, we then selected villages for the sample within each – splitting the 30 households equally in three villages in each GP – at the second stage. Where a GP comprised more than three villages, we used used Simple Random Sampling (SRS) to select three villages. Accordingly, the final sample comprised 97 villages across 33 GPs.

Finally, we selected the USUs (Ultimate Stage Units) or the households through in-field randomization for administering the survey in the Computer-Assisted Personal Interviewing (CAPI) mode. 40% of the total sample was allocated to female respondents to ensure adequate representation of women. A more detailed version of the survey methodology can be found in Annex II.

SAMPLE OVERVIEW



16 For comparison, the latest round of state-level NARSS survey interviewed 4140 households in 276 villages across the state.

SURVEY FINDINGS

1. RESPONDENT PROFILE

The sample consists of 60% male respondents and 40% female respondents (Table 12). While the greenfield area sample has similar 60:40 gender ratio, it is the opposite for the plug-in area sample (36% males and 63% are females).

TABLE 11: GENDER OF RESPONDENTS

Gender	Plug-in	Greenfield	Dhenkanal District (Rural)
Male	36%	64%	60%
Female	63%	36%	40%
Others	0.66%	0.12%	0.20%

The sample is well spread across the age categories (Table 13). This is true for both plug-in and greenfield area. There is, however, low representation of people in the age group of 18-25 years. Women respondents are relatively younger than the male respondents. The average age of a female respondent is 41 while it is 46 for the males.

TABLE 12: PAGE PROFILE OF RESPONDENTS

Age (years)	Greenfield	Plug-in	Dhenkanal District (Rural)
18-25	9%	6%	8%
26-35	22%	25%	22%
36-45	27%	32%	28%
46-55	22%	19%	22%
>=56	20%	18%	20%

30% of the sample is from general category, while the rest of the sample is distributed among OBC (34%), SC (24%) and ST (13%) (Table 14). Relative to other three categories, ST has higher share of male respondents (70%). The sample almost entirely consists of Hindu religious group.

TABLE 13: SOCIAL CATEGORY OF RESPONDENTS

Category	Greenfield	Plug-in	Dhenkanal District (Rural)
General	29%	34%	29%
OBC	35%	28%	34%
SC	22%	35%	24%
ST	15%	3%	13%
>=56yrs	20%	18%	20%

Most of the respondents are either self-employed in agriculture (35%) or are casual labour in non-agriculture sector (31%) (Table 15). While majority (44%) of the respondents from SC category are employed as casual labour in non-agriculture, 62% of the ST respondents are self-employed in agriculture. On the other hand, General and OBC respondents are mainly from three occupational categories- self-employment in agriculture, self-employment in non-agriculture and casual labour in non-agriculture. General and OBC respondents also show higher share, than SC and ST respondents, in the salaried occupations, both government and private.

80% of the sample has MPCE between INR 500-2000 (Table 16). Also, 92% of the sample has a ration card. Average MPCE is slightly higher for the plug-in area (INR1270) compared to the greenfield area HHs (INR 1185). Salaried respondents show higher average MPCE (Govt-INR 2262, Private-INR 1413), followed by self-employedin non-agriculture (INR 1362). General and OBC HHs have mean MPCE of INR 1300(approx.) while it is lower for

TABLE 14: OCCUPATIONAL PROFILE OF THE RESPONDENTS

Income source	Greenfield	Plug-in	Dhenkanal District (Rural)
Self-employed in agriculture	37%	22%	35%
Self-employed in non-agriculture (including self-employed mechanic)	15%	24%	17%
Casual labour in agriculture	4%	5%	4%
Casual labour in non-agricultural	29%	41%	31%
Salaried-Public/Government	3%	3%	3%
Salaried- Private	10%	3%	9%
No source of Income	1%	3%	2%

TABLE 15: MONTHLY PER CAPITA EXPENDITURE OF THE SAMPLED HOUSEHOLDS

MPCE (INR)	Greenfield	Plug-in	Dhenkanal District (Rural)
<=500	15%	9%	14%
500-1000	38%	34%	37%
1000-2000	40%	51%	42%
2000-5000	7%	6%	7%
>5000	0%	1%	0%

TABLE 16: AVERAGE MPCE ACROSS SOCIAL CATEGORY

Social category	Mean MPCE		
	Greenfield	Plug-in	Dhenkanal District (Rural
General	1346	1217	1324
OBC	1295	1387	1307
SC	1092	1243	1125
ST	755	1100	768

TABLE 17: TYPE OF DWELLING OF THE SAMPLED HOUSEHOLDS

House type	Greenfield	Plug-in	Dhenkanal District (Rural)
Kutcha	29%	20%	28%
Pucca	71%	80%	72%

SC (INR 1125) and further lower for the ST HHs (INR 768) (Table 17). It is found that the SC/ST families were concentrated in the lower consumption categories. 84% of the ST households and 53% of the SC households lie in the lowest two consumption quintiles, while the figure is 40% for General and OBC HHs.

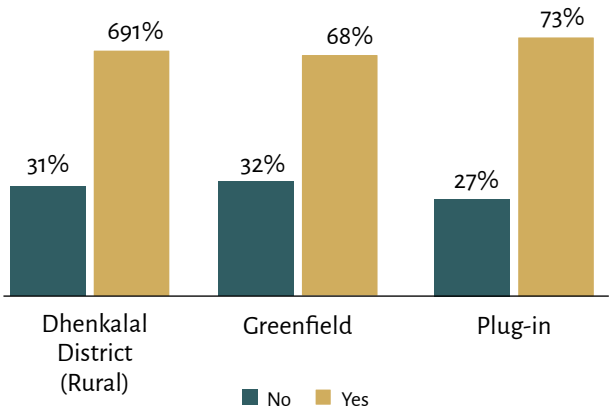
28% of the sampled HHs are kutcha dwellings while 72% are pucca (Table 18). The share of pucca dwellings is slightly higher at 80% in the plug-in area compared to 71% in the greenfield area. Almost all the dwellings are owned. Less than 1% of the sampled HHs are living in rented accommodation. HHs in Kutcha dwellings show lower expenditure levels. Also, while four-fifth of the general and OBC categories live in pucca dwellings, the figure reduces to three-fifth for SC and ST categories.

2. TOILET FACILITIES

a. Access to toilet

69% of the sampled HHs own a toilet. Ownership is slightly higher in plug-in area (73%) compared to greenfield (68%) (Figure 12). 95% of the toilets have been built after 2014. While majority of the toilets in the plug-in area are built during 2015-17, those in greenfield are built between 2016-2019.

FIGURE 13: ACCESS TO TOILET

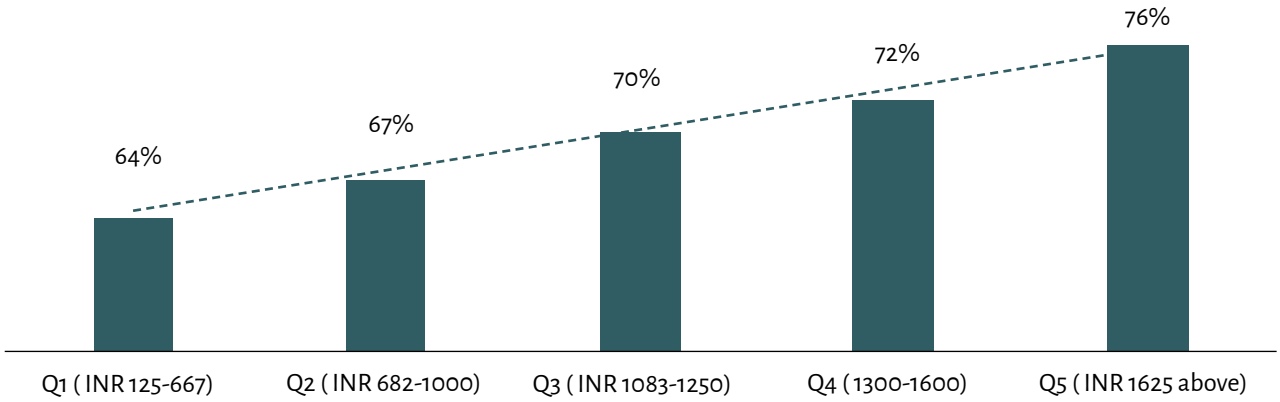


Access to IHHL does not vary across the social categories, except that the OBC category has marginally higher (72%) ownership than others (66-68%). Toilet ownership show a positive relation with the expenditure levels of the HHs (Figure 13). 72% of the pucca dwellings reported IHHL ownership while this figure is 60% for the kutcha houses.

Around 95% of the toilets are scheme-led, built majorly (99%) under the Swachh bharat Mission scheme (less than 2% reported other schemes like Biju Pucca Ghar Yojana (BPGY) and PMAY). The toilet construction year, therefore, matches the time period of SBM i.e., 2014 onwards. On the other hand, the non-scheme led toilet construction is spread across the years (starting 1980) but show a slight increase during the SBM period.

More than half (55%) of the scheme-led toilets have sourced both material and labour requirements from NGO/CSR, while 34% received both the inputs from the GP/GP contractor. Rest used their own HH members or hired labour for the purpose. One-tenth of the HHs with

FIGURE 14: ACCESS TO IHHL ACROSS CONSUMPTION QUINTILES



scheme-led toilets also reported to have received money for toilet construction (Majority of the HHs reporting an amount of INR 12000). However, less than 40% of the HHs were consulted while designing the toilet. This figure is 56% in cases where GP led construction took place, however, it drops to mere 18% in cases where the NGO/ CSR were involved in toilet construction (true for both as a source of labour and that of material) (Figure 14 & 15). The stakeholder interviews also highlighted prevalence of contractor-led construction with minimal beneficiary involvement. The construction was reportedly target-oriented and rapid.

In addition to this, it is found that the HHs in lower consumption quintiles are more likely to have a scheme-led toilet relative to HHs with higher consumption levels. 98% of the HHs in the lowest consumption category have a scheme led toilet, while it decreases to 88% for the highest consumption category (Table 19).

FIGURE 15: CONSULTATION WITH HOUSEHOLDS ON TOILET DESIGN ACROSS MATERIAL SUPPLIER

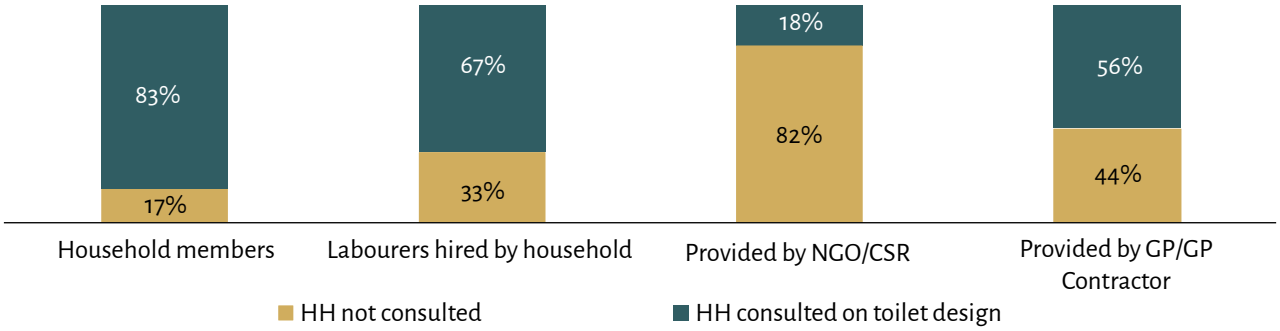
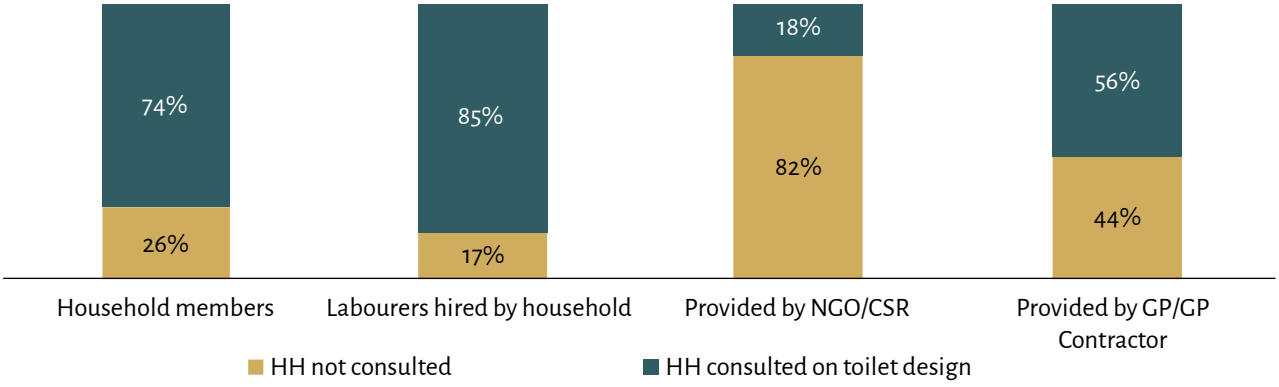


FIGURE 16: CONSULTATION WITH HOUSEHOLDS ON TOILET DESIGN ACROSS LABOUR SUPPLIER



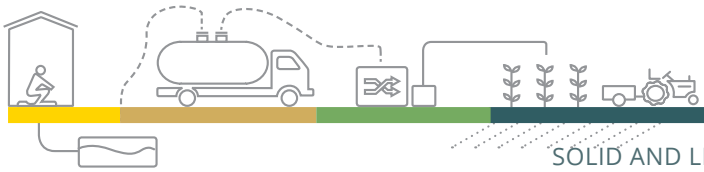


TABLE 18: PREVALENCE OF SCHEME-LED TOILETS ACROSS CONSUMPTION QUINTILES

Consumption Quintile	Non-scheme led toilet	Scheme-led toilet
Lowest	2%	98%
Second	3%	97%
Third	4%	96%
Fourth	8%	92%
Highest	12%	88%
Total	6%	94%

b. Alternative to toilet facility

All the HHs with no access to IHHL rely on open defecation. Reliance on PT/CT is negligible (less than 1%) and the reported reason for the same is that there is no PTCT in the village.

It is found that open fields that are situated far away from the hamlet are used as OD spots by majority of the HHs. This is true for both male and female family members. Moreover, open fields that are near or even inside the hamlet are also reported, more so in case of female members (16% for male members and 25% for female members). Correspondingly, the distance to the OD site is found to be less than 500m for 73% of the female members and 54% of the male members. The OD sites are majorly gender separated. Only one-fifth of the HHs reported common OD sites for males and females.

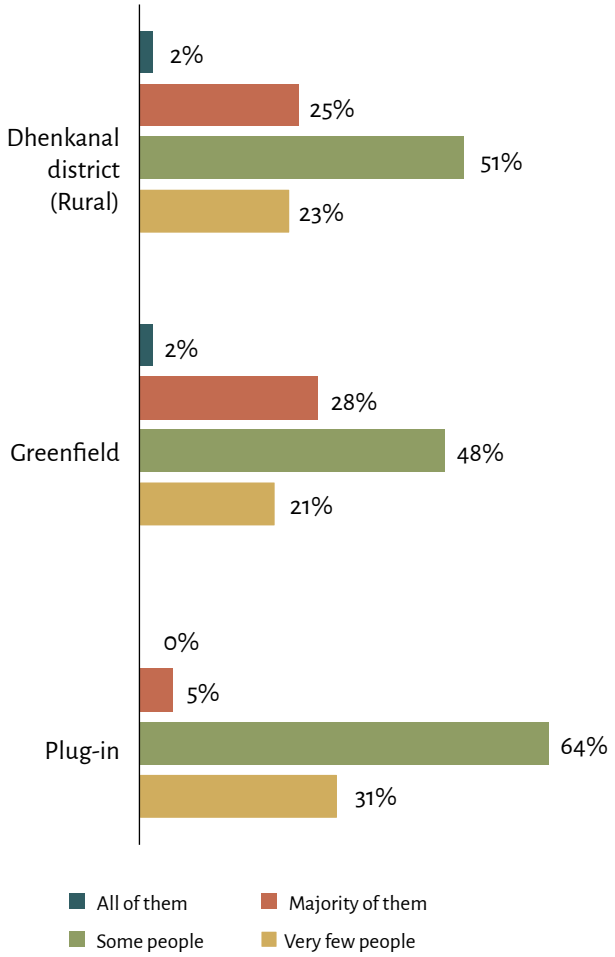
77% of the HHs cited difficulty in accessing subsidy as the reason for not having a toilet. This is most cited reason both for male as well as female respondents. Space constraint is a reason for 21% of the respondents. Compared to male respondents (16%), a higher share of female respondents (30%) expressed lack of space as a challenge. Apart from this, maintenance costs and the perceived convenience of practising OD are other reported reasons for not having a toilet in the house (Table 20).

TABLE 19: REASONS FOR NOT HAVING A TOILET AMONG NON-IHHL HOUSEHOLDS

Reason for not having a toilet	Male Respondents	Female Respondents	Overall
Could not access subsidy for constructing the toilet	80%	71%	77%
Do not have space for constructing a toilet	16%	30%	21%
Toilets are costly to build and maintain	15%	9%	13%
OD is more convenient	12%	8%	11%
Can do other works like fetching water/inspecting fields/ grazing cattle/collect forest produce	6%	3%	5%
Others	2%	0%	1%

Overall scenario, with respect to OD at village level, can be understood by knowing people's perception about it. All the 8 GP Sarpanches, that were interviewed, confirmed that households were left-out (10—400 HHs) under SBM-G & are continuing OD. The data also highlighted that nearly half of the respondents had the perception that "some people" in the village practise open defecation while 25% said "majority of the people" practise OD. 23% pointed that only "few people" do it. In plug-in areas, however, the perception is more positive with only 4% citing OD to be a common practise among HHs (Figure 16). Women respondents perceived the OD situation in the village marginally more positively as compared to the male respondents (19% men said "very few people" while the figure was 27% for the women).

FIGURE 17: PERCEPTION OF PEOPLE ON PRACTICE OF OD IN THE VILLAGE



c. Toilet usage

40% of the toilet owning HHs have one or more members that practise open defecation. To understand that further, the HH roster was analysed. 66% of the family members always use the toilet while 22% do not use it ever. Rest 12% use it sometimes or during emergencies. This pattern is similar across the gender and age categories, except that for the children below 5 years, the figure for "never use" is higher (34%) than the overall.

For the differently abled members also, the trend is not very different. Only 62% use the toilet regularly, 12% sometimes and rest 26% do not use it at all and practise OD. The members that do not use the toilet or use it rarely, rely on open defecation, irrespective of their gender or age.

Non-functional toilet is the most common reasons for practising OD, despite owning a toilet. Other than that, OD is more convenient for many and allows for other works like fetching water and inspecting fields etc. for some (Table 21).

TABLE 20: REASONS FOR NOT USING A TOILET AMONG THE IHHL OWNING HOUSEHOLDS

Reason for not using the toilet	Male Respondents	Female Respondents	Overall
Non Functional Toilets	47%	40%	44%
Convenience of OD	45%	51%	48%
Tanks/Pit gets filled	6%	11%	9%
Insufficient water for toilet use	10%	5%	8%
Toilets are impure, costly to build and unavailability of subsidy	3%	3%	3%
Others	3%	2%	2%

d. Characteristics of the toilet

Data also highlights certain variations in the characteristics of the toilet facility across scheme-led and non-scheme led toilets.

Of the scheme-led toilets, 86% are situated in the yard (front/back) of the house while 11% are in the shared area near the dwelling (Table 22). Only 3% are inside the dwelling. On the other hand, 20% of the non-scheme led toilets are inside the dwelling (5% being attached to the sleeping room).

Nearly 90% of the scheme-led toilets have water source outside the toilet. However, this figure is 53% for the non-scheme led toilets. Rest have a water tap inside the toilet (43%) or a water container inside the toilet (5%) (Figure 17).

95% of the scheme-led toilets have the pour/flush using mug facility. This, however, is true for only 60% of the non-scheme toilets with rest 40% having a flush (valve-35% and tank-5%) system (Table 23).

All the above toilet characteristics highlight that non-scheme led toilets have better facilities which is in-line with the result that the non-scheme toilet HHs are economically better off.

TABLE 21: LOCATION OF THE TOILET

Location	Non-scheme led toilet	Scheme-led toilet	Total
In the front yard/back yard of the house	73%	86%	85%
Inside the dwelling	15%	2%	3%
Attached to the sleeping room	5%	0%	1%
Shared area near the dwelling	8%	11%	11%

FIGURE 18: TYPE OF WATER ACCESS ACROSS SCHEME-LED AND NON-SCHEME LED TOILETS

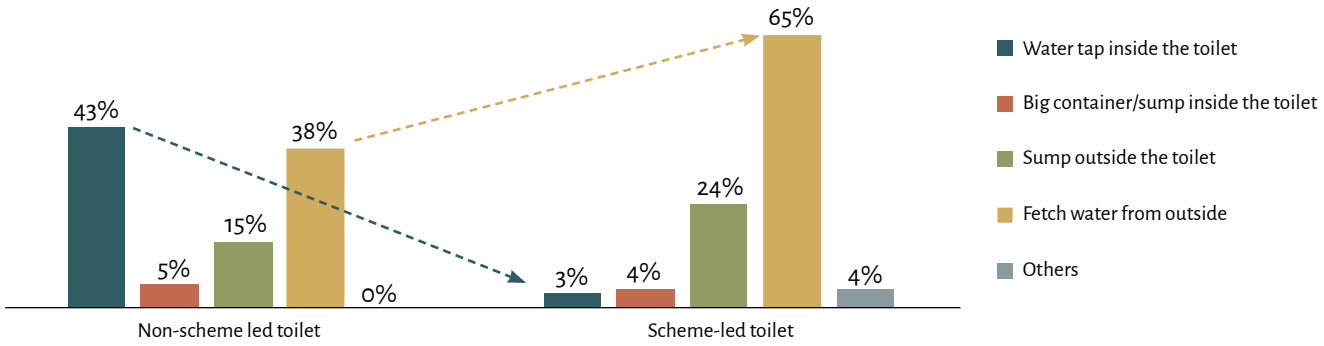


TABLE 22: TYPE OF FLUSHING SYSTEMS

Flushing system	Non-scheme led toilet	Scheme-led toilet	Total
Pour-Flush using bucket/mug	60%	95%	93%
Cistern Flush (Tank)	5%	0%	1%
Cistern Flush (Valve)	35%	1%	3%
Others	0%	4%	4%

e. Issues with toilet

28% of the HHs reported to have or had (during time of construction) faced some issue with the toilet. Compared to other social categories, ST households are reporting more toilet issues (Figure 18). Moreover, the lower consumption quintiles are reporting more issues than the higher (Figure 19). Mostly OSS related issues have been cited.

26% of the male respondents and 30% of the female respondents reported some issue with the toilet. For 25% of the women respondents, small size of OSS system is a concern while 27% of the male respondents do not consider their OSS type to be suitable (Table 24). Damaged/non-functional infrastructure is also a challenge (14% reported damaged toilet cubicle, 13% reported damaged pit).

FIGURE 19: SHARE OF HOUSEHOLDS THAT FACED ISSUES WITH TOILET ACROSS SOCIAL CATEGORIES

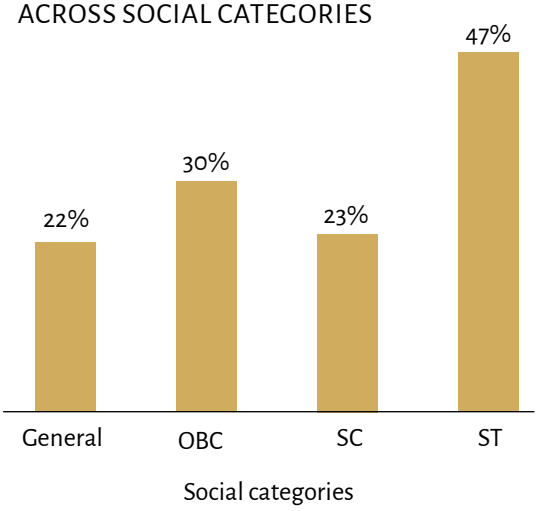


FIGURE 20: SHARE OF HOUSEHOLDS THAT FACED ISSUES WITH TOILET ACROSS CONSUMPTION QUINTILES

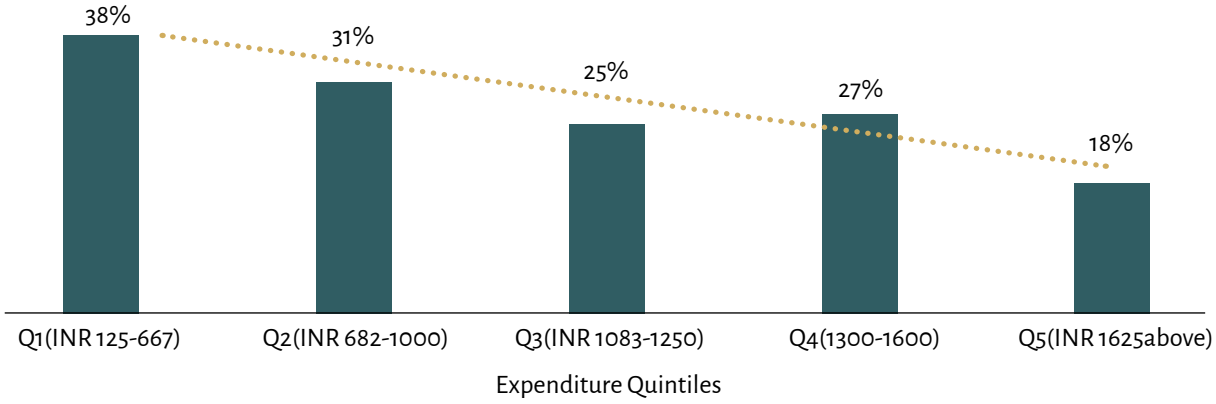


TABLE 23: TYPE OF TOILET ISSUES BEING FACED BY HOUSEHOLDS

Issues with the toilet	Male Respondents	Female Respondents	Overall
Toilet cubicle is damaged	17%	11%	14%
Toilet seat is broken	13%	9%	11%
Door/roof not installed	17%	7%	12%
Septic tank/pit is missing	13%	9%	11%
Septic tank/pit is small	19%	25%	22%
Toilet is not aesthetically pleasing	1%	1%	1%
Toilet cubicle is too small	7%	11%	9%
Septic tank/pit is not suitable system	27%	18%	23%
Damaged pit	8%	19%	13%

3. BLACKWATER MANAGEMENT

80% of the toilets in the sample are connected to single pits. While in the greenfield area, both twin pits (8%) and septic tanks (7%) are also reported; in the plug-in area, septic tanks (13%) are reported but no twin pits. All the 8 GP sarpanches, that were interviewed, confirmed that single leaching pits to be the predominant system constructed under SBM-G initiially. Moreover, it is found that contractors also prefer single pits so as to achieve targets in time as it takes less time to build them. Other reported reason for low share of twin pits is the misalignment of contractor incentives as the same amount is paid for both types of pits (Box 1).

Prevalence of single pit decreases and that of septic tank and twin pit increases as one moves from lower to higher consumption quintiles (Figure 20). The income effect on the choice of OSS is visible for all the categories (Table 26), except ST where the sample owning a septic tank is low for any meaningful comparison.

Single pits are more common among the ST (98%) and SC (87%) as compared to General (72%) and OBC (80%). Correspondingly, share of septic tanks and twin pits are higher among the latter.

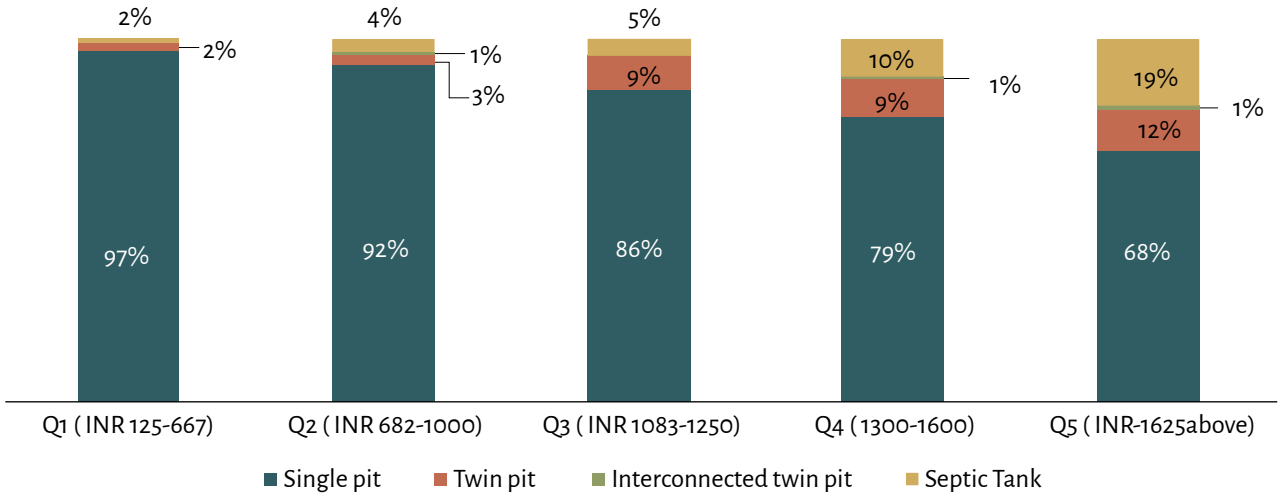
BOX 1: REPORTED REASONS FOR PREFERRING SINGLE PITS

	REPORTED REASONS FOR PREFERRING SINGLE PITS
Capital	▪ Savings on labor and materials
Socio- Religious Behaviors	▪ Norms of Impurity with using Y-junction ▪ Lack of ownership over toilet due to impurity notions & lack of awareness
Construction Mode	▪ Contractor preference for single pit to achieve targets in time ▪ Misalignment of contractor incentives (paid same amount for both types of pits) ▪ Contractor-led construction with minimal beneficiary involvement ▪ Programmatic target-oriented and rapid construction

TABLE 24: MEAN MPCE FOR VARIOUS SOCIAL CATEGORIES ACROSS THE OSS TYPE

OSS Type	Mean MPCE (INR)			
	General	OBC	SC	ST
Single pit	1289	1335	1149	757
Twin pit	1618	1653	1467	-
Interconnected twin pit	-	1663	-	-
Septic Tank	1739	1582	1577	750
Others	931	1044	907	750

FIGURE 21: TYPE OF OSS ACROSS CONSUMPTION QUINTILES



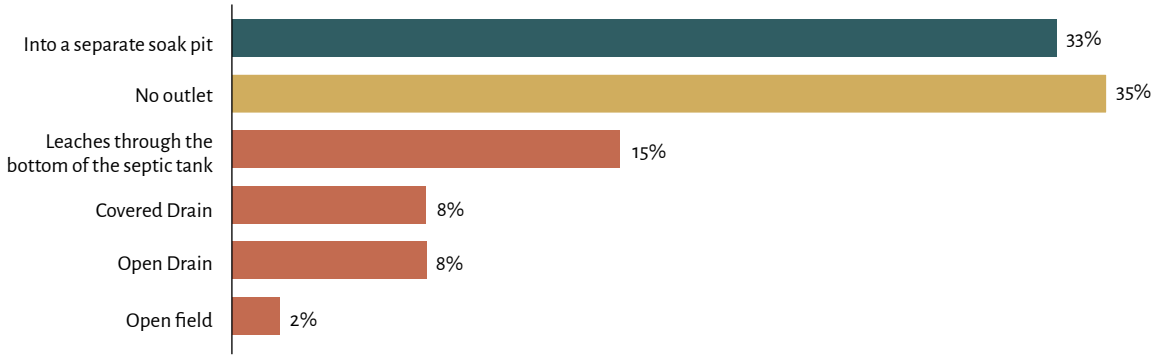
The toilets that are constructed under a scheme are predominantly connected to a single pit (84%). However, majority of the non-scheme led toilets have septic tanks (55%) followed by single pits (38%).

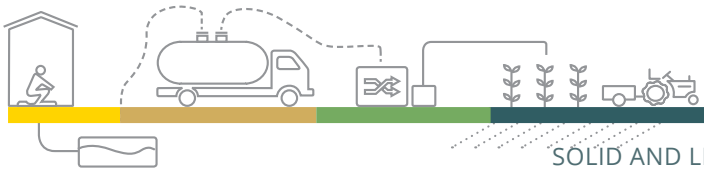
It is also found that while single and twin pit systems have gained popularity only recently, septic tanks started getting built much earlier. Almost all the single and twin pits show year of construction to be post 2014. Septic Tanks also show an increase in the same period but structures dating up till 1980s have also been reported.

90% of the septic tanks are rectangular in shape, mostly 8-10 feet long (Range: 5-15 feet), 6-8 feet wide (range: 4-11 feet) and 8-10 feet deep (Range: 6-15 feet). Rest 10% are reported to be circular with diameter of 3-5 feet and 7-8 feet deep. Barring few, all the tanks have sealed walls and kutcha bottom that allows water seepage. Two third tanks are single chambered and one-third are 2-chambered. None reported any problems during monsoon. 35% of the septic tanks do not have any outlet and only 33% were connected to a soakpit (Figure 21).

97% of the pits (single or twin pit) are circular in shape, mostly (95%) with a diameter of 3 feet (Range: 2-8 feet) and (79%) a depth of 3 feet (Range: 2-10 feet). Rest 3% were rectangular with dimensions of 4.5(average length) X 3.95(average width) X 5.15(average depth) in feet. Only 16% pits have a ventpipe and less than 1% have an outlet. 90% of the pits are located at the backside of the premises

FIGURE 22: OUTLET FOR WASTEWATER FROM THE SEPTIC TANK





and rest 10% in the frontside. Only 23% of the pits are raised above the ground and 66% are constructed with sand outside its wall(s). Predominantly, the walls are lined with mortared rings (93%) and bottom lined with gravel/sand (84%). Remaining 14% had no lining at the bottom. 96% of the HHs with pits didn't report any problems during or after monsoon. Rest 4% faced problems like overflowing pit, clogging of toilet and backflow in the toilet.

Less than 2% of the reported single pits have a junction for connecting a new pit. However, one-fourth of the HHs are of the perception that addition of a second pit would make toilet use more convenient and maintenance easier, with only 10% to be willing to pay for the second pit (median estimated cost INR 250). Though the willingness to pay for second pit was marginally higher among the female respondents, the average amount was higher for the male respondents. Stakeholder interviews highlighted that retrofitting faces both financial and technical challenges. All the 6 Swachhagrahis interviewed for the study said that financial support or subsidy was imperative to motivating HHs for retrofitting. Moreover, only 1 out of 5 masons interviewed had any prior experience in retrofitting.

To compare the volume of two most prevalent OSS systems, single pits and septic tanks, the T-test was carried out. The results show that the volume of septic tank is significantly higher than the single pits. As already discussed, septic tanks are more common among general or OBC categories and among economically better off HHs, thereby making average OSS volume for these groups higher than others. This is validated when OSS volume was compared across the social categories using the Kruskal-Wallis H test (Non parametric test, given the OSS volume is not normally distributed). It is found that there is a significant difference in distribution of OSS volume across the social categories. However, when we run the test for a specific OSS system (for example comparing only single pits), there is no significant difference across the social categories implying that the difference in volume is due to the choice of OSS structure. So volume of single pit is similar across the social groups but because certain groups are choosing septic tanks, their OSS volume is more.

4. DESLUDGING BEHAVIOUR

Only 2.4% (17 out of 694 toilet owning HHs) of the OSS systems have been emptied at least once (2% of the single pits, 4% of the twin pits and 8% of the septic tanks). None of the systems that are constructed post 2017 have been emptied yet. Most of them were emptied during rainy season. Around half have been emptied just once while the other half more than once. Backflow from the toilet is more commonly cited reason for desludging than leakage from the tank/pit. Out of 17 HHs, 10 (59%) used service of a manual labour, while 5 relied on municipal operator (29%) and 2 on private operator (12%). This is when 10/17 (59%) HHs are aware that employing manual labour for cleaning septic tanks or pits is illegal. Data highlights that manual labour is predominantly being used for single pit emptying. They are also providing same day service more often than other providers. It is found from the stakeholder interviews that between 2-6 people together desludge the system.

It is also found that the service providers are specific to a gram panchayat, to a great extent. The reason being that HHs get information about the service provider mainly through family and friends. Sludge disposal is done primarily in a vacant land in the vicinity. Around one-third HHs reported to be not aware of site of sludge disposal.

7 households (41%) paid INR 1000 for desludging. Highest amount cited is INR 5000. While manual labour is charging average amount of INR 1270, municipal and private operator are charging INR 2300 and 3000, respectively. One possible reason being that manual cleaning is being used mostly for single pits, which on average have a smaller volume. As per Manual Scavenger interviewed, desludging costs vary between INR 500-1000 per person depending on size of pit/tank. Desludging fees is perceived as high by half and as affordable by the other half. Willingness to pay for 3-yearly desludging is INR 1000 for 12 HHs (70%), highest amount being INR 2500.

96% of the pits reported no desludging till now, which is expected given that majority of the pits have been constructed in the recent past.(Similarly, 92% of the septic tanks have not been emptied even once). HHs with pits are expecting a time period from less than a year upto 20 years as the expected pit fill up time, with majority (60%) of them reporting 5-8 years. Of these HHs, 43% are planning to call a manual labour, once the pit fills up, while rest would call a cesspool operator (28%) or dig a new pit (24%). While manual labour remains the preferred choice for all respondents, digging of a new pit is higher among the male respondents compared to the female respondents. On self-emptying of twin pits, only 11% HHs are willing to do it.

If we compare single pit with twin pit, anticipated reliance on manual labour is higher among the twin pit owners, while digging a new pit is higher among the single pits (Figure 22). The average amount HHs are willing to pay for desludging service (either by manual labour or cesspool operator) is INR 714 for single pits as compared to INR 1353 for twin pits (Table 26).

Of the 4% remaining HHs that have reported pit filling in past, majority (57%) got the pit emptied while some (35%) even went back to open defecation.

Desludging capacity is a challenge as per the administration. From the stakeholder interviews, it is found that GP administration exhibits high recognition of need for SLWM services – including publicly-provided desludging services. Moreover, sarpanches perceive low capacity to deal with SLWM at GP-level & low willingness to pay among households.

FIGURE 23: ACTION THAT WILL BE TAKEN ONCE THE PIT FILLS UP

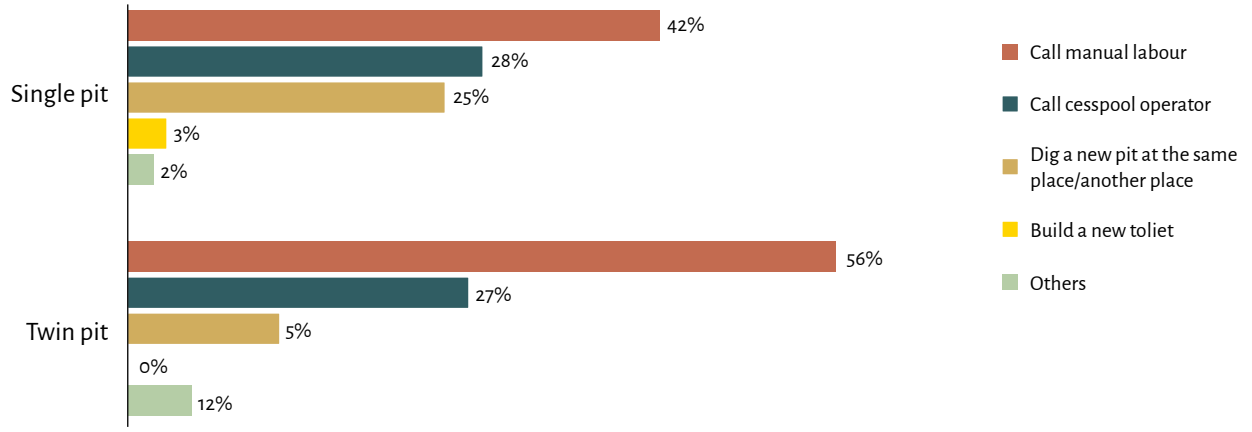
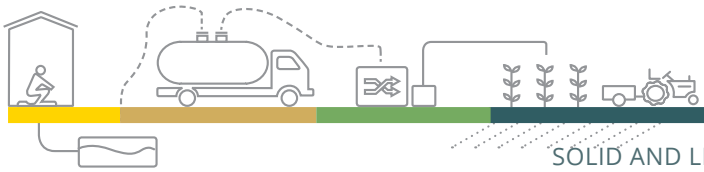


TABLE 25: WILLINGNESS TO PAY FOR PIT EMPTYING SERVICE

Willingness to pay for pit emptying service (INR)	Single pit	Twin pit	Total
0	8%	0%	7%
<500	47%	12%	44%
501-1000	33%	35%	33%
1001-2000	9%	38%	11%
>2000	3%	15%	4%



5. WATER SUPPLY

67% of the sample relies on common water sources (both piped and groundwater) for drinking purpose. Plug-in areas exhibit low share of public piped water (6%) and none of the surveyed HHs have access to personal piped water source. Reliance on surface water (river/pond) or tankers is quite low (Table 27). 35% of the HHs treat water before drinking, mostly by boiling or using a cloth as filter. Around 7% HHs in greenfield areas and 13% in plug-in areas reported issue with water quality.

For the houses with IHHL and water source within the premises, the median distance between groundwater source and OSS is 15m. 32% of the single pits and 29% of the septic tanks lie at a distance of less than 10m from the water source (Table 28). (Absolute numbers of twin pits and other systems is not enough to infer anything meaningful in this case).

17% of the HHs have separate sources for drinking and supplementary water. Sources like ponds and public handpumps are the major sources for these HHs to get supplementary water. Among the HHs with piped water connection, 6% reported to have had to pay for getting the connection. The amount paid ranges from INR 200 to 5000 (average value: 2575). 31% of the HHs are also paying a monthly fee for using the piped water, reported to be below INR 100 by all. Piped water supply is maintained predominantly by the Gram Panchayat (78%) or the village water and sanitation committee (20%). Supply of water is reported to be daily, mostly in morning for less than 2 hrs. Only 6% cited scarcity of piped water during summer season when they shift to non-piped public water sources.

TABLE 26: PRIMARY SOURCE OF DRINKING WATER

Primary source of drinking water	Greenfield	Plug-in	Dhenkanal District (Rural)
Piped water connection to dwelling provided by Gram Panchayat	8%	0%	7%
Piped water to yard/plot provided by Gram Panchayat	4%	0%	4%
Personal dug well	12%	26%	14%
Personal borehole/tube well	5%	1%	4%
Public borehole/tube well	22%	20%	22%
Public dug well	25%	38%	26%
Public standpipe/stand post	14%	6%	13%
Public Handpump	7%	6%	6%
River	1%	0%	1%
Water Tanker(Government)	1%	0%	1%
Others	1%	3%	2%

TABLE 27: PRIMARY SOURCE OF DRINKING WATER

For HHs with both IHHL and water within the premises					
Distance between groundwater source and OSS	Single pit	Twin pit	Septic Tank	Others	Total
<3m	3%	0%	0%	20%	3%
3-10m	29%	33%	29%	60%	30%
10-18m	31%	50%	48%	0%	33%
>18m	38%	17%	24%	20%	34%

Water fetching, from the house yard or from any public source, is done by the adult female members in 85% of the HHs. In case of piped public water, 26% of the HHs travel more than 50m to fetch water. This share is much less in comparison to non-piped water sources where half of the HHs have to travel more than 50m to fetch water. Of the houses with personal well or tubewell, one-third have installed motorised pumps. Except few (less than 1%), no one is paying for the non-piped water. 21% of the HHs relying on non-piped water-source, face water scarcity during summers. HHs relying on public handpump or public well were the most affected. Poorest quintile was more water stressed than others (Figure 23).

Around 70% of the HHs, relying on non-piped sources, want government supplied piped water. The willingness is higher among the HHs that are facing water shortage. 88% of the HHs are ready to pay between INR 20-50 for the same.

FIGURE 24: WATER SCARCITY FACED WITH NON-PIPED WATER SOURCE ACROSS EXPENDITURE CATEGORIES

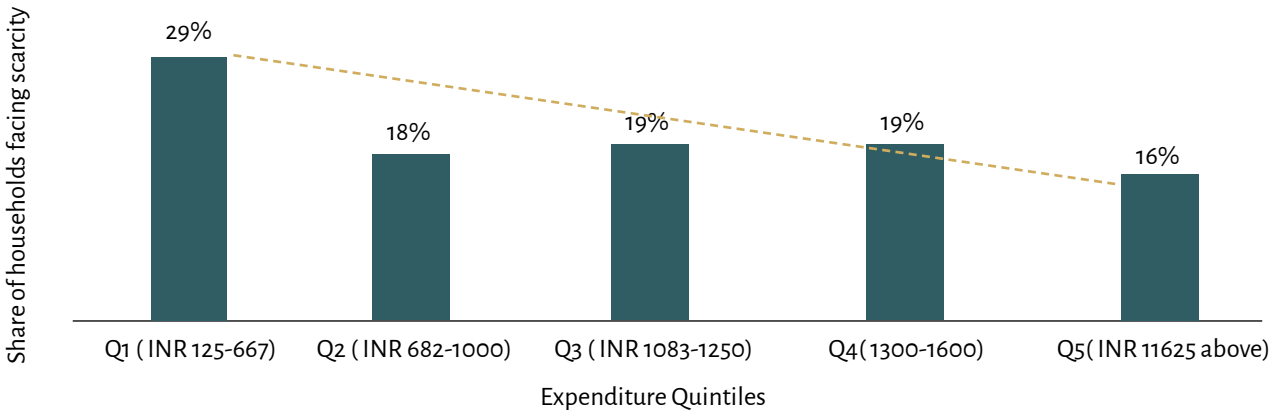
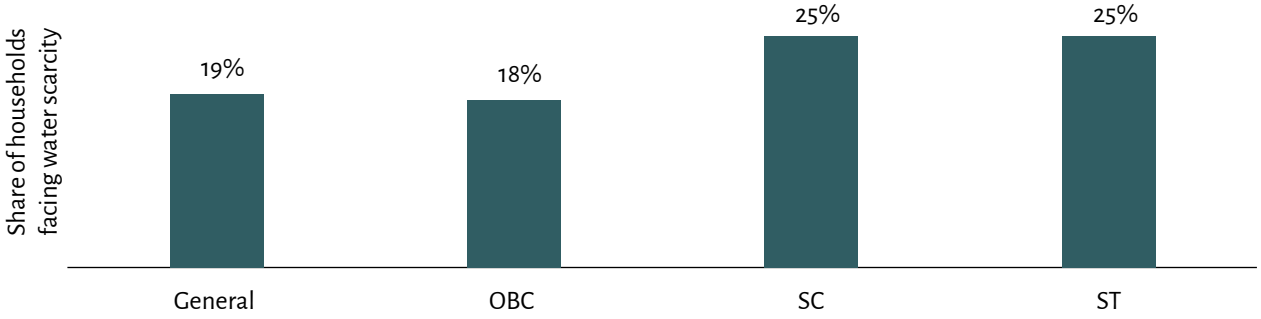


FIGURE 25: WATER SCARCITY FACED WITH NON-PIPED WATER SOURCE ACROSS SOCIAL CATEGORIES



6. GRAYWATER MANAGEMENT

The average reported daily water usage (for all potable and no-potable purposes) is 61 litres per capita. Assuming that 80% of the water used by a HH is released as the graywater, average quantity of graywater being generated on a daily basis is 49 litres per capita. Households that rely on public sources of water have reported lower average graywater generation (Figure 26). Moreover, ST households reported significantly lower quantity of per capita graywater generation, compared to other categories.

With respect to graywater disposal, it is found that the access to drainage is low in the district but relatively higher in plug-in areas (Figure 27). Disposal without treatment is the primary mode of graywater management. 91% of the households are disposing the graywater into the open field or backyard. Rest are disposing it in drains (4%) or using it in kitchen garden (4%). Less than 1% HHs reported water recharging or rainwater harvesting structures within the premises (Figure 28).

FIGURE 26: QUANTITY OF GRAYWATER GENERATED

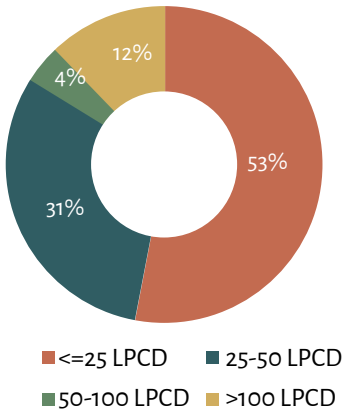


FIGURE 27: QUANTITY OF GRAYWATER GENERATED (LPCD) ACROSS SUPPLEMENTARY WATER SOURCES

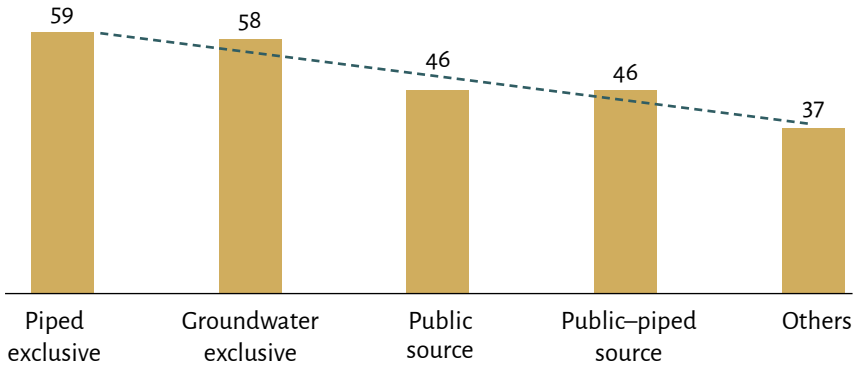


FIGURE 28: ACCESS TO DRAINAGE

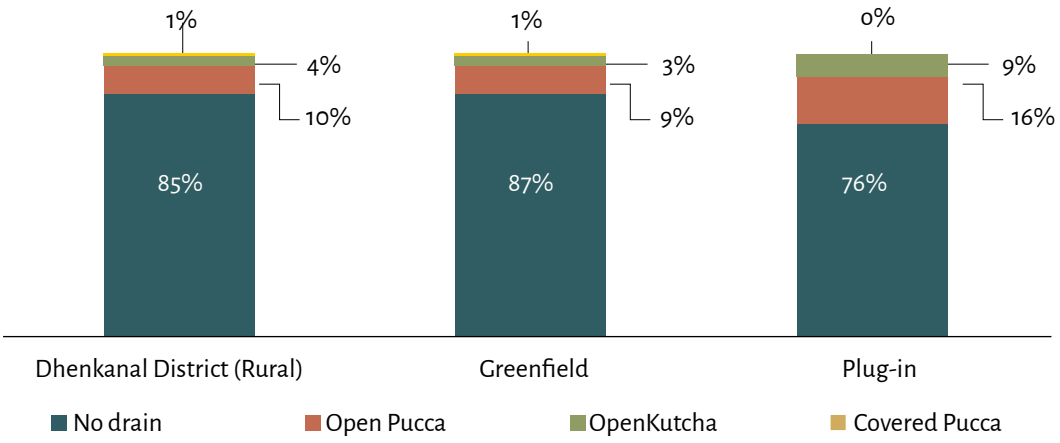
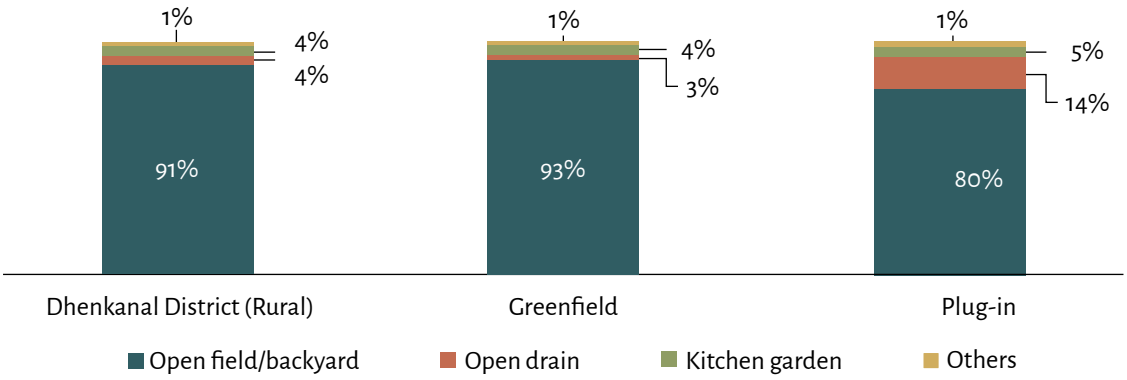


FIGURE 29: DISPOSAL OF GRAYWATER

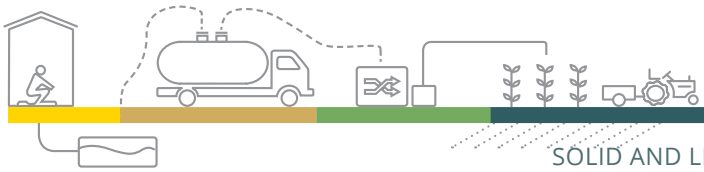


7. SOLID WASTE MANAGEMENT

For managing solid waste, the data highlights that there is neither any community level disposal mechanism in place nor any market developed for the same (kabaddi or exchange of goods). While organic waste (kitchen waste, cattle waste, crop residue) is being reused to some extent, as cattle feed or as compost, plastic waste is either being burnt or thrown/buried in the backyard. E-waste generation is limited. Used sanitary napkins and child faeces are either buried/thrown in backyard or dumped in open (Table 29). From the stakeholder interviews, it is found that GP accept that there is a need for a door to door collection of solid waste, for designated spot/bin for dumping waste, storage shed for plastic waste, etc. However, all of them also highlighted the incapability of GP to single-handedly ensure SLWM, in a comprehensive manner. Moreover, it was reported that even institutions like schools or anganwadi lack solid waste management system, at most a dustbin is available for collection but nothing was found in relation to safe disposal of solid waste.

TABLE 28: DISPOSAL OF SOLID WASTE

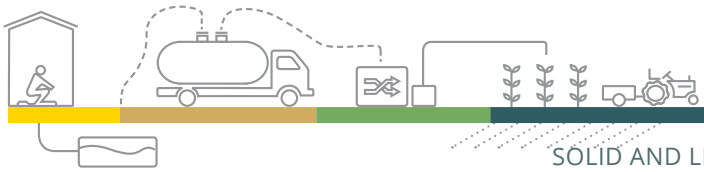
Disposal method	Kitchen waste	Cattle waste	Leaves/ Trees/ Crops residue	Plastic bottles/ containers	Plastic sachet/ packaging	e-waste	Used sanitary napkins	Child faeces
No such waste is generated	0%	52%	3%	2%	16%	90%	27%	72%
Bury/Throw it in the house/backyard	43%	4%	18%	42%	24%	2%	50%	21%
Reuse it as fuel	0%	1%	19%	0%	0%	0%	0%	0%
Reuse it as cattle feed	40%	42%	0%	0%	0%	0%	0%	0%
Compost it	14%	0%	33%	0%	0%	0%	0%	0%
Burn it	2%	0%	26%	43%	55%	3%	4%	0%
Dump it nearby road/ vacant plot/water body	1%	0%	1%	7%	5%	0%	18%	7%
Give it to a kabadi wala	0%	0%	0%	5%	0%	5%	0%	0%
Others	0%	1%	0%	0%	0%	0%	1%	0%



None of the houses reported a solid waste collection system to be in place. 74% of the respondents think that their village requires a solid waste management system. This perception is significantly higher among the female respondents (80%) compared to the male respondents (71%). A common dumping spot which is cleaned daily is perceived to be most suitable by 72% of the respondents followed by a door to door collection system (20%). However, only 26% of the respondents showed willingness to pay (predominantly between INR 10-30) for any solid waste management system. The willingness was marginally higher (though not statistically significant) among the female respondents (Table 30).

TABLE 29: PERCEPTION OF HHS ON SWM AND THE WILLINGNESS TO PAY FOR IT

Variable (p-value)	Value	Gender of Respondent	
		Male	Female
SWM Interest (0.001)	Yes	29%	20%
	No	71%	80%
SWM Willingness to Pay (0.068)	No	76%	71%
	Yes	24%	29%



POST-SBM CHALLENGES AND WAY FORWARD

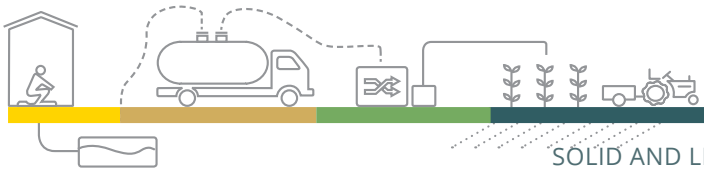
The Dhenkanal district has made steady, significant, and measurable gains in enabling access to toilets among its rural households – going from ~18% during Census of India 2011 to 69% at the time of the present survey. Second to access, 66% of households report that all members always use a toilet – indicating the overall effectiveness of the programmatic investments under SBM-G over the last five years despite a share of last-mile gaps in access and behaviour change persisting. Just as importantly, the survey underscored the need for a post ODF agenda for the district. Access to toilets is the first step towards safely managed sanitation, and the prevalence of on-site systems in the district, not unlike rural areas across the rest of the state and the nation, necessitates a closer consideration of the need for Faecal Sludge Management (FSM).

Among toilet-owning households, single pits are the most prevalent type of on-site system in use at 86%, followed by twin pits and septic tanks at 8% and 7%, respectively. With the district lying in a high water-table area, retrofitting of single pits to twin pits is rendered impractical as per the guidance from SBM-G Phase II. In limited areas within the district where feasible, raising household awareness and financial support is imperative to counteract the low willingness to pay for retrofitting reported by households. Taken together, ceteris paribus, the share of single pits and septic tanks results in 93% of all toilet-owning households in the district requiring safe services for the periodic evacuation of faecal sludge and its off-site treatment before safe disposal.

The institutionalization of FSM services would be critical to not just prevent risks to public health and the environment but also for the safety and dignity of those providing manual desludging services. The data showed that a high share of households engages manual labour for desludging their on-site sanitation system in the absence of widely available, affordable, and much safer mechanized desludging services. When asked to anticipate the need for such services in the future, a large share of both single pit and twin pit system owning households reported the engagement of manual labour as the go-to-solution – pointing to limited household awareness of these issues. Especially among those with the twin pit system, a clear need has emerged for raising awareness on the operating principle and maintenance of the twin pit system. The twin pit systems are designed to completely sanitize the faecal sludge through extended storage, with the end-product being safely emptiable by the households themselves, precluding the need for any desludging services and off-site FSM.

As per the data, while GP Sarpanches recognize these gaps in services for desludging and SLWM more broadly, they expressed limitations in their capacity to manage their provision and low confidence in households willing to pay during interviews. The data confirms the latter, with a significant proportion of households dismissing a need for SLWM services. Therefore, as the Dhenkanal district gears up to take on these second-order challenges, it will need to address two main overarching issues – first, the capacity building of Gram Panchayats (GPs) in managing the new set of services and second, Information, Education, and Communication (IEC) for households to boost cost recovery and financial sustainability.

The UNICEF-CPR anchored Dhenkanal Pilot Project for Solid and Liquid Waste Management (SLWM) aims to tackle these multi-dimensional challenges to enable FSM services for rural households district-wide. Building on the data insights from the present Brief, the Project hopes to emerge as a lighthouse for rural FSM initiatives, toward the protection of public health and the environment, in the state of Odisha and nationally.



ANNEX I
REGRESSION MODEL FOR TOILET ACCESS

The regression equation is as follows:

y = f(a,b,c,d,e), where

y =% of HH with toilets

a = % of HH with water inside the premises

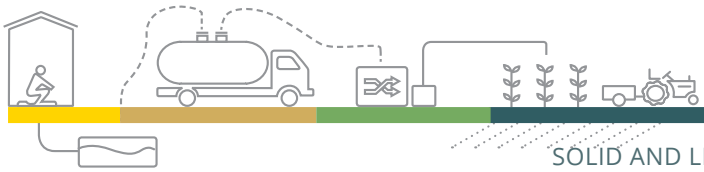
b =% of ST household

c =% of SC household

d =% of literate population

e = % of HH with no assets

Characteristic	Beta	p-value
% HH with water source inside the premises	0.28	<0.001
% ST households	-0.19	0.7
% SC households	-1	0.1
Literacy rate	3.7	0.003
% HH with no assets	4.3	0.1



ANNEX II
SURVEY SITE SELECTION AND SAMPLING

- We conducted a survey of 1000 households across the Dhenkanal district. The sample size of 1000 households translates to a margin of error (MoE) of 4.07% at a confidence level of 99%, or alternatively, an MoE of 3.09% at a confidence level of 95%. 30 observations is typically considered adequate for performing simple statistical analysis 30 households in each GP. Accordingly, we distributed the sample of 1000 households across 33 GPs (33 x 30 = 990 households. To identify 1000 households across 33 GPs for conducting the survey, we employed a multistage stratified sampling design with random selection of the units at each stage (similar to National Sample Survey, India Human Development Survey, National Annual Rural Sanitation Survey)[16]. Here, the GP served as the First Stage Unit (FSUs), villages within the GPs served as the Second Stage Units (SSUs), and households were the Ultimate Stage Units (USUs). The total number of GPs in the sample are ~17% of the total number of GPs in the district. To select these, we first stratified all the GPs based on the proportion of ST population into two strata. Based on the population share of the two strata, we proportionately divided the 33 GPs between them. Accordingly, we allocated one GP from the sample to the 'predominantly tribal GPs' stratum (more than 50% of population is ST), while the rest went to the 'non-tribal GPs'. For selecting 32 GPs and 1 GP in each of the stratum, we employed the Probability Proportionate to Size (PPS) method.

- We conducted a survey of 1000 households across the Dhenkanal district. As per the Cochran Method for calculating the sample size of a survey[17], at the district-level, the sample size of 1000 households translates to a margin of error (MoE) of 4.07% at a confidence level of 99%, or alternatively, an MoE of 3.09% at a confidence level of 95%. For example, the survey finds that 86% of the toilet-owning households in the sample are dependent of a single pit, which means that we can say with 99% certainty that at the district-level, between 82.05% (86 - 4.05) and 90.05% (86 + 4.05) of the toilet-owning households depend on a single pit.

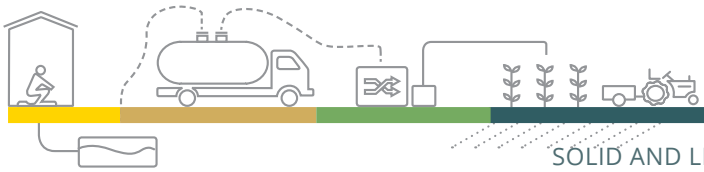
- Since a sample of 30 observations is typically considered adequate for performing simple statistical analysis, we decided that to be able to conduct the analysis at the Gram Panchayat-GP level, we would survey 30 households in each GP. Accordingly, we distributed the sample of 1000 households across 33 GPs (33 x 30 = 990 households; remaining 10 households were distributed among the largest villages in the sample).

- To identify 1000 households across 33 GPs for conducting the survey, we employed a multistage stratified sampling design with random selection of the units at each stage (similar to National Sample Survey, India Human Development Survey, National Annual Rural Sanitation Survey)[18]. Here, the GP

17 For comparison, the latest round of state-level NARSS survey interviewed 4140 households in 276 villages across the state.

18 Please refer to online calculator which automatically finds the sample size based on the total population in the survey area and desired confidence interval and level at https://www.surveymonkey.com/mp/sample-size-calculator/

19 For comparison, the latest round of state-level NARSS survey interviewed 4140 households in 276 villages across the state.



served as the First Stage Unit (FSUs), villages within the GPs served as the Second Stage Units (SSUs), and households were the Ultimate Stage Units (USUs).

- The total number of GPs in the sample are ~17% of the total number of GPs in the district. To select these, we first stratified all the GPs based on the proportion of ST population into two strata. Based on the population share of the two strata, we proportionately divided the 33 GPs between them. Accordingly, we allocated one GP from the sample to the 'predominantly tribal GPs' stratum (more than 50% of population is ST), while the rest went to the 'non-tribal GPs'.

- For selecting 32 GPs and 1 GP in each of the stratum, we employed the Probability Proportionate to Size (PPS) method through the R software. Simply put, PPS method requires arranging GPs in a random order and calculating the cumulative population of the GPs. The method then used a random number to select the GP (the GP associated with the population band within which the random number falls).

- With 33 GPs selected in the manner, we then selected villages for the sample within each – splitting the 30 households equally in three villages in each GP – at the second stage. In cases where a GP had less than three villages, we surveyed all the villages in the GP distributing the sample of 30 households equally between them. Where a GP comprised more than three villages, we used used Simple Random Sampling (SRS) to select three villages. Accordingly, we ended up with a sample of 97 villages across 33 GPs.

- For validation, we compared the sample and the population basis Census of India 2011 data for attributes like SC and ST population, the population living in large dense villages[19] , share of households with tap-water supply, share of households with water source inside the premises, share of households with access to an individual toilet, and the share of female-headed GPs (information from district office).

- Finally, we selected the USUs (Ultimate Stage Units) or the households through in-field randomization for administering the survey in the Computer-Assisted Personal Interviewing (CAPI) mode. CPR collaborated with the Cadasta Foundation, a Washington, D.C.-based technology service provider for creating the digital survey form using the esri ArcGIS platform, one of the world's foremost GIS software. Due to the unique nature of the platform, all the household's interviews got recorded as a geospatial information layer in real-time allowing for easy and comprehensive quality control over the survey. CPR researchers vetted the incoming data on a daily basis in the first week of the survey roll-out, and then biweekly for subsequent weeks, to minimize all data quality errors from the onset.

- 40% of the total sample was allocated to female respondents to ensure adequate representation of women.

20 Large Dense Villages, a classification coined by an earlier CPR study, refers to census villages with a population of more than 1000 and a population density of more than 400 people per square kilometers.

SCALING CITY INSTITUTIONS FOR INDIA (SCI-FI)

The Water and 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 to develop policies and programmes for intervention with the goal of increasing access to inclusive, safe and sustainable sanitation.

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