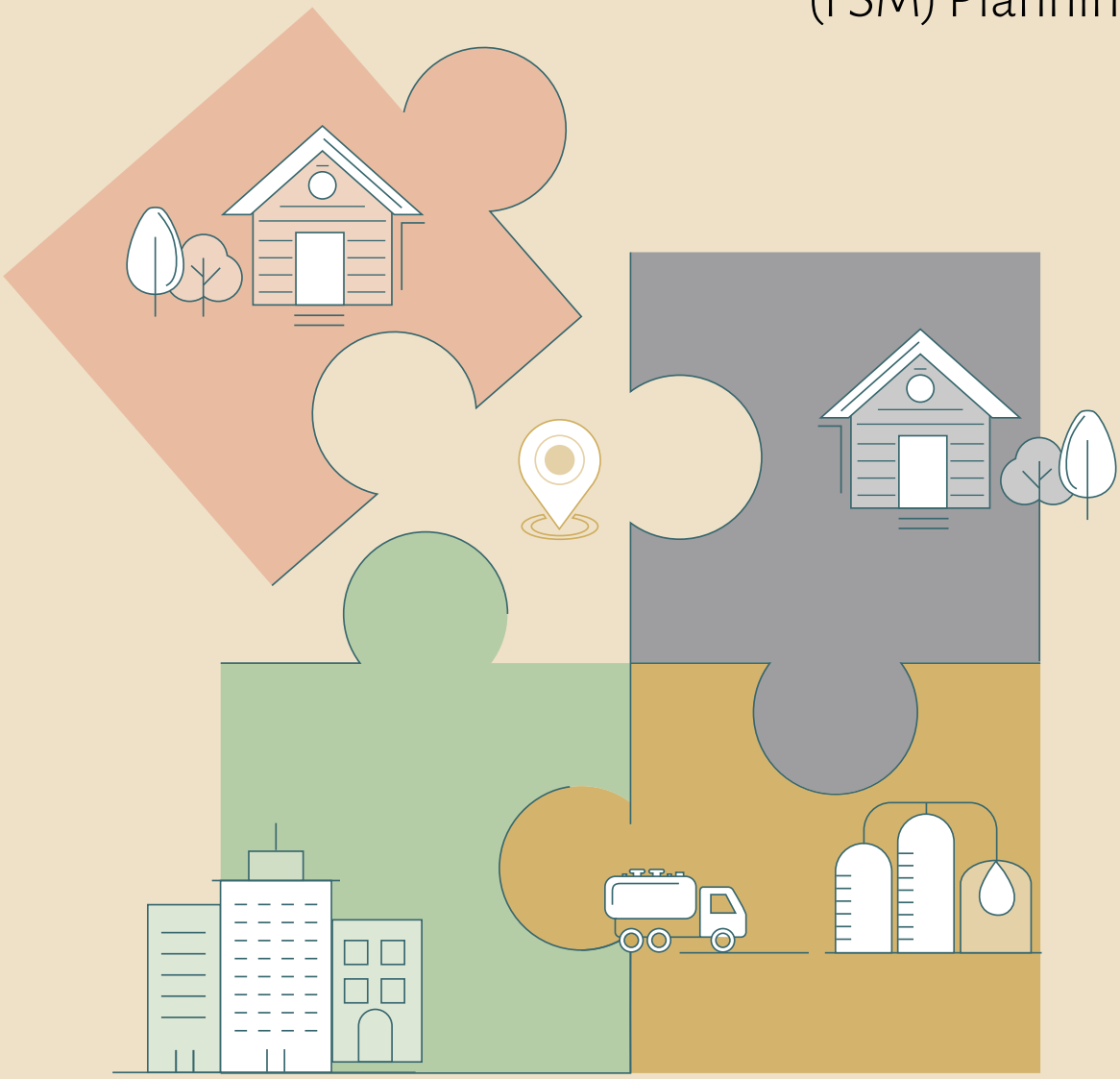
TOWARDS DISTRICT-WIDE SAFELY MANAGED SANITATION:

MARCH 2022

Template for District-level Faecal Sludge Management (FSM) Planning



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TOWARDS DISTRICT-WIDE SAFELY MANAGED SANITATION:

Template for District-level Faecal Sludge Management (FSM) Planning

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Acknowledgement

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SCIFI, CPR is responsible for the content of this publication.

Prepared by
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1 Background

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, improved nutrition and education outcomes, increased productivity, and the physical and mental well-being of individuals[1]. With nearly 70% of India's population residing in rural areas, instituting and sustaining rural sanitation systems is crucial. 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. Since the launch of the Central Rural Sanitation Programme in 1986, nationwide programmes have successively followed to increase access to improved sanitation, largely understood to comprise individual toilet facilities, among rural households.

The Swachh Bharat Mission – Gramin (SBM-G), launched on October 2, 2014, implemented a mission-mode drive to construct subsidised toilet facilities across rural India. At the end of the first phase of SBM-G in 2019, districts and states had declared themselves Open-Defecation Free (ODF) by constructing about 103 million toilets across rural India during 2014-19. Nonetheless, ODF is only the first step in India's journey toward the Sustainable Development Goal 6 of ensuring 'availability and sustainable management of water and sanitation for all'. While toilets ensure the safe collection of faecal waste, access to toilets necessitate the safe management of the septage and sludge accumulating over time in on-site sanitation systems.

If not completely treated on-site, septage and sludge must be conveyed to and treated/co-treated or safely disposed at an off-site facility like a Faecal Sludge Treatment Plant (FSTP), a Sewage Treatment Plant (STP), or a Deep Row Entrenchment (DRE) facility. When disposed without adequate treatment, septage and sludge can pollute the environment and adversely impact public health. Accordingly, the recently launched SBM-G Phase II consolidates the post-ODF agenda on rural sanitation. First, it reinvigorates the focus on ensuring the sustainability of the Open Defecation Free (ODF) status by continued investment in behaviour change. Second, it mainstreams and finances Solid and Liquid Waste Management (SLWM) and Faecal Sludge Management (FSM) for achieving complete sanitation.

As states pursue the goal of clean and sanitised villages - both under the mandates of the programme and the larger SDG framework - planning for rural sanitation systems through a unique district-level lens holds the potential to

- unlock economies of scale, higher efficiencies, and spatial synergies in setting up and managing infrastructure
- mitigate the challenges of limited last-mile governance capacities by creating solutions at the cluster level for a group of Gram Panchayats (GPs) together
- generate a greater momentum towards sanitation efforts than planning for sanitation at the level of individual GPs would
- enable a more optimal allocation of district-level financial resources
- create a more holistic understanding and articulation of enhanced resilience, improved water quality, pollution abatement, and gains in public health as sanitation goals cutting across administrative boundaries

The present Template for FSM Planning aims to aid state and district governments, practitioners, and developmental partners in creating a District-level FSM Plan. It lays out the step-by-step process for the preparation of the plan including,

- assessment of available secondary data,
- collection and analysis of primary data to fill gaps in understanding,
- analysis of secondary and primary spatial data to form clusters and identify suitable sanitation strategies
- creation of an implementation framework for each strategy

[1] Retrieved from http://sbm.gov.in/sbm (India Ministry of Drinking Water and Sanitation, 'Swachh Bharat Mission-Gramin')

2. Introduction to the Plug-in and Greenfield Approaches to FSM

The Template is founded on two primary approaches to enabling FSM services for rural areas – plug-in and greenfield – aligned to the guidance from the SBM-G Phase II and leveraging the ongoing scale-up of urban FSM in the country. The SBM-G Phase II provides for the adoption of three pathways towards enabling Safely Managed Sanitation in response to differentiated local contexts. It recommends:

- Retrofitting single pits to twin pit systems where the groundwater table is lower than three meters
- Retrofitting single pits (and twin pit systems) in areas with a groundwater table higher than three meters to 'in-situ treatment' and implementing FSM
- Desludging septic tanks every 3-5 years and implementing FSM

Of these three, retrofitting of single pits to the twin pit systems as the first priority for settlements with a low groundwater table aims to obviate the need for off-site FSM. For all settlements with a high groundwater table, FSM emerges as a necessity for the safe management of faecal waste beyond the toilet. When planning for FSM, the district can adopt one of the two strategies for any given settlement or a cluster of settlements:

- 'Plugging-in' rural areas to the urban FSM-S and
- Developing 'Greenfield' FSM-S

The first approach of 'Plug-in' refers to providing desludging services to rural households and treating the evacuated sludge through the existing urban FSM-S, provided the urban FSM-S (specifically, the FSTP or an STP with co-treatment ability) has spare capacity available. The approach leverages existing partially-utilized urban FSM infrastructure to serve the GPs peripheral to urban centres. It is equivalent to the option of 'Co-treatment at STP or Disposal at FSTP' recommended by the SBM-G Phase II Guidelines for rural areas within 10 kilometres of urban centres. The second approach of 'Greenfield' focuses on GPs that can't feasibly be plugged into the urban FSM-S and aims at the development of a greenfield rural FSM-S to serve these. Together, these approaches would enable the district-wide safe and scientific management of faecal waste.

2.1 Plugging-in Rural areas to Urban FSM-S

Until a few years ago, the focus of urban wastewater management had been on the development of centralised sewerage systems. However, the consensus on their resource intensiveness for capital works and operation and maintenance (O&M) has been steadily paving the way for non-networked sanitation and FSM as the preferred citywide sanitation solution, especially among smaller towns in India and South Asia, more broadly. The ascendant role of FSM in citywide wastewater management is evidenced in the issuing of the National Faecal Sludge and Septage Management Policy in 2017 and the subsequent allocation of funds for FSM infrastructure under Atal Mission for Rejuvenation and Urban Transformation (AMRUT). FSM will continue to play a strong role in urban sanitation since the new phase of SBM Urban finances FSM for cities and towns with a population of less than 1,00,000.

The parallel emergence of the need for rural FSM and nationwide scale-up of urban FSM presents a tremendous opportunity for leveraging existing urban FSM-S to cater to peripheral rural areas. Therefore, the strategy of Plug-in underscores the importance of approaching urban sanitation planning at the level of the district too. Practitioners, planners, and governments scaling up urban FSM can factor in these rural-urban synergies from the outset when planning new infrastructure such that by default, urban FSTPs are designed to cater to not just the urban population but also the peripheral peri-urban and rural areas.

2.2 Developing 'Greenfield' FSM-S

The Plug-in approach, while suitable for GPs abutting urban centres, is neither a feasible solution for GPs located at longer distances nor when the urban FSM-S is running close to its design capacity. Both situations require the creation of greenfield FSM-S to enable Safely Managed Sanitation services for rural households. Infrastructurally, creating such a greenfield FSM-S entails the construction of an FSTP or a safe disposal facility like DRE (if environmentally-suitable) and the procurement of an appropriately-sized fleet of desludging vehicles.

3. Understanding the Existing Sanitation Scenario

Understanding the on-ground water and sanitation scenario is essential to creating a responsive and effective District-level FSM Plan. As part of developing the Plan, it is critical to identify which one of the aforementioned approaches, viz. retrofitting, plug-in, greenfield, is most suitable for a given settlement or a set of settlements. The following points of information are key to the process:

- Total number of households
- Decadal/annual growth rate of rural households at the district/ state level
- Number of households dependent on different types of on-site sanitation systems (mainly, septic tank with or without soak pit, single leaching pit, pits in series or interconnected pits, twin leaching pits)
- Average size of the different types of on-site sanitation systems to estimate the desludging frequency
- Groundwater level in the region

While existing secondary data from various governmental bodies can fill some of these gaps, a primary survey is important to developing detailed sanitation-specific insights. The upcoming sub-sections discuss the different types of secondary and primary data instrumental in sanitation planning.

3.1 Secondary Sources of Data

Of the basic information required for creating the District-level FSM Plan, the total number of households can be obtained through the Census of India, GP administrations, or programmatic Management Information System (MIS) like the (erstwhile) National Rural Drinking Water Programme database. Similarly, the decadal growth rate can be calculated using the Census of India data for two or more consecutive periods. The growth rate helps understand how the demand for FSM services is expected to grow in the medium- to long-term. It thereby helps in appropriately sizing the infrastructure to meet the needs of the present and the future populations.

The district-level data on types of sanitation systems may be available from the SBM-G MIS. At its very basic, the SBM-G MIS data available at the GP/district/ state level could detail what type of on-site sanitation systems have accompanied the toilets constructed under the programme. Table 1 provides a summary of these different types of secondary data needed and their sources.

3.2 Need for Primary Survey and Related Assessments

Secondary data can provide an overview of the district's sanitation landscape. However, it often does not suffice for informing detailed planning calculations, viz. the sizes of the different on-site sanitation systems, hydraulic loading to these systems, and the average number of users. Using assumptions based on the literature review may not be a feasible option since the specificities of rural sanitation research have thus far largely focused on the change in the prevalence of open defecation.

In this context, a primary survey of households coupled with structured interviews with key stakeholders like masons can help refine and deepen the understanding of rural sanitation infrastructure. Table 2 provides a simple household-level questionnaire that can be administered to a representative sample of households for capturing planning-specific sanitation data. To enable the accuracy of responses, the enumerators can use flashcards as visual aids for explaining terminologies to the households. The survey can incorporate physical verification of 1-2% (or more, depending on the total sample size) of dimension-related responses.

Just as importantly, while household-level data can help identify the suitable strategy and the infrastructural capacities of FSM Systems (FSM-S), the actual infrastructure designing needs additional technical data on:

- Characteristics of septage and sludge in the intended service area
- Depth to groundwater table, topography and soil profile at the selected site for infrastructure development

These assessments are not needed in the initial stages of FSM planning but may be indispensable during implementation and should be accounted for while estimating overall project costs.

TABLE 1: Types of data and its sources

Type of Secondary Data	Potential Sources	Relevant for
Total Population/Number of Households	Census of India (latest), District/Block Records, MIS Databases	Infrastructure Planning
Annual/Decadal Growth Rate	Census of India (two consecutive periods), the population at any two distinct points in time from MIS Databases or District/Block Records	Infrastructure Planning
Types and Average Sizes of On-Site Sanitation Systems	SBM-G MIS for types, Primary survey for sizes	Infrastructure Planning
Depth to Groundwater	Central Groundwater Board (CGWB) Reports	Infrastructure Planning
Road Network	OpenStreetMap, Google Maps, Governmental Road Infrastructure Geospatial Datasets, Census Handbooks	Clustering
Administrative Boundaries for District, Block/Tehsils, Villages	Governmental Geospatial Datasets, Census of India 2011 (or latest) District Census Handbooks, privately sold/open-source geospatial datasets	Clustering
Distance between Villages and Urban Centers	District Census Handbooks	Clustering

TABLE 2: Questionnaire for sample survey

Question	Responses
Name of Block	_____
Name of Gram Panchayat	_____
Name of Village	_____
Name of Respondent*	_____
Contact Number of Respondent*	_____
GPS Coordinates of Dwelling*	_____ , _____
What is the size of the household?	_____
Does the household have a toilet?	o Yes o No (Exit interview if the household does not have a toilet)
What type of sanitation system does the household have?	o Twin Pits with functioning junction-chamber o Twin Pits without junction-chamber o Single Pit o Septic Tank with Separate Soak pit o Septic Tank with Soaking Chamber and with/without Outlet o Fully Watertight Septic Tank with/without Outlet o Others
What are the dimensions of the sanitation system?	_____ width or diameter (in feet) if system is cylindrical in shape
	_____ length (in feet) (to be left blank if system is cylindrical in shape)
	_____ depth (in feet)
What does the household discharge into the sanitation system ?	o Only blackwater o Blackwater and greywater

*These identifiers may be useful during the physical verification stage of the survey. However, following the completion of the survey, the data should be anonymised to address privacy concerns. Even when GPS coordinates are used to provide any spatial insights on the spread of data, they should still be delinked from the other two attributes.

4. Clustering Gram Panchayats

With an understanding of the on-ground needs established, the next step in formulating the District-level FSM Plan is the formation of settlement clusters. These clusters – which may or may not be perfectly contiguous spatially - would comprise one or more GPs that require the same approach to Safely Managed Sanitation. Data-led clustering is a dynamic exercise responsive to evolving on-ground contexts and the broader shifts in the policy environment. The clustering may undergo multiple iterations till the final consensus amongst the various stakeholders is reached. The present Template employs geospatial analysis for clustering GPs with the following advantages over the conventional statistics-only approach:

- More communicative and collaborative – Geospatial analysis can help facilitate discussions with administrative officials and stakeholders at all tiers by parsing the data in the form of more intuitive and engaging data-rich maps. Using maps can create more interactive and informed engagement with GP administrations and communities and resultingly produce planning processes that are more locally informed and owned.
- More efficient planning: Geospatial analysis creates spatial relationships between different types of data viz. demographic, sanitation, administrative, topographic, and mobility. By creating and visualising these relationships in an easy to understand manner, geospatial analysis enables holistic decision-making for clustering, site selection for FSM infrastructure development, etc.

The following sub-sections discuss the step-by-step methodology for creating clusters out of all the GPs in the district.

4.1 Delineating the Plug-in Clusters

As mentioned earlier, the SBM-G Phase II considers plugging-in GPs to nearby urban FSM-S (or co-treatment) as a viable sanitation solution. The programme guidelines recommend using a distance of 10 kilometres (km) between a GP and the urban FSTP or STP as the threshold for determining whether plug-in. would be feasible. Different states may issue their own guidance in the matter. For example, the state of Odisha has recommended a threshold of 20 km for identifying GPs suitable for plugging-in[2]. Nonetheless, it is important to recognise that at the initial stage, all broad-based distance thresholds would be arbitrary. The suitable distance threshold for a given context would ultimately be a function of factors like the FSTP's spare capacity and the need for FSM in the potential plug-in area. Later sections discuss this requisite analysis in more detail, but delineating a cluster based solely on distance suffices as a good initial condition upon which later iterations of planning and clustering can build upom.

Once an initial distance threshold has been set, the next task is to identify the GPs that qualify for plugging-in according to it. All urban centres with existing or upcoming FSTPs should be considered for evaluating the district-level plug-in potential. Since a GP, unlike a ULB, is not a singular spatial entity but instead comprised of one or more villages, the distance threshold would need to be applied at the level of the village. Early experience in applying the threshold in the districts of Angul and Dhenkanal in Odisha shows that not all villages of a GP would always individually qualify for plug-in. Given that GPs are the main rural administration unit for service delivery, it becomes important to adopt a combined village-GP criterion to handle the complex ground realities. The examples of such criteria include:

- Consider the whole GP suitable for plugging-in if even one village of the GP qualifies for plugging-in based on distance threshold
- Consider the whole GP suitable for plugging-in if x% of villages (e.g. 25%, 75%, etc.) in the GP qualify for plugging-in
- Consider the whole GP suitable for plugging-in if the number of villages in the GP qualifying for plugging-in is higher than that

[2] Vide notification PR-RS-MISC-0009-2020.8667 issued jointly by the Panchayati Raj and Drinking Water, and Housing and Urban Development departments, Government of Odisha on May 28, 2021

of those not qualifying

- Consider the whole GP suitable for plugging-in if all of the villages in the GP qualify for plugging-in

All four of these criteria could be experimented with to identify the one most suitable to a given context. The distance threshold in conjunction with a criterion as aforementioned would ultimately result in as many clusters of GPs as there are urban centres (with existing or upcoming FSTP) in the district.

4.2 Delineating the Greenfield Clusters

The plug-in GPs from the previous step would likely form only a subset of the total number of GPs in the district. The remaining GPs would require their own solution to FSM. Technologies or safe disposal mechanisms for faecal sludge vary widely in complexity, from simple Deep Row Entrenchment to the energy-intensive Omniprocessor that is capable of creating water of potable quality as an end-product. Since GPs are less dense and usually less populous than the average city, implementing infrastructure at the scale of individual GPs may not be cost-efficient. Moreover, creating many GP-level FSM-S could lead to challenges stemming from inadequate regulatory and administrative capacities. Therefore, the GPs not eligible for plugging-in can be grouped into separate clusters for implementing cluster-level greenfield FSM-S.

Before diving into the process of greenfield clustering, it is imperative to consider the suitability of retrofitting single pits to the twin pit system as a potential solution in these remaining GPs. Although the SBM-G Phase II highly recommends retrofitting, where hydrogeologically suitable, it still does not directly fund retrofitting. Even if the funding of INR 230 per capita that the programme provides to districts for FSM is co-opted for retrofitting, it will not cover its complete cost. Districts should strongly consider the following factors for determining the region-wise suitability of retrofitting as a solution:

- Depth to groundwater table in the region
- Availability of government funds to support households in retrofitting
- Willingness of households to retrofit and pay for it

Geospatial analysis can help determine the retrofitting potential based on the first of these. If the district has areas with a low groundwater table and manageable socio-economic barriers to retrofitting, the district can demarcate these areas for retrofitting and discount them from greenfield clustering. Accordingly, for the final subset of GPs where neither plug-in nor retrofitting is possible, the district can adopt clustering based on the following parameters:

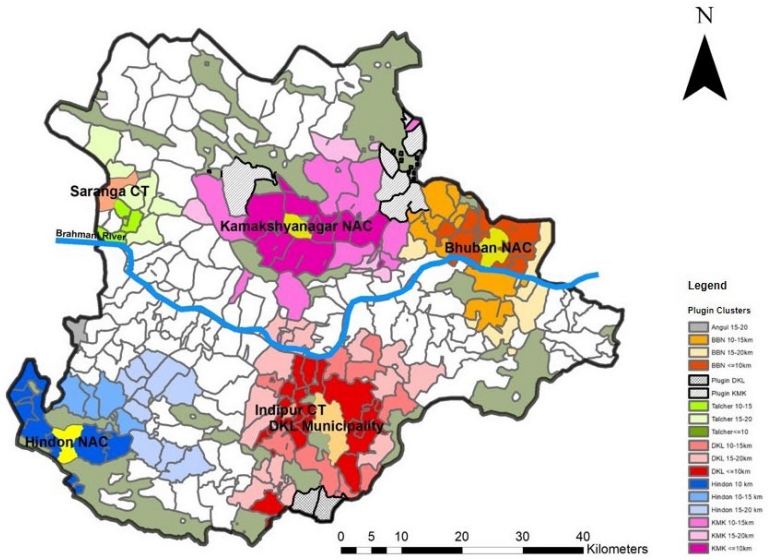
- **Topography –** The natural features of the district, in particular topography, can impose a hard constraint on the accessibility of certain regions and isolate them from others. Therefore, the topography is important in identifying any naturally occurring geographic clusters in the district.
- **Road Connectivity –** The present approach centres on creating cluster-level FSM-S that reliably serve all rural residents of that particular cluster, and hence ensuring that individual clusters have adequate road connectivity across them is important. Accordingly, road connectivity features as a parameter in the clustering process.
- **Block Boundaries –** To enable seamless and unfragmented governance of FSM services in the cluster, the clustering process can consider breaking up the cluster on the basis of block boundaries. However, it may not be necessary to use block boundaries as a cluster-determining parameter depending on the specific governance settings.

Overall, following the same logic as that underlying the development of FSM-S at the level of the cluster instead of the GP, the number of clusters in the district needs to be optimised for administrative convenience.

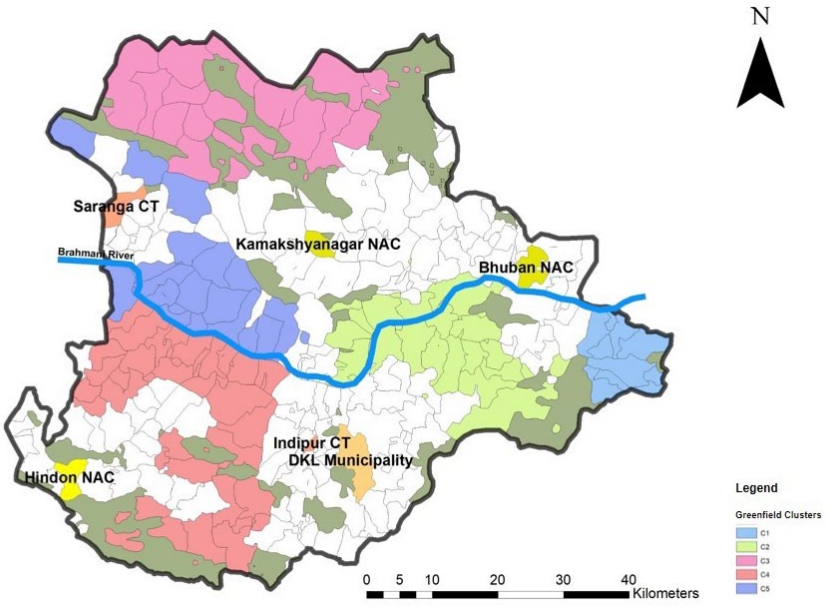
With the clustering process defined, it can be implemented via any geographic information system (GIS) software like QGIS or ArcGIS. The set of clusters thus obtained can serve as a basis for consultative decision-making with district/block/GP administrations.

Identifying Plug-in and Greenfield Clusters of Gram Panchayats in Dhenkanal district

The Dhenkanal district, Odisha is one of the first districts in the country to demonstrate a clustering-based and district-level approach to sanitation planning under the Dhenkanal Pilot Project for Solid and Liquid Waste Management. The district, in alignment with the state's guidance on urban-rural convergence for sanitation, identified clusters of GPs that could be plugged-in to the existing and upcoming urban FSTPs in the district. In the next step, spatial analysis informed the identification of five cluster of GPs that would require greenfield solutions for FSM.



Plug-in Clusters



Greenfield Clusters

5. Planning for Plug-in

Planning for the implementation of 'Plug-in' is a multi-faceted process and requires the coordination of government(s) at the district, block, and local levels. The following sections discuss the process for formally plugging in a cluster of GPs to an urban FSTP in its vicinity.

5.1 Identifying Plug-in Potential

The process begins with matching the spare capacity of the urban FSTP with the FSM demand from the rural households in the initially identified cluster (based on the initial distance threshold determined in section 4.1). The FSM demand of the cluster should be estimated over a multi-year period and accounting for the urban FSTP's design period. Similarly, the spare treatment capacity should be calculated using the FSTP's records and anticipated increase in demand on account of population growth over the remaining years in its design period.

If the spare capacity is more than the estimated demand, the size can be increased. On the other hand, if the demand is higher than the available spare capacity is in the short term, the cluster size can be reduced. If instead, the demand is higher than the estimated spare capacity in the medium-term, two options could be considered – augmentation of the FSTP or construction of a greenfield rural treatment facility once the average capacity utilisation starts to reach threshold levels.

Once the demand for FSM services among rural households and the FSTP's spare capacity has thus been matched, the District Administration, along with the rural and urban local bodies, can ratify the final cluster for implementing the Plug-in model.

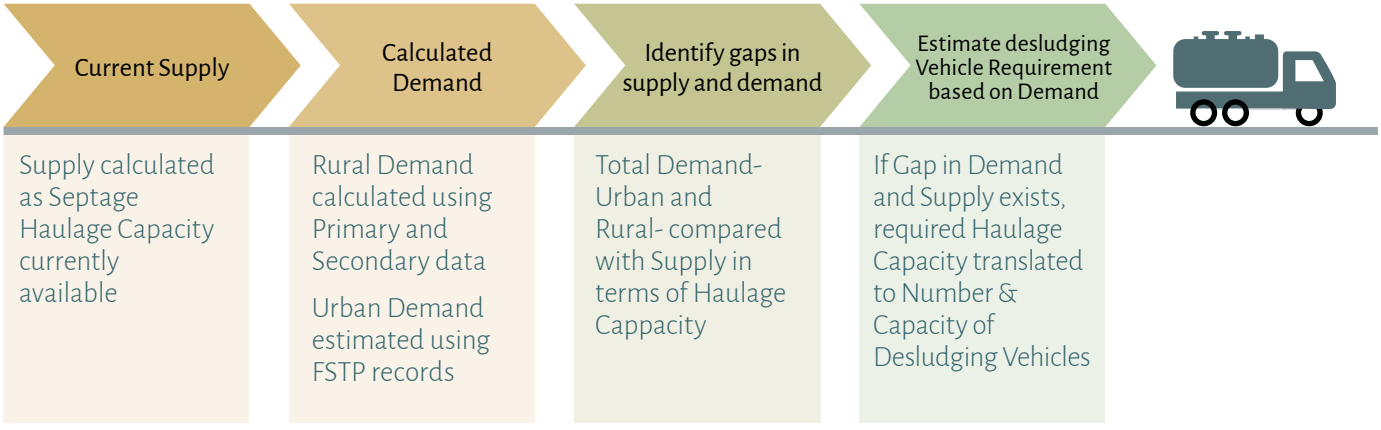
Annexure II describes one of the methods for estimating the demand (in terms of KLD).

5.2 Estimating the Requirement for Additional Desludging Vehicles

The supply and demand match of the FSTP capacity notwithstanding, successfully catering to the extended service area under the Plug-in Cluster while not compromising on the Service Level Benchmarks (SLBs) for timely desludging could require augmenting the fleet of desludging vehicles. Continuing with the estimated rural demand for FSM services in KLD, the existing Septage Hauling Capacity (SHC) can be calculated as the total cumulative capacity of desludging vehicles multiplied by the benchmark number of trips possible per vehicle (Figure 12). If the total urban and rural demand for FSM services exceeds the SHC, additional vehicles would need to be procured.

For example, with a 3 KL and 1 KL vehicle each performing a maximum of 4 trips a day per vehicle, SHC = (3 + 1)*4 = 16 KLD. If the total urban and rural demand is 18 KLD, then one or more additional vehicle (depending on their size) would be required to cater to the total service area.

Figure 1: Process for estimating the requirement for additional desludging vehicles



5.3 Estimating Costs

Depending on the agreed need for augmentation of the FSTP and the fleet of desludging vehicles, the Plug-in Model can lead to incurring capital costs. Regardless of whether capital investments in assets and infrastructure are required or not, serving rural areas through the urban FSM-S would certainly lead to Operation and Maintenance (O&M) costs.

5.3.1 Capital Costs

The Plug-in cluster would incur major expenditure only if augmentation of the FSTP or of the fleet of desludging vehicles is necessary for catering to the extended service area. For the former, the costs would depend on a variety of factors such as the type of FSTP technology, whether partial augmentation of specific unit processes is required or the entire FSTP, availability of space within the FSTP for expansion, among others. Similarly, the capital costs for additional desludging vehicles would depend on the number of vehicles required and their capacity.

5.3.2 Operation and Maintenance (O&M) Costs

Due to the extended travel distances between the FSTP and the rural areas beyond the urban boundary, the operational cost of delivering desludging services per trip would be higher for rural areas compared to urban ones. The resulting mark-up on the O&M costs per trip can be calculated as a function of the average round trip distance between the GPs and the FSTP, the mileage of the vehicle, and the fuel cost per litre. The GP should aim to recover at least part of the total O&M costs for desludging through a service fee for the rural households. The GP can make up the remaining share through its own funds demarcated for sanitation under the Finance Commission or any other relevant sources.

5.4 Recordkeeping for Monitoring and Planning

Urban FSTP operators or the ULB sanitation in-charge(s) typically maintain service delivery records that provide information on how many requests were served daily, the customer profile, the type of on-site sanitation system, and other related points. However, the system for FSM-S operational monitoring and the quality of the resultant data can vary widely across different ULBs. The proper functioning of the Plug-in model requires that the ULB and GPs maintain good quality records for managing service delivery, as well as, diagnosing the health of the FSM-S over time.

In the case that a proper system of FSM recordkeeping, including different components like a standardised database format, personnel(s), and computer(s), are absent, the ULB should strive to strengthen the system before commencing plug-in operations. Such a system can take the form of a simple call centre with one or more employees (depending on city size) to receive, record, and administer desludging requests.

Such a system should record the following parameters associated with each request under the plug-in operations:

- Number of desludging requests coming from the Plug-in Cluster on any given day
- Date of request and date of service delivery
- Record of invoice
- Total fees charged

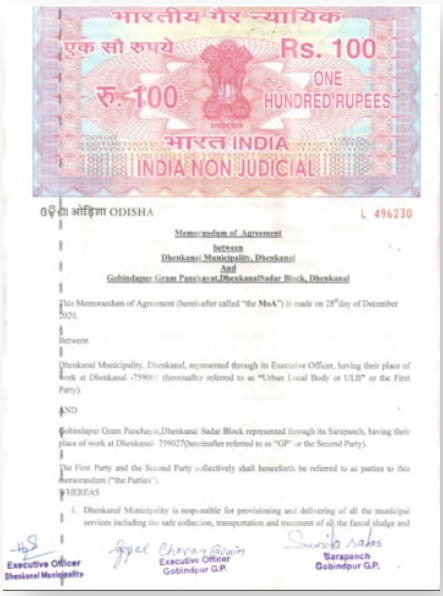
This data would be indispensable to the financial transactions and coordination between the ULB and GPs. Moreover, maintaining such a database would help diagnose and monitor the health of the Plug-in model and the FSM system more broadly. Therefore, as the model is operationalised, the GPs would need to commence basic recordkeeping, and the ULB would have to update its recordkeeping systems to collect the aforementioned data. Annex III provides a template for database preparation. The template can be implemented in any simple spreadsheet-based software such as Microsoft Excel or through free online tools such as Google Sheets.

Plug-in Model for Dhenkanal Municipality and 17 Neighbouring Gram Panchayats

The Dhenkanal District Administration has demonstrated the Plug-in Model for one of the clusters of GPs identified in the district as being suitable for the application of the strategy. The FSTP at the Dhenkanal Municipality has been operational since October 2018, with average utilization of 50% of the plant's total capacity. During the peak demand months of August, September and October, the average utilization was 73% in 2019 but had come down to 53% during these same months in 2020. Given the FSTP's spare capacity, a cluster - within 0-10 kms from the FSTP - was considered as the initial Plug-in area. The list of constituent Gram Panchayats and villages in the cluster was discussed with the heads of the respective urban and rural local bodies, as well as the District Administration.

With the ratification of the list, the District Administration, with support from the partner organizations, conducted capacity- and consensus-building among the local body representatives and issued official direction to the local bodies for signing a Memorandum of Agreement (MoA). The MoA was drafted to clarify the roles and responsibilities of both the urban and rural local body, the tariffs for rural residents, the GP-level financing sources for the services rendered, and the coordination and payment mechanisms between the urban and rural local body.

The local bodies finalized the terms of the MoA in successive consultations, and the discussions led to an eventual reduction in the desludging tariff from INR 1,500 per trip pre-MoA to INR 1,250 per trip for the 3KL-truck and INR 750 for the 1 KL-truck. Following the finalization of these terms, the Municipality and all the 17 GPs passed Resolutions committing to signing the MoA. On December 28 2020, the Dhenkanal Municipality and the 17 neighbouring GPs signed the MoA under the chairpersonship of Collector and District Magistrate, Dhenkanal District Administration. The signing of the MoA has been followed by extensive capacity-building of the GPs for managing the delivery of services and the requisite amendment of the contract between Area Level Federation (ALF) operating the FSM-S and the Dhenkanal Municipality.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ଓଡ଼ିଶା ओड़िशा ODISHA
L 496230
Memorandum of Agreement
between
Dhenkanal Municipality, Dhenkanal
And
Gobindapur Gram Panchayat,Dhenkanal Sadar Block, Dhenkanal
Executive Officer
Dhenkanal Municipality
Executive Officer
Gobindpur G.P.
Sarapanch
Gobindpur G.P.

6. Planning for Greenfield

GP clusters that are either not in the vicinity of an urban FSTP with sufficient spare capacities would require their own greenfield solutions to providing FSM services to rural households. In planning for such 'greenfield clusters', larger clusters may be divided into smaller zones of 2-5 GPs for ease of operational management. With the list of clusters and zones, if latter applicable, ready, the planning process follows a sequential order starting with the estimation of faecal sludge loading, moving on to characterisation of faecal sludge in the service area, selection of technology, the selection and assessment of the site for FSTP construction, and the preparation of a Detailed Project Report (DPR) (Figure 2).

6.1 Estimating FSTP Size and Desludging Vehicle Requirement

Estimating the faecal sludge loading from a greenfield cluster involves a multi-part calculation that first estimates the average desludging frequency, followed by the number of septic tanks and single pits requiring desludging each year, the related annual faecal sludge loading, and finally, the estimated loading per day. As noted earlier, the functional twin pit systems – constructed primarily under SBM-G - are designed to preclude the need for FSM. Therefore, settlements where retrofitting of single pits to the twin pit system is feasible based on the guidance from SBM-G Phase II, should be demarcated and excluded from the estimation of FSTP size[3]. The baseline design population should only consider households with septic tanks and those single pits which cannot be retrofit.

Since typically, the required FSTP capacity is designed for a minimum period of 10 years, the population would need to be projected using available population growth rates. One approach to calculating the growth rate is looking at the decadal growth between two consecutive Censuses.

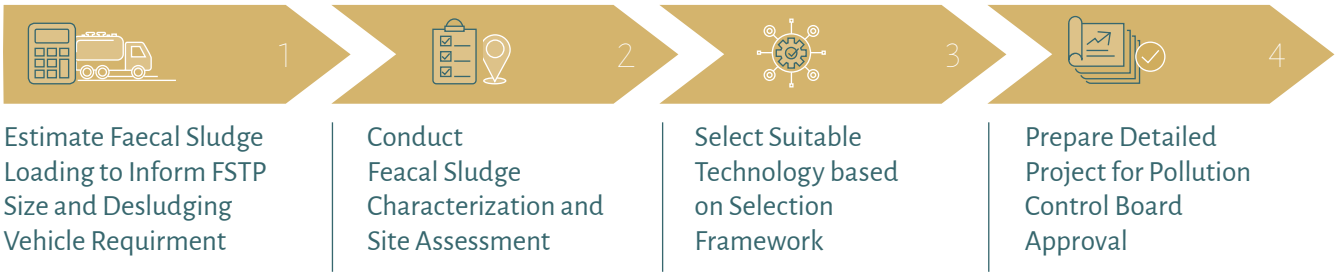
Annex II provides a sample calculation for estimating expected daily loading in KLD. The calculated daily loading would also serve to inform the number and size of desludging vehicles that the greenfield cluster would have to procure to collect and convey faecal sludge from the on-site sanitation system to the FSTP. Depending on the geographical size of the cluster, a benchmark for the maximum number of trips per day per vehicle should be identified as the first step. An example for the estimation is as follows,

Assuming that one vehicle can complete four trips in a day,

Number of trips achievable per vehicle per day = 4 trips per day

Total septage haulage in KLD achievable with one vehicle of 1 KL = 1 x 4 = 4 KLD

Figure 2: Planning process for greenfield clusters



[3] As per the Annexure 1 of SBM-G Phase II Guidelines, in prioritizing sustainability of sanitation outcomes, the programme recommends the construction of or retrofitting to the twin pit system in areas where the groundwater level is below three meters and soil condition is normal/ sandy/permeable/hard strata beyond 1.2 meters from the surface.

Similarly, Total septage haulage in KLD achievable with one vehicle of 3 KL = 3 x 4 = 12 KLD

Basis the above sample calculation, if the total estimated loading is 6 KLD, the district/block/GP administration(s) procure one 3 KL vehicle to comfortably serve the cluster until the end of the design period. Alternatively, and perhaps, more efficiently, the cluster could be served with a single 1 KL vehicle to start with (matching 67% of total design capacity). The single small vehicle would suffice in the short and medium-term for the sample case discussed since the average daily loading would take time to ramp up to the full designed capacity over the 10-year period.

6.2 Characterising Sludge and Assessing Potential FSTP Construction Site

The estimation of faecal sludge loading provides an understanding of how much sludge the FSTP would be required to handle on a daily basis. However, evaluating its characteristics is important to identifying the type of treatment it would need and informing the specifics of the treatment design. Accordingly, sludge characterisation would involve the sampling and testing of faecal sludge from a small sample of on-site sanitation systems in the greenfield cluster for parameters like biochemical oxygen demand (BOD), total suspended solids (TSS), sludge volume index (SVI), total and faecal coliform, among others. If it is infeasible to conduct sludge characterisation, average values of the different parameters from literature can be considered.

The second set of assessments relate to the actual physical site for the construction of the FSTP. While basic information on the size of the site and the depth to groundwater plays a crucial role in the selection of the technology itself, factors such as slope and gradient of land would inform the layout of the FSTP. Before diving into any of these assessments, however, the district/block/GP officials should ensure that the shortlisted site meets the fundamental requirements set forth by the Central and State Pollution Control Boards. To ensure that the infrastructure development does not compromise any water sources and their quality, the site feasibility assessment should take into consideration

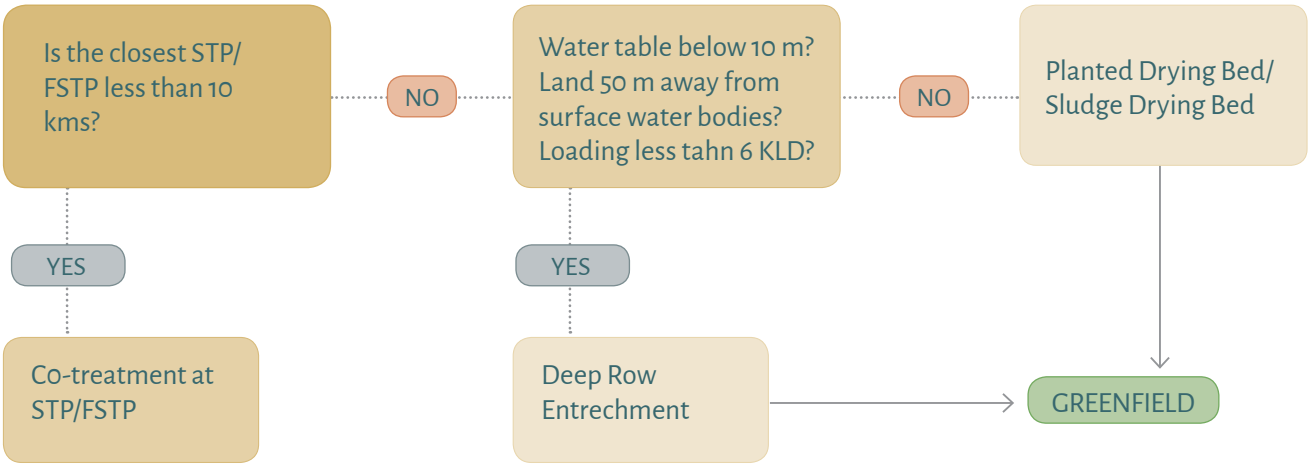
- distance of the site from any water bodies in the vicinity,
- possibility of flooding or waterlogging at the site,
- the environmental sensitivity of the region where the site is located, and
- the distance of the site from habitations.

At this point, it would also be important to understand if the geoclimatic position of the site exposes it to any harsh weather events over the course of the year which the FSTP may require mitigation against. Ensuring the disaster-resilience of the site is important – either through selecting a site that minimises these risks or disaster- and climate-proofing the site. The latter can include the development of components like dykes, ensuring availability of reliable backup power sources, situating critical treatment processes at lower-risks areas within the site, and elevating infrastructure to an appropriate level, among other mitigatory solutions.

6.3 Selecting Suitable Technology

The SBM-G Phase II considers three FSM interventions - co-treatment of faecal sludge at a Sewage Treatment Plant (STP) or disposal at an FSTP, Deep Row Entrenchment (DRE), and a standalone rural FSTP – in that order of preference (Figure 3). Therefore, once it is established that a cluster requires a greenfield FSM-S, the more suitable option between DRE and a standalone rural FSTP would need to be implemented and desludging vehicles procured. The main factors for choosing between the two are water safety and the daily loading. The former entails a consideration of the depth to the groundwater table and the distance of the chosen site from surface water bodies. As with site selection, any applicable disaster- or climate-related risks should also be accounted for during the technology selection stage.

Figure 3: Framework for identifying broad FSM strategy (adapted from SBM-G Phase II guidelines)



If DRE is not suitable, an FSTP based on the planted or unplanted drying bed technology would have to be designed. The precise process flow of the FSTP, with the drying bed as its core unit process, would need to be arrived at based on the following criteria:

- Required level of solid and liquid treatment
- Size of site
- Available capital financing
- Resources to meet FSTP O&M costs
- Availability of technical expertise for O&M

6.4 Estimating Costs

The total cost of the greenfield FSM-S would comprise the cost to build, procure and operate the FSTP and desludging vehicles. The capital costs for the FSTP would depend on a variety of factors such as the type of FSTP technology determined in the previous step, the site conditions, the geographical location of the cluster, among others. Similarly, the capital costs for the desludging vehicles would depend on the number of vehicles required and their capacity.

Secondly, both the FSTP and desludging vehicles require ongoing and appropriate maintenance to ensure long-term functionality. O&M activities are at the interface of the technical, administrative, and institutional frameworks that enable sustained FSM-S function. Proper O&M of the FSM-S requires a number of crucial tasks to be carried out by skilled personnel in a timely manner and in accordance with best practices. Two of the strongest determinants of the O&M costs of an FSM-S are the type and complexity of the FSTP technology and the extent of its service area.

6.5 Recordkeeping for Monitoring and Planning

As discussed in section 5.4 for the Plug-in clusters, recordkeeping would be indispensable to the smooth functioning and operational planning in the Greenfield clusters too. Accordingly, a call centre or similar facility could be set up either at the level of individual clusters or at the level of the block (for all the clusters in a given block) or the district depending on the availability of resources and size of the clusters. The call centre – equipped with basic digital infrastructure and adequate human resources - could serve the dual purpose of maintaining data on the FSM-S, as well as, routing the requests to the desludging vehicle operators for further action.

The template presented in Annex III can be employed for recordkeeping with modifications to account for the level at which the call centre is implemented and eliminating data fields pertaining only to Plug-in clusters. Greenfield clusters falling in an environmentally-sensitive region can additionally adopt a programme on environmental monitoring, especially water quality monitoring, to evaluate the impact of the sanitation intervention over time and course-correct if required.

7. Governance Arrangements

Given that the Plug-in and Greenfield strategies are based on the rural-urban and rural-rural coordination of multiple local bodies, it is critical to set out a clear framework that specifies the terms of their engagement. In the case of the Plug-in strategy, when the plug-in area boundary and constituent GPs, the estimated O&M cost per trip for rural desludging requests, the tariff, and other details are determined, they must be codified through a formal regulatory instrument. Similarly, in the case of greenfield clusters, similar details, as well as, additional ones like the nature and composition of the cluster-level coordinating body would need to be specified within a regulatory instrument.

Under both strategies, such a formal regulatory instrument can help define the roles and responsibilities of the district/block/local governments towards the successful implementation and sustainability of the Plug-in and Greenfield FSM-S.

The instrument can take the form of a partnership agreement through a memorandum viz., Memorandum of Agreement (MoA) or Memorandum of Understanding (MoU). It should aim to enable ownership and accountability among the concerned stakeholders by providing a clear framework for the day-to-day engagement between the urban and rural local bodies, as applicable, on issues of invoice generation, payment transfers, monitoring and recordkeeping, among others.

8. Financing and Tariff-Setting

Successful implementation and sustainability of rural FSM-S would need robust financial planning, timely funding, mobilisation of adequate resources, and prudent utilisation of funds. A feasible financial plan would enlist and leverage the diverse resources available to GPs towards different components of the FSM-S, as listed in Table 4. Some of the available resources include the Central fund, State fund, 15th FC grants to GPs, and funds available under Mahatma Gandhi National Rural Employment Generation Scheme (MGNREGS), Members of Parliament Local Area Development Scheme (MPLADS), Member of Legislative Assembly Local Area Development Scheme (MLALADS), Corporate Social Responsibility (CSR) (Table 4). The financial plan could also incorporate any other governmental or private sector sources.

Tariffs for desludging services, and FSM services more broadly, would be an important pillar of such a financial plan. Paying adequate attention to the affordability of desludging services during the tariff design brings two-fold benefits – first, enabling ODF Sustainability and second, reducing the incidence of manual desludging. Service fees from the households and other customers can help achieve cost recovery, at least in part. While setting the tariffs, the district/block/GP administrations should strive to balance the affordability of services, especially among marginalised and vulnerable communities, with cost recovery. Accordingly, the tariff design can seek to develop a graded structure with cross-subsidisation. If the clusters are spread out over large areas, the districts can further grade the tariff structure according to distance. An example of a tariff structure is presented in Annex IV.

Table 4: shows funding provision with different schemes.

Funding Source	FSM-S Component to Which Applicable
SBM-G Phase II	Trenching, Drying beds and or any other technology where co-treatment or retrofitting is not possible
State Finance Commission (SFC)	Funds for innovative practices, Creation of Capital assets for revenue generation, Preservation and development of water body, Maintenance of capital assets, and All-Weather Connectivity
15th Finance/ Central Finance Commission (CFC)	Tied Grants (60% of the total recommended grant) under sanitation and maintenance of ODF status.
Member of Legislative Assembly Local Area Development (MLALAD) Fund	Under small but essential projects/works
Member of Parliament Local Area Development (MPLAD)	Under Implementation of SBM Projects
District Mineral Foundations (DMF)*	Environment preservation and pollution control measures and Sanitation
MGNREGA and Sanitation	Under institutional projects, For the construction of sanitation facilities (including wages of skilled, semiskilled and the mate)

*Applicable to specific contexts

The plan should be prepared in consultation with all the GPs in the cluster. Based on the financial plan, the required resource can be procured from the various schemes for the implementation and continued operation of the FSM-S.

Prioritizing Clusters for Intervention: Due to limitations in technical capacity, financial resources, or any other related constraints, the district may need to adopt a phased approach to the development of infrastructure. In such a scenario, the district can prioritize among different clusters based on criteria like regional environmental sensitivity (presence of rivers, high incidence of pollution, etc.), population density, status of toilet usage (with ODF status as a possible proxy), the ease of implementing stopgap arrangements, among others.

9. Capacity Building and Social and Behaviour Change Communication

FSM is a fundamental cornerstone of safely managed sanitation. The indiscriminate disposal of faecal sludge to the open environment, however, is not only attributable to a lack of an FSM-S but may also result from individual and institutional behaviours resulting from low awareness about the consequences of such actions. Therefore, addressing any gaps in the knowledge, attitude and skills of governmental actors and communities across the different functional domains of FSM is indispensable to ensuring the sustainability of sanitation and, more specifically, FSM-S. The following sections discuss the two key pillars of such an endeavour – first, Social and Behaviour Change Communication (SBCC) directed towards rural residents and second, capacity building of governmental actors involved in FSM service delivery and management.

9.1 Social and Behaviour Change Communication (SBCC)

The SBCC strategy should be developed based on formative research to understand the community's perceptions, social norms, and practices relating to sanitation and FSM. Understanding how they behave in a particular context and accounting for these local and indigenous behaviours and practices is critical to developing an SBCC strategy. Such an understanding helps define key drivers of change, identify people who can be engaged to act as FSM champions in building the capacities and awareness of others and what kind of messaging and methods would be most impactful to bring about the desired change in the communities.

Different modes and media, including Interpersonal Communication (IPC) and door-to-door visits, can be adopted to disseminate the key messages for promoting FSM-related behaviour among the communities. Accordingly, the district administration, in consultation with the block administrations and GPs, can plan for a district-wide SBCC campaign to introduce the concept and establish the importance of FSM to rural households. Key stakeholders such as Panchayati Raj Institutions (PRIs), Community Based Organisations (CBOs) like Self-help Groups (SHGs), youth groups, educational institutions, and any other relevant institutions can be involved as disseminators in the campaign. The SBCC campaign can target the following indicative areas for awareness-building:

- **Construction of appropriate toilet or retrofitting the single and unsanitary toilets–** Discussion cards, posters, leaflets – incorporating the relevant governmental guidance –can be used to apprise households of the correct design of toilets and on-site sanitation systems, need for conversion or retrofitting of single pits to the twin pit system, among other related topics.
- **Operation and Maintenance (O&M) of septic tanks, soak pits and twin pits –** Household-level O&M of on-site sanitation systems is a key determinant of good operational performance. Especially owing to the relative novelty of toilets and on-site sanitation systems in rural areas, communities need to be informed about the importance of periodic desludging and appropriate desludging frequencies of different types of systems.
- **Awareness about desludging services –** Accompanying the institution of rural FSM services – through either the Plug-in or Greenfield strategy – is the need to inform rural residents of their availability. Posters, wall paintings, brochures, stage-on-wheels, and traditional methods like folklore, music, ballads, and street theatre can be used to inform communities about the available mechanised desludging services. Any such attempt should strive to highlight how communities may access these services through toll-free numbers, the contact details of desludging operators, and any other contact information. Parallelly, it should also increase awareness towards the prevention of hazardous cleaning of septic tanks and single pits.
- **Possibility of productively recycling treated faecal sludge:** Hoardings, posters, leaflets,

and dialogues and consultations with the community, necessary government departments and potential private consumers of treated faecal sludge can be potential pathways to inform the stakeholders about the benefits of recycling treated faecal sludge from FSTP, as well as, pit humus from twin pit systems.

9.2 Capacity Building

The capacities and competencies of district-, block, and GP-level governmental actors, service providers, and community groups needs to be enhanced to enable them to plan, deliver, and monitor FSM services. These stakeholders include the functionaries of PRIs, officials of District Water and Sanitation Mission (DWSM), members of the Village Water and Sanitation Committees (VWSCs), Accredited Social Health Activists (ASHAs), Anganwadi Workers, SHG members, masons, Civil Society Organisations (CSOs)/ Non-Governmental Organisations (NGOs), desludging vehicle and FSTP operators, among others. The District FSM Plan should provide for capacity building training covering topics such as basic concepts of FSM, O&M needs of FSTP and desludging vehicles, contract management, basic digital literacy for recordkeeping, Standard Operating Procedures (SOPs), safety guidelines, and others, as relevant to the role of the different stakeholders. The plan for capacity building can cover the following list of indicative topics (which is by no means exhaustive and must be elaborated to suit the local context):

Conducting SBCC Campaigns in Dhenkanal district

Following the institutionalization of FSM services in the Plug-in cluster surrounding the Dhenkanal municipality, an extensive SBCC campaign was conducted to apprise rural residents of the availability of FSM services. A diverse portfolio of tools like wall paintings, public announcements, and others were employed as part of the campaign.

- **Construction of safe and effective septic tanks and twin pit systems:** Local masons should be trained in the construction of safe and effective septic tanks and twin pit systems as per the design norms specified in the relevant Indian Standards (IS 2470 and IS 12134, respectively). The training can also be linked to a certification programme for masons.
- **Basic concepts of FSM in the rural context and associated Central and State Government policies/programmes:** The PRI functionaries and government officials at the district-, block- and GP-level should be sensitised about the need for FSM in rural areas and the role of different FSM ecosystem actors to enable them to undertake planning, execution, and coordination for FSM

services. Such a module can also cover the FSM-related policies and programmes of the Central and State Governments.

- **Planning, implementation, and O&M of FSM services:** The PRI functionaries should be trained in the proper planning, implementation, and O&M of desludging services and the FSTP.

- **Contract management:** The GP officials should be trained in contract management to enhance their ability to successfully deliver desludging services and the FSTP in collaboration with other ecosystem actors like private operators, CBOs, and SHGs.

- **Exposure to best practices:** Study visits to the best FSM models within and outside of the state could be arranged for the PRI functionaries and government officials to enhance their motivation and knowledge based on on-ground experience.

- **Safety practices during desludging operations:** Desludging operators should be trained to deliver desludging services safely by imparting education on the use of safety gears and equipment, first aid basics, and the O&M requirements of the desludging vehicle. As with the training of masons, the training of desludging vehicle operators can be linked to a certification programme.

- **Implementation of monitoring mechanisms for desludging operators:** To ensure safe collection, conveyance, and disposal of septage, monitoring mechanisms by Municipality/ Gram Panchayats shall be implemented. The mechanism shall include participatory components through which users can comply in the case of non-delivery of adequate services.

- **Training on O&M of the FSTP:** The operator of the FSTP shall be trained on safe and hygienic O&M of the treatment plant. A certification program could be useful. Knowledge materials shall be provided to them for reference.

- **Implementation of monitoring mechanisms for FSTP operator:** For safe and efficient running of the treatment plant, samples of wastewater should be taken regularly from the plant by an independent agency for analysis.

- **Regulatory guidelines for the operation of the FSTP:** For appropriate operations of the FSTP, guidelines should be developed defining intervals for regular maintenance and checklists for unforeseen issues.

9.3 Institutional Strengthening

In addition to building the capacities of individual actors, as discussed in the previous section, strengthening institutions involved in FSM service delivery is vital. The following measures support the development of strong institutions that can effectively tackle the task of planning for and managing rural FSM-S:

- **Strengthening of GPs:** GPs would play a central role in the planning, implementation, management, and monitoring of both the infrastructural and non-infrastructural components of the FSM-S. Thus, GPs need to be empowered with additional funds and the ability to engage the requisite human resources to manage the FSM-S successfully.

- **Setting up a ULB-level Monitoring and Review Committee:** The ULB-level Monitoring and Review Committee could be set up under the chairmanship of the Commissioner or the Executive Officer of the ULB to review the functioning of the overall Plug-in FSM-S periodically. Based on the status of FSM service delivery to the rural areas and the city/ town itself, the Committee can assess and plan to address any requirement of additional assets and infrastructure that may come up.

- **Setting up a Block-level Review Committee:** The Block-Level Review Committee could be set up under the chairmanship of the Block Development Officer will periodically review the FSM service delivery with the Sarpanches and GP Executive Officers in a cluster. Through such a meeting, the relevant stakeholders can deliberate upon evolving requirements in assets and infrastructure, household awareness generation, capacity building, recordkeeping and monitoring, and others, with the intent of strengthening the FSM-S.

- **Setting up a District-level Coordination Committee:** The District-level Coordination Committee could be set up under the chairmanship of the District Collector for periodically reviewing the FSM activities and i) provide guidance in planning and implementation of the FSM-S, ii) monitor the progress as per its expected deliverables and milestones; iii) facilitate the implementation in the clusters by supporting the quick redressal of any challenges faced, iv) direct the coordination of the activities of line department frontline personnel towards enabling planned sanitation outcomes; v) facilitate allotment of land for the establishment of the FSTP, vi) facilitate the selection of technology best suited to the local context; vii) facilitate the development of O&M model of the FSM-S, viii) aid the determination of the desludging tariff based on criteria like the socioeconomic condition of the household, the distance from FSTP, and others.

- **Enforcement of relevant regulations and guidelines:** For environmental protection and ensuring healthy living conditions, various rules, regulations, and guidelines pertaining to FSM should be adopted and enforced.

10. Conclusion

The present Template has provided a roadmap for conducting district-wide and cluster-based rural sanitation planning. The planning considers two distinct approaches of 'Plug-in' and 'Greenfield' for enabling universal access to safely managed sanitation among all rural households in the district. With its technology-agnostic approach, the Template enables government officials and developmental partners in identifying locally-optimised solutions for sanitation service delivery.

With the nation embarking on the next five years of the post-toilet sanitation agenda under SBM-G Phase II, the Template can support districts and states across the country in their endeavours to increase access to safely managed sanitation at scale and with speed.

ANNEXURE I:
Creating a Sampling Methodology

A sample survey helps ascertain the average values of specific parameters for a given population by making a trade-off between precision and the tremendous financial and time costs of surveying the entire population, especially at the level of a district. A proper sampling methodology ensures that the sampled households taken together are representative of the population at large and that the values of attributes determined for the sample are indicative of the values applicable to the larger population within an acceptable margin of error.

Overall, sampling is a two-part process – first, calculating the appropriate sample size and second, allocating the samples across different settlements and sub-groups comprising the larger population.

Calculating the Sample Size depends on multiple factors – both technical and operational. These include:

- Acceptable margin of error
- Desired confidence level
- Population size
- Financial resources available

The first three of these factors combine in Cochran's formula that provides a mathematical basis for calculating the sample size. As per the formula,

Number of samples, $n = \frac{Z^2 pq}{e^2}$

Where e is the margin of error; p is the estimated proportion of the population with the attribute being discussed; q is (1 – p); and Z is the z-value to be identified from the Z-table. Many freely accessible tools are available online for implementing the calculation (examples here and here).

Using the formula, sample sizes for different confidence levels and margins of error for a population size of 2,00,000 are as follows:

Confidence Level	Margin of Error	Sample Size
95%	5%	384
95%	2%	2,373
99%	5%	6,62
99%	2%	4,063

In most cases, a confidence level of 95% and a margin of error of 5% is adequate. If financial resources are available, the sample size can be increased to bring down the margin of error.

Distributing the Sample across the population requires an understanding of whether any population sub-group with distinct characteristics need to be accounted for. As an example, if the type of on-site sanitation system can be expected to vary strongly with hydrogeography, then the sample can be first allocated to different hydrogeological regions and then to different settlements and households within these. The allocation is usually based on the share of the population of each sub-group. These sub-groups are designated as 'strata', and the resulting sampling is called 'stratified sampling'.

In the case of District Planning, examples of such sub-groups or strata could include:

- Blocks or tehsils
- Settlements with and without a predominantly tribal population
- Low, medium, and high-density settlements

As an example, stratified sampling for distributing a total sample size of 1000 across the district and taking blocks as the strata would take the following shape:

Block	Block Population	Sample Allocation Calculation	Sample Allocated
Block 1	1,00,000	=1000 x (1,00,000/2,00,000)	500
Block 2	50,000	=1000 x (50,000/2,00,000)	250
Block 3	50,000	=1000 x (50,000/2,00,000)	250
Total	**2,00,000**		**1,000**

Each of the GPs or villages can be assigned an equal number of samples with a minimum of 10 at the level of GP. Accordingly, the next step would be to identify the number of GPs or villages to be surveyed within each stratum. For instance, if it is decided to survey ten households in each of the GPs, then the number of GPs to be surveyed in Block 1 would be = 500/10 = 50 and similarly 25 each in Block 2 and Block 3. Randomised sampling can then help select the required number of GPs within each stratum.

In-field randomisation using the left-hand rule can be employed to finally select households for the interview within the sampled villages. The ultimate goal of sample distribution is to ensure that the final sample is representative of the population and the attributes of the sample are applicable to the population within an acceptable margin of error and confidence level.

ANNEXURE 2: Methodology for Calculating Demand (in KLD)

For calculating the demand (in KLD) among rural households, obtain data listed in the following table. The values listed in the table are indicative and solely for the purpose of the sample calculation.

Parameter	Value	Remarks
Total number of households (A)	4,000	
Service period (B)	5	The service period for the plugging-in intervention needs to be less than or equal to the FSTP's remaining design period.
Annual growth rate of the rural population (C)	0.05%	The annual growth rate could be sourced for the district or the state. If the annual growth rate is not available, the Census data from two consecutive periods can allow for the calculation of the decadal growth rate.
Share of households with functional twin pits (D)	30%	Functional twin pits in the present context are defined as 'Twin pits with a functioning junction-chamber in a region with a water table depth of more than 3 meters'.
Share of households with septic tanks (E)	20%	
Share of households with single pits/twin pits in areas with water table depth of less than 3 metres (F)	50%	

Total number of households by the end of the service period (J) = (A)*[(1 + (C)/100)^(B)] = 4,000*[(1 + 0.005)^5] = 4,100

Total demand from septic tank-owning households (K) = (J)*[(E)/100]*0.00365 KLD = ~3 KLD

Total demand from single pit/dysfunctional twin pit-owning households (L) = (J)*[(F)/100]*0.001 KLD = ~2 KLD

Total FSM demand for the plug-in area over the service period = (K) + (L) = 5 KLD

Where 0.00365 and 0.001 are constants calculated based on the average size and desludging frequency of on-site sanitation systems in[4] rural and urban Odisha.

As a more detailed example, the calculation in the pilot greenfield cluster under the Dhenkanal Pilot Project proceeded as follows. A district-wide sample survey conducted as part of the Project informed the assumptions relating to the share of the FSM-dependent population, the share of septic tanks and single pits among on-site sanitation systems, the sizes of septic tanks and single pits.

[4] (1) Jain, A., Mukherjee, A. & Agarwal, N. (2020). Rural Sanitation Factsheet: Dhenkanal, Odisha. New Delhi: Centre for Policy Research. DOI: 10.13140/RG.2.2.16928.51202 (2) Dasgupta, S., Agarwal, N. & Mukherjee, A. (2019). Unearthed - Facts of Onsite Sanitation in Urban India. New Delhi: Centre for Policy Research. DOI: http://dx.doi.org/10.13140/RG.2.2.11717.06887

Base population in 2020 from MIS = 24,726

The decadal rural growth rate in Odisha between Census 2001 and 2011 = 11.8%

Total base population in 2030 = 24,726 x (1 + 11.8/100) = 27,644

Total number of base households in 2030, taking five as the average household size = 27,644/5 = 5,528

Desludging frequency of septic tanks calculated using average size of septic tanks, a sludge accumulation rate of 77 litres per capita per year in accordance with Indian Standard 2470, and water supply of 55 litres per capita per day = 10 years

Desludging frequency of single pits calculated using average size of single pits, a sludge accumulation rate of 58litress per capita per year in accordance with Indian Standard 12134 = 2.5 years

Total estimated annual septage loading = (Total number of septic tanks/Desludging frequency of septic tanks)*Average size of septic tanks + (Total number of single pits/ Desludging frequency of single pits)*Average size of single pits = 1.7 million litres per day (MLD)

Operational per day septage loading, assuming 300 operational days in a year in KLD = (1.7/300) x 1000 = 5.7 KLD

Total design capacity with a safety threshold of 5% over operational per day loading = 6 KLD

ANNEXURE 3:
Template for FSM Recordkeeping

Date Request Received	Date Request Served	Name of Customer	Type of Area (Within ULB or Outside ULB)	Name of Gram Panchayat, if applicable	Street Address of Customer	Contact Number of Customer	Type of Customer (Residential or Institutional or Commercial)	Whether Slum Category Applicable (Yes or No)	Type of On-Site Sanitation System (Septic Tank or Single Pit or Others)	Total Fees Applicable (in INR)

ANNEXURE 4:
Sample Tariff Structure

The necessary increment in tariff between different distance bands can be based on the fuel surcharge.

Vehicle Type	GPs within x km of ULB	GPs between x and y km from ULB	GPs between y and z km from ULB
Vehicle Type/Size A			
Vehicle Type/Size B			

The present Template has been prepared under the Pilot Project for Solid and Liquid Waste Management, being implemented by the Dhenkanal and Angul District Administrations with support from UNICEF and the Centre for Policy Research. The Project aims at demonstrating a novel district-wide approach to sanitation planning and, as part of its endeavours, has piloted the Plug-in and Greenfield strategies in two GP clusters of the districts. For more information about the Project, please contact Ms Shipra Saxena, WASH Specialist, UNICEF (ssaxena@unicef.org, +91 9810081962) or Ms Anju Dwivedi, Associate Fellow, Centre for Policy Research (anju.dwivedi@cprindia.org, +91 99714 00663).

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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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