CENTRE FOR POLICY RESEARCH

SCI-FI SCALING CITY INSTITUTIONS FOR INDIA WATER SANITATION

RESEARCH - ACTION - LEARNING NOTES

About Project Nirmal

The overall vision of Project Nirmal is the demonstration of appropriate, low-cost, decentralized, inclusive and sustainable sanitation service delivery solutions for two small towns (Angul and Dhenkanal) in Odisha leading to improved sanitation access for all households and integration of FSM in the sanitation value chain, through enabling institutional and financial arrangements and increased private sector participation.

The project is being implemented by Practical Action and Centre for Policy Research with support from Bill and Melinda Gates Foundation; Arghyam; Housing and Urban Development, Government of Odisha; and Municipalities of Angul and Dhenkanal.

The project aims to :

- Demonstrate State Government and ULB commitment towards sanitation service delivery in small towns;
- Capacity development of states and cities for effective sanitation service delivery;
- Increase in number of people in Angul and Dhenkanal with access to better sanitation services;
- Improve city-wide planning approaches for sanitation; and
- Demonstrate models for Faecal Sludge Management (FSM).

PLANNING FOR FAECAL SLUDGE MANAGEMENT IN SMALL TOWNS – EXPERIENCES FROM ANGUL AND DHENKANAL

BILL & MELINDA GATES foundation

Arghyam Safe, sustainable water for all

DHENKANAL MUNICIPALITY

Practical ACTION

Background

Faecal Sludge Management (FSM) is the process of safe collection, transportation, treatment and disposal/reuse of faecal sludge from On-Site Sanitation (OSS) systems[1]. A typical FSM system involves mechanized desludging of septic tanks/ pit latrines using a suction/vacuum emptier machine, transportation of the collected waste and its treatment at a facility[2], which could either be a dedicated Faecal Sludge Treatment Plant (FSTP) or a co-treatment facility at a Sewage Treatment Plant (STP). (Figure 1) The final residual product can either be reused or disposed safely into the environment. There can be many variations to the processes outlined above, along the FSM value chain, depending on the existing sanitation situation in a city/town, the techno-economic feasibility as well as capacities of local operators. Under Project Nirmal (PN), a detailed planning process was undertaken for designing FSM interventions in Angul and Dhenkanal Municipalities.

Planning for FSM – Key proceses adopted in Angul and Dhenkanal

The planning process adopted for designing FSM interventions in Angul and Dhenkanal Municipalities had seven steps, namely, baseline survey to understand the existing sanitation situation; physical survey to prepare a base map and plotting data using Geographical Information System (GIS); participatory planning processes anchored by community engagement structures created under PN (including Slum Sanitation Committees and Ward Sanitation Committees); situational analysis (based on primary and secondary data collected as a part of the baseline survey); analysis of demand and supply and assessing the existing gap in services; assessment of technological options to identify the most suitable technologies and formulation of a strategy and plan for FSM as an integral part of the City Sanitation Plan (CSP). (Figure 2)

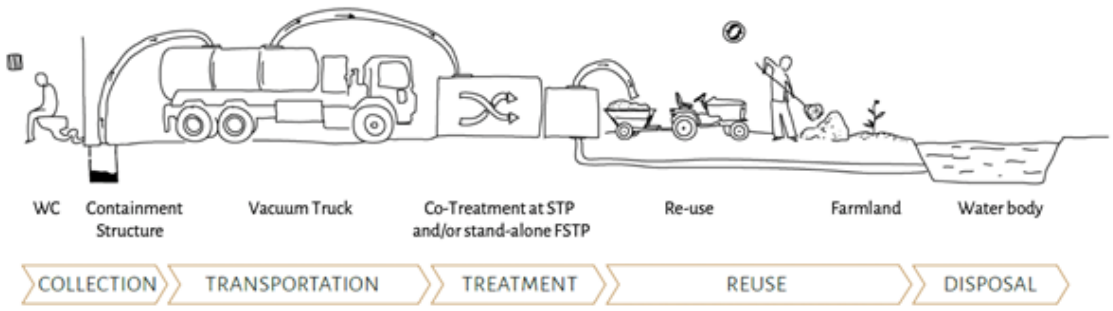


Figure 1: A typical FSM value chain[3]

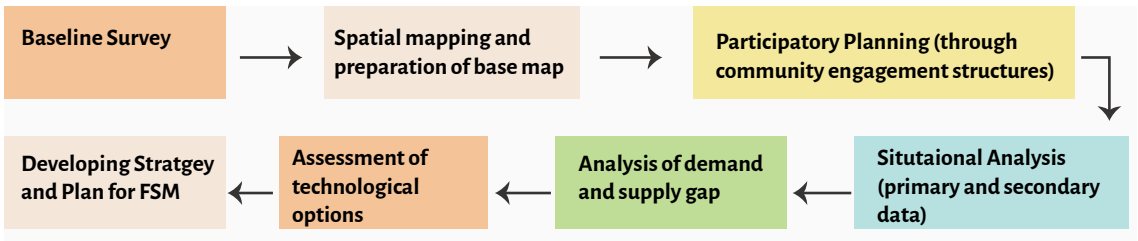


Figure 2: Steps adopted for designing FSM interventions under Project Nirmal

[1]Including septic tanks, pit latrines, etc.
[2]In some cases, there is a transfer station for temporary storage of faecal sludge and septage before being transported to a treatment facility by another vehicle.
[3]Source: Dasgupta, S., Murali, R., George, N., & Kapur, D. (2016). Faecal Waste Management in Smaller Cities Across South Asia: Getting Right the Policy and Practice. New Delhi: Centre for Policy Research.

Figure 3: Infrastructure sectors covered by the baseline survey and City Sanitation Plan (CSP)

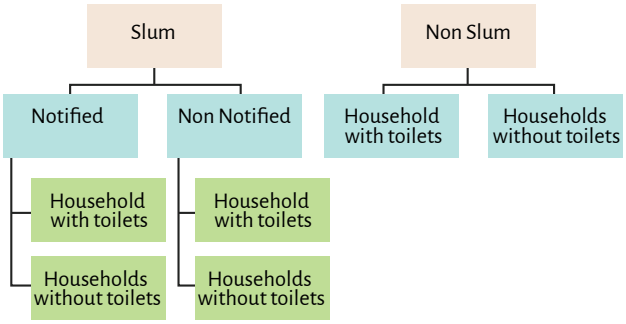


Figure 4: Stratum of households in slum and non-slum areas based on legal status and access to toilets

Photographs showing broad mapping exercise underway in Angul and Dhenkanal

Baseline Survey

The baseline survey was aimed at collecting information on current arrangements with respect to water, sanitation (toilets), wastewater, solid waste and storm water management and was the first step in identifying operational challenges with respect to sanitation service delivery. (Figure 3) The survey was conducted using a variety of research tools and techniques including broad mapping, Focus Group Discussions (FGDs), sample household survey, Key Informant Interviews (KIIs), institutional assessments and observations.

Broad Mapping

A spatial and pictorial representation of existing services and facilities in a community/ward, the broad map was developed through a participatory exercise carried out with a group of local residents. The main objective of this exercise was to identify the number of households under different stratum – slum, non-slum, notified slum, non-notified slum, households with and those without toilets (Figure 4). The aim was also to map all available water and sanitation facilities (including drinking water sources and storage points, public toilets, drainage network, solid and liquid waste disposal locations, etc.). The collected information was plotted on a ward map. The broad mapping exercise facilitated sampling for the household survey.

Focus Group Discussions (FGDs)

FGD were conducted across all wards of Angul and Dhenkanal[4] to understand sanitation related needs, challenges and aspirations of local residents. Both men and women were a part of these discussions which helped understand the gender perspective on various sanitation related issues and problems.

Sample Household Survey

A household survey covering slum and non-slum households was conducted in both towns. In Angul 2,540 households were surveyed, of which 875

[4]Both towns have 23 administrative wards each

were residing in slums and 1,665 in non-slum communities. In Dhenkanal, the survey covered 4,253 households of which 831 were residing in slums and 3422 in non-slum communities. The sample was selected such that all wards were covered and the sample size in each ward was calculated as a proportion of the ward's total population considering 95 percent level of significance. A structured questionnaire was administered to collect information on the following themes – socio economic profile, sanitation service delivery, FSM, health and hygiene.

Key Informant Interviews (KIIs)

In order to bring on board perspective of other key stakeholders including state and local government officials, non-government actors and private service providers, KIIs were conducted with key officials of the municipality (including Executive Officer, Chairperson, Councillors, Municipal Engineer, Sanitary Inspector and Finance Officer), supervisors of public toilets, cesspool emptier managers, scavengers and Non-Governmental Organisations (NGOs).

Institutional assessments

Institutions, including educational and health facilities, were surveyed to assess whether they had adequate WASH facilities. A sample of primary, upper primary, high schools and hospitals were covered across both towns.

Observation

Research teams also conducted visits to record their observations regarding factors affecting water supply, sanitation and solid waste management systems at different locations in Angul and Dhenkanal Municipalities.

Findings of the baseline survey

The baseline survey revealed that there was no centralised sewerage system in both towns. Further, of the five steps of FSM (i.e., collection / emptying of faecal sludge from OSS systems, transportation of sludge, disposal, treatment and reuse) two critical steps, namely, treatment and reuse were completely absent. With respect to collection / emptying of sludge from OSS systems, majority of such systems in Angul (54 percent) and Dhenkanal (58 percent) were emptied manually in the absence of suitable mechanised facilities. In Angul, emptying services were being provided by private cesspool operator and manual scavengers while in Dhenkanal municipal cesspool operator and manual scavengers were involved in emptying of OSS systems. In both Angul and Dhenkanal buckets, tractors, tricycles, trolleys with drum were being used for emptying septic tanks/pits and for transporting sludge. The baseline survey also revealed that majority of the households were unaware about the required frequency for emptying of septic tanks/pits. In Angul, only 36 percent of households surveyed reported emptying their septic tank/pit while in Dhenkanal this proportion was 29 percent. Disposal of collected sludge also emerged as a serious problem. In the absence of a designated place for disposal, the collected sludge was being disposed into open drains, open fields and water bodies. Only one quarter of the sludge collected was being disposed in a dumping yard. (Figure 5 and Figure 6)

Spatial Mapping and Preparation of Base Map

The base maps for both towns were prepared following spatial surveys and using high resolution satellite images. The mapping was done on a GIS platform, which enabled overlaying of multiple layers of information[5] collected during primary and secondary research, and this facilitated detailed spatial analysis.

Participatory Planning Processes

In order to facilitate participatory bottom-up planning for sanitation, community engagement structures have been created at the slum and ward levels in the form of Slum Sanitation Committees (SSCs) and Ward Sanitation Committees (WSCs) under Project Nirmal. The SSCs members are represented in the WSCs and members of both SSCs and WSCs find representation in the City Sanitation Task Force (CSTF), which has been constituted at the town level as per the provisions of the National Urban Sanitation Policy, 2008 and the Odisha Urban Sanitation Strategy, 2017. These

[5]Administrative boundaries (municipality and ward boundaries), land use, roads, water bodies, natural drains, slums, institutions (hospitals, schools, municipal offices), infrastructure (health facilities, educational institutions, religious sites, public spaces, markets and commercial spaces, public toilets, solid waste dumpsite, open defecation sites, open garbage dumping spots, waste water discharge points, storm water drains, transport network and water supply network)

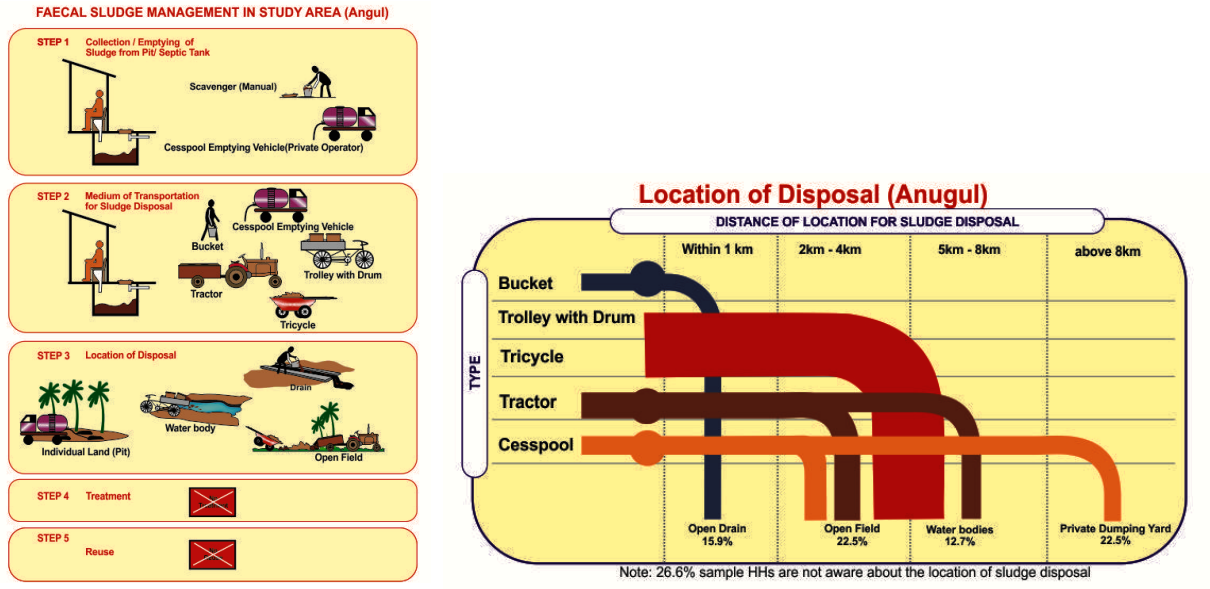


Figure 5: Baseline survey findings related to FSM in Angul

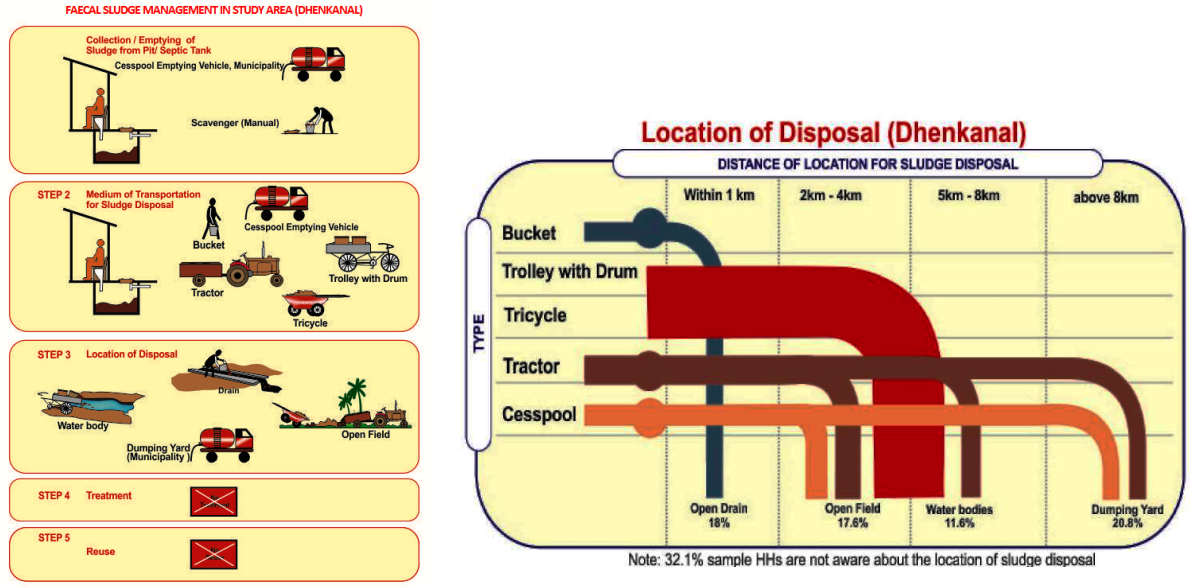


Figure 6: Baseline survey findings related to FSM in Dhenkanal

Photograph showing spatial survey under progress and plotting on satellite maps

community structures have proved to be of great value in identifying key issues related to sanitation and while planning to address the same.

Table 1: Standards for provision of services

Water Supply	135 LPCD
Wastewater Generation	80% of per capita water demand
Public toilets	1 seat / 100 persons
Community toilets	1 seat / 35 persons
Solid waste generation	400 grams per capita per day

Demand Supply Gap Analysis

To assess the demand for various infrastructure services, existing national standards for service delivery were used. (Table 1) Comparing the demand with available supply helped identify the service delivery gaps.

Assessing Technology Options

An assessment of available technological options for addressing gaps related to sanitation, solid waste management, wastewater and FSM was undertaken by an in-house technical and CSP review team. Participatory selection tools including financial and technical assessment tools were adopted to select a set of appropriate and feasible technological options.

Strategies and Project Formulation

Strategies for addressing service delivery gaps were prepared for both towns, with a strong focus on covering the unserved areas following an incremental approach. Inputs from community engagement structures, namely, SSCs and WSCs as well as CSTF were sought and integrated while preparing strategies and projects.

Putting an end to open defecation and improving access to toilet facilities

In order to ensure improved access to toilet facilities and to put an end to open defecation, a multipronged approach has been adopted which includes (a) provision of new Individual Household Latrines (IHHLs); (b) conversion of insanitary latrines to sanitary ones with proper design and Operation and Maintenance (O&M); (c) rehabilitation and augmentation of existing public toilets; and (d) construction of new public/community toilets.

Implementing FSM related initiatives

The responsibility for institutionalising mechanisms for safe emptying, collection, transportation and treatment of faecal waste along with creation of required treatment infrastructure, appropriate regulation and monitoring systems has been placed on the respective Municipalities. Recognising the importance of awareness generation among households to generate demand for adequate and safe sanitation as well as making other stakeholders (including municipal officials, masons, private desludging operators) aware about their roles and responsibilities regarding sanitation/FSM, a communication strategy was developed and rolled out. Further, in order to ensure that Onsite Sanitation (OSS) systems function effectively, it was proposed to undertake a detailed survey of all OSS systems followed by specific initiatives to ensure that existing and newly constructed OSS systems conform with national standards. Also, in order to ensure adequate treatment of wastewater outflow from OSS systems simplified decentralised waste water management systems were proposed. The last two proposals, relating to detailed survey of OSS systems and decentralised wastewater management systems, were not a part of Project Nirmal. An account of the strategies and plans related to sanitation and wastewater management, that have formed an integral part of the CSP for both Angul and Dhenkanal, are presented in Table 2.

Development of Draft City Sanitation Plan (CSP) and its finalization

Aimed at ensuring "inclusive and participatory planning for systematic and improved water, sanitation and hygiene for all" the CSPs for Angul and Dhenkanal are based on four guiding principles, including, city wide integrated planning, participation of local communities and stakeholders in planning processes, inclusive planning and sustainability of interventions. (Figure 7) A draft CSP was shared with all stakeholders and their inputs sought through city level workshops. The final CSP document integrated inputs received from all stakeholders.

Table 2: Strategies and plans proposed under the CSPs for Angul and Dhenkanal

Objective	Strategies	Details of Plans
Putting an end to Open Defecation	*Awareness campaign to end Open Defecation and to promote toilet usage*	**To put an end to the practise of Open Defecation and to promote toilet usage** • Citywide awareness campaign to promote usage of toilet facilities (especially public toilets) instead of open defecation • To be implemented initially in "critical" wards where open defecation was found to be rampant and where IHHL coverage was less than 60 percent
Ensuring improved access to toilet facilities	*Promotion of Individual Household Latrines (IHHLs)*	**To ensure that every household has access to adequate toilet facilities, preferably at household level** • Space and funding were identified as major constraints for households to construct IHHLs • To address space constraints shared / community toilets were suggested • To address financial constraints, linkages with existing government schemes and/or banking or microfinance institutions were proposed
	Rehabilitation and capacity augmentation of existing public toilets	**Ensuring adequate public toilets which have bathing and washing facilities and are inclusive and user friendly** • Ensuring provision of adequate seats in public toilets • While rehabilitating public toilets provision of bathing and washing facilities to be ensured • The design of public toilets to be inclusive and user friendly
	Construction of new community and public toilets	**Ensuring that all unserved areas and where IHHLs are not possible to be constructed due to space constraints should have access to adequate public / community toilets** • In slum areas, where lack of space is a major constraint for construction of IHHLs, access to toilet facilities must be ensured through construction of community toilets. • New public toilet to be constructed in areas frequented by floating population
Upgradation of OSS systems to make them efficient	*Upgradation of existing on-site sanitation systems (septic tanks and pits)*[6]	**Survey of existing OSS systems** • In order to ensure upgradation of OSS systems a detailed survey of such systems was proposed to be carried out by the respective Municipality **Ensuring that OSS systems meet design and construction norms and enable adequate on-site treatment of wastewater** • Pits and septic tanks need to be designed to ensure segregation and retention of solid part from the wastewater. • Construction plans for all new building should make provisions for properly designed septic tanks / pits. • For the existing septic tanks, repairs or necessary reconstruction to be carried out.
Excreta Disposal and Wastewater Management	*Simplified Sewer System and DEWATS*[7]	• A simplified sewer system with smaller diameter pipes connecting outlets of household septic tank / pits and outlet of communal septic tank to a decentralized treatment facility[8].
	Decentralised systems[9]	• Decentralized systems have been proposed in areas that have adequate space for siting of wastewater treatment plants and disposal systems
	Faecal sludge and management system	• An effluent septage or faecal sludge collection, transportation and treatment system to be institutionalised by the respective Municipalities. • Appropriate regulation and monitoring mechanisms to be put in place to ensure safety of sanitary workers and abatement of environmental pollution.

[6]While a part of the CSP, these components were not a part of Project Nirmal
[7]While a part of the CSP, this component was not a part of Project Nirmal
[8]Decentralized Wastewater Treatment System (DEWATS) is a technology based on anaerobic treatment of domestic and industrial (organic) sewage. It is applicable to even small clusters of houses or communities in remote places and does not require any external energy sources for treating the wastewater
[9]While a part of the CSP, this component was were not a part of Project Nirmal

City wide integrated planning

- City wide - covering all areas and all services and facilities
- Integrated approach - covering all aspects of sanitation (technical, social, institutional, financial, awareness, hygiene, health etc.)

Participation of local communities and stakeholders in planning processes

- Active involvement of local communities and other key stakeholders in identifying key issues, gaps and for planning solutions

Inclusive Planning

- Covering all unserved population groups and settlements (including low income communities, notified and non notified slums)
- Addressing the needs of the floating population

Sustainaility of Interventions

- Awareness generation
- Institutional stergthening and capacity building
- Resource mibilisation and institutional reforms

Figure 7: Guiding principles of the City Sanitation Plans for Angul and Dhenkanal

Formulating Projects

Projects related to putting an end to open defecation and ensuring improved access to and usage of sanitation facilities

In order to ensure improved access and usage of sanitation facilities the following projects were planned and implemented – (a) awareness generation to put an end to open defecation and to ensure usage of toilets, (b) construction of IHHLs for households which did not have toilets and where toilet construction was feasible, (c) upgradation of existing community / public toilets with additional seats, bathing and washing facilities, and (d) construction of new community / public toilets to cater to unserved households and floating population. The above-mentioned initiatives were dovetailed with GoI's Swachh Bharat Mission Urban (SBM-U). (Table 3)

Preparation of projects related to ensuring adequate systems for collection, transportation and treatment of faecal sludge and septage

In order to ensure effective excreta disposal and wastewater management the following initiatives were planned and implemented – upgradation of OSS systems as per the national design standards[10] and construction of treatment facilities in the form of Faecal Sludge Treatment Plant (FSTP). In addition, the municipalities also worked towards putting in place systems for safe collection, transportation and treatment of faecal sludge including appropriate regulation and monitoring. (Table 4)

Angul and Dhenkanal have the distinction of being the first two small towns in Odisha to have prepared CSPs, with FSM as an integral part of these plans.

Nine AMRUT cities followed and revised their CSPs integrating FSM as a part of the CSP

Table 3: Details of projects aimed at improving access and usage of sanitation facilities in Dhenkanal and Angul

Element	Dhenkanal	Angul
Open Defecation *(city wide awareness campaign to promote use of toilets and to put an end to the practice of open defecation)*	The awareness campaign was implemented initially in the most critical wards where the toilet coverage was below 60 percent (as per the baseline survey) and was subsequently scaled up to cover the entire town	
Individual Household Toilets (IHHLs) *(construction of IHHLs in houses which did not have toilets and where toilet construction was feasible)*	3,394 IHHLs were to be constructed in a phased manner over 2016-2019	3,191 IHHLs were to be constructed in a phased manner over 2016-2019
	Technology options for OSS systems to be shared with households	
Rehabilitation and capacity augmentation of existing Public toilets *(adding additional seats in Public toilets to meet the demand supply gap and adding bathing and washing facilities)*	920 new toilet seats were required in existing public toilets	320 new toilet seats were required in existing public toilets
	While rehabilitating public toilets, bathing and washing facilities were to be added based on the service level benchmarks and design standards	
Construction of new Community toilets *(construction of new community toilets in slum areas where IHHL construction isn't feasible)*	6 new community toilet blocks were to be constructed in 5 wards with 59 seats	7 new community toilet blocks were to be constructed with 51 seats 2 new public toilets with 16 seats

Preparing Detailed Project Reports (DPRs) for construction of FSTPs

Baseline survey and CSP findings enabled the preparation of DPRs for construction of FSTPs at Angul and Dhenkanal, with a capacity of up to 18 kL per day and 27 kL per day respectively. The following elements were considered while preparing the DPR:

Source and quantity of faecal sludge:

The main source of faecal sludge in both towns are OSS systems (including septic tanks and pits) connected to IHHLs and public toilets. The amount of faecal sludge generated was calculated based on the projected population for 2030 assuming an average household size of 5 persons and a per capita sludge generation rate of 0.00021 cum per

Table 4: Details of projects aimed at effective excreta disposal and wastewater management in Dhenkanal and Angul

Element	Dhenkanal	Angul
Upgradation of OSS systems[11]	The baseline studies in both Angul and Dhenkanal captured the distribution of various OSS systems and outflow disposal mechanisms (including septic tank / pits, connection of outlets to soak away pits or open drains). However, it was felt that the available information wasn't enough to draw an estimate of the number of OSS systems that would need to be upgraded / improved. It was, thus, proposed that a detailed survey of OSS and their conveyance mechanisms be undertaken by both municipalities. While a part of the CSP, this component was not a part of Project Nirmal	
Construction of FSTP	FSTP capacity = 27 kL /day	FSTP capacity = 18 kL / day
	Technology: Anaerobic treatment and drying/ planted drying bed technology Technical Partner: Consortium for DEWATS Dissemination Society	

[10]While a part of the CSP, this component was not a part of Project Nirmal

day[12]. The sludge generated was calculated for households, public toilets and the floating population. (Table 5)

Faecal sludge characteristics:

Knowledge of faecal sludge characteristics and its variability is crucial while designing a treatment facility. The faecal sludge characteristics assumed for designing the FSTPs at Angul and Dhenkanal were as follows – Chemical Oxygen Demand (COD) 25000 mg /L; Total Solids (TS) 30,000 mg/L and pH range 7-8.5.

Rate at which faecal sludge will feed into the treatment system (peak flow):

The faecal sludge feeding into the treatment system depends on the capacity and discharge arrangement of the desludging trucks. The treatment modules at the FSTPs in Angul and Dhenkanal were designed considering a flow rate generated by discharging 3,000 litres of faecal sludge from the truck into the treatment plant in 8-10 minutes. The design also took into account low flow to enable the plant to cope with lower flow rates.

Hydraulic retention time:

In order to ensure effective treatment of sludge as well as sludge water, it is necessary to provide adequate sludge and hydraulic retention time for each of the treatment module. The design of the FSTPs has incorporated appropriate retention time for each treatment module.

Climatic conditions:

The following climatic conditions have an impact on the design of treatment modules – temperature which affects treatment efficiency; rainfall which affects the drying of solids in the sludge drying beds; and humidity which affects the drying time. The design and detailing of the treatment modules in both FSTPs took the aforementioned factors into consideration. The treatment process was designed to operate in a temperature range of 25 – 40 °C which is a mesophilic range favourable for many beneficial bacteria.

Odours:

The most characteristic odour of faecal sludge is that of rotten egg due to the presence of hydrogen sulphide and other gases. In order to minimize the odour related issues, the design has incorporated vent pipes and good housekeeping practices in the facility. Additionally, the siting of the FSTP has to be such that there is a reasonable buffer of around 200 meters between the plant and any habitation.

Table 5: Details used for calculating faecal sludge generation – based on the baseline survey

Parameters	Dhenkanal	Angul
Total Number of households	14,908	9,778
Number of households surveyed	4,253	2,540
Number of HHs with septic tanks	929 (22 percent)	677 (41percent)
Number of HHs with pit latrines with slabs	1229 (29 percent)	567 (35 percent)
Number of HHs with pit latrines with ventilated open pit	290 (7 percent)	390 (24 percent)
Number of HHs with OSS type of containment systems	2448 (58 percent)	1634 (64 percent)
Number of Public Toilets	4	3 (30 seats)
Number of Community Toilets	0	0
Total Faecal sludge generated per day	26.03 cu. m	19.24 cu. m
Capacity of FSTP	27 cu. m (three streams of 9 cum.)	18 cu. m (two streams of 9 cum each)

[12]As per IS: 2470 - Part 1. Code of Practice for Installation of Septic Tanks - Design Criteria and Construction: Section 3.4.3.3

Treatment Concept and Design of FSTPs at Angul and Dhenkanal

The treatment concept proposed for FSTPs in Angul and Dhenkanal has been based on the following principles: a) maximum treatment efficiency; b) hygienisation and safe operation; and c) minimum operations and maintenance requirements.

In Dhenkanal the FSTP is subdivided into three parallel decentralized units of 9 cu.m each while in Angul FSTP there are two parallel units of 9 cu.m each. In Dhenkanal, there are three screen and grit chambers, three stabilization reactors and 36 sludge drying beds (12 for each stabilization tank). In Angul FSTP one screen and grit chamber, two stabilization reactors and 24 sludge drying beds (12 for each stabilization tank) were planned. After this stage, the percolate goes into DEWATS modules for further treatment. There are three anaerobic baffled reactors and three anaerobic filters in both FSTPs. The partially treated effluent is pumped through a Sand and Carbon Filter for final treatment in order to achieve the disposal standards and gets collected in a common treated effluent collection tank. (Table 6) The treated water is proposed be collected for use within the plant and excess, if any, shall be provided to nearby farmland for agricultural re-use or will overflow into a nearby natural pond. In Dhenkanal, the ground water table is high (approx. 2-3 m) with rock at about 3 m thus percolation of treated water isn't recommended. (Figure 8 and Figure 9)

Lessons learnt

- A detailed planning process was adopted for designing FSM interventions in Angul and Dhenkanal Municipalities under Project Nirmal. The planning process enabled an in-depth assessment of the existing sanitation situation in both towns, the technical and economic feasibility of the proposed projects as well as the capacities of local operators which in turn enabled designing FSM interventions which were appropriate for the local conditions.
- The FSM interventions under Project Nirmal, have been two pronged. While the first set of interventions have been aimed at improving access to toilet facilities and putting an end to open defecation, the second set of interventions have focussed on institutionalising mechanisms for emptying, collection, transportation, treatment, disposal / reuse and putting in place the required infrastructure. This approach, it is believed will help ensure sustainability of the interventions.
- The engagement of community structures created under Project Nirmal, namely, Slum Sanitation Committees and Ward Sanitation Committees have ensured that the planning process is truly bottom up and participatory. This, in turn, has also resulted in higher ownership of the processes and outcomes by the local communities.
- The use of participatory and spatial tools for planning FSM interventions has been innova-

Table 6: Details of the Modules and number of units installed / proposed at the Dhenkanal and Angul FSTP

Modules	Units in Dhenkanal FSTP	Units in Angul FSTP
Screening and Grit Chamber	3	1
Stabilization Reactor	3	2
Sludge Drying Bed	36	24
ABR and AF (DEWATS)	1	1
Planted Gravel Filter	1	1
Sand and Carbon filter	1	1
Collection Tank	1	1
Loading Capacity	27 Cum/per day	18 cum/per day
Effluent Quality	BOD< 10mg/l	BOD< 10mg/l

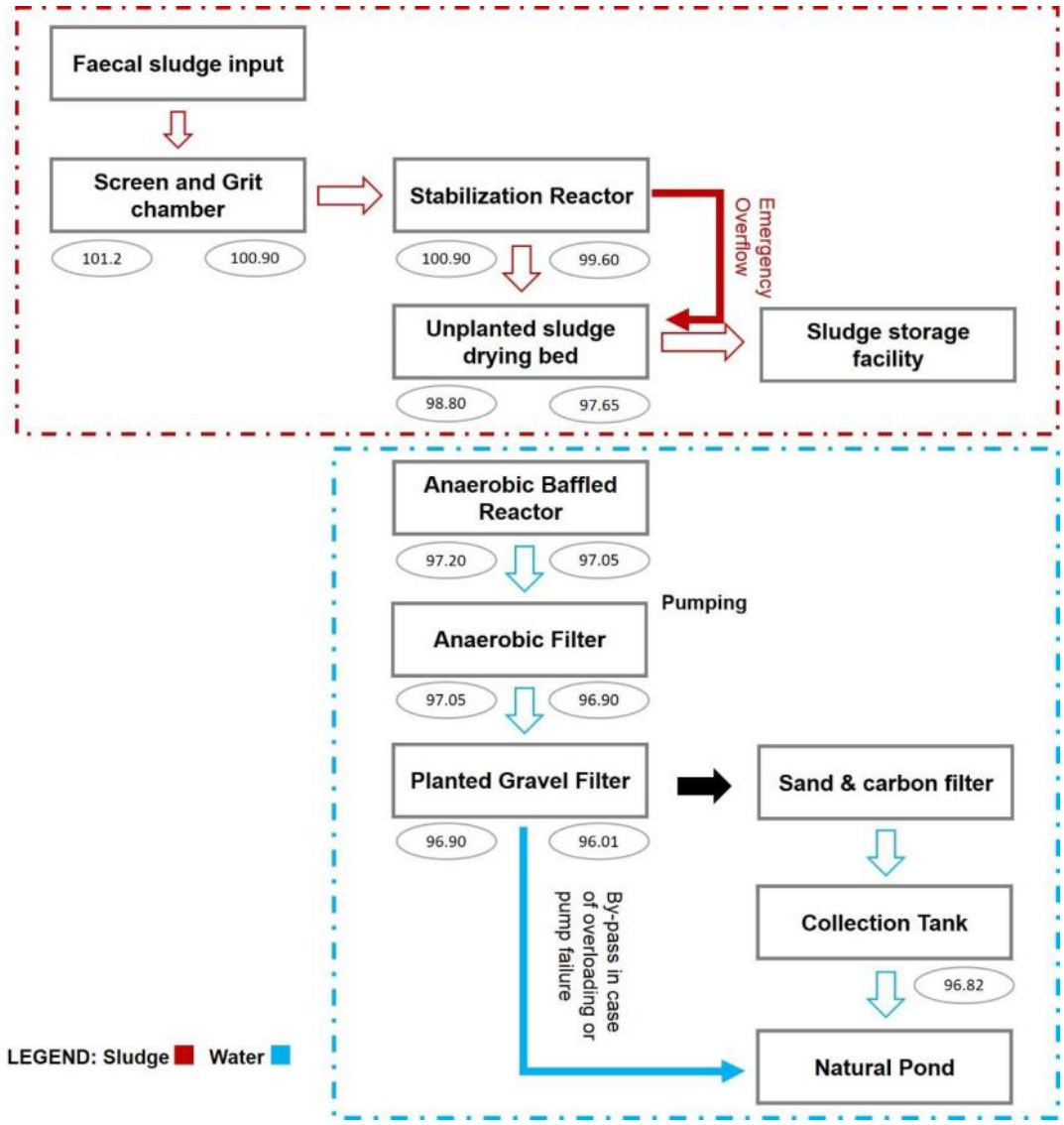


Figure 8: Process Design flow for the FSTP at Dhenkanal

tive. Angul and Dhenkanal have been the first two small towns to adopt these approaches as a part of the planning process for FSM. There exists great potential for the adoption of this approach by other similar sized towns across the state and country.

- Forging strategic partnership with Consortium for DEWATS Dissemination (CDD) Society, which has technical expertise and experience in designing and operating Faecal Sludge Treatment Plants (FSTPs) has proved crucial for choosing the appropriate technology and for ensuring speedy project formulation and implementation. Use of simple, cost effective and environmentally conscious technologies for treatment of faecal sludge has been an innovative approach taken by Project Nirmal.

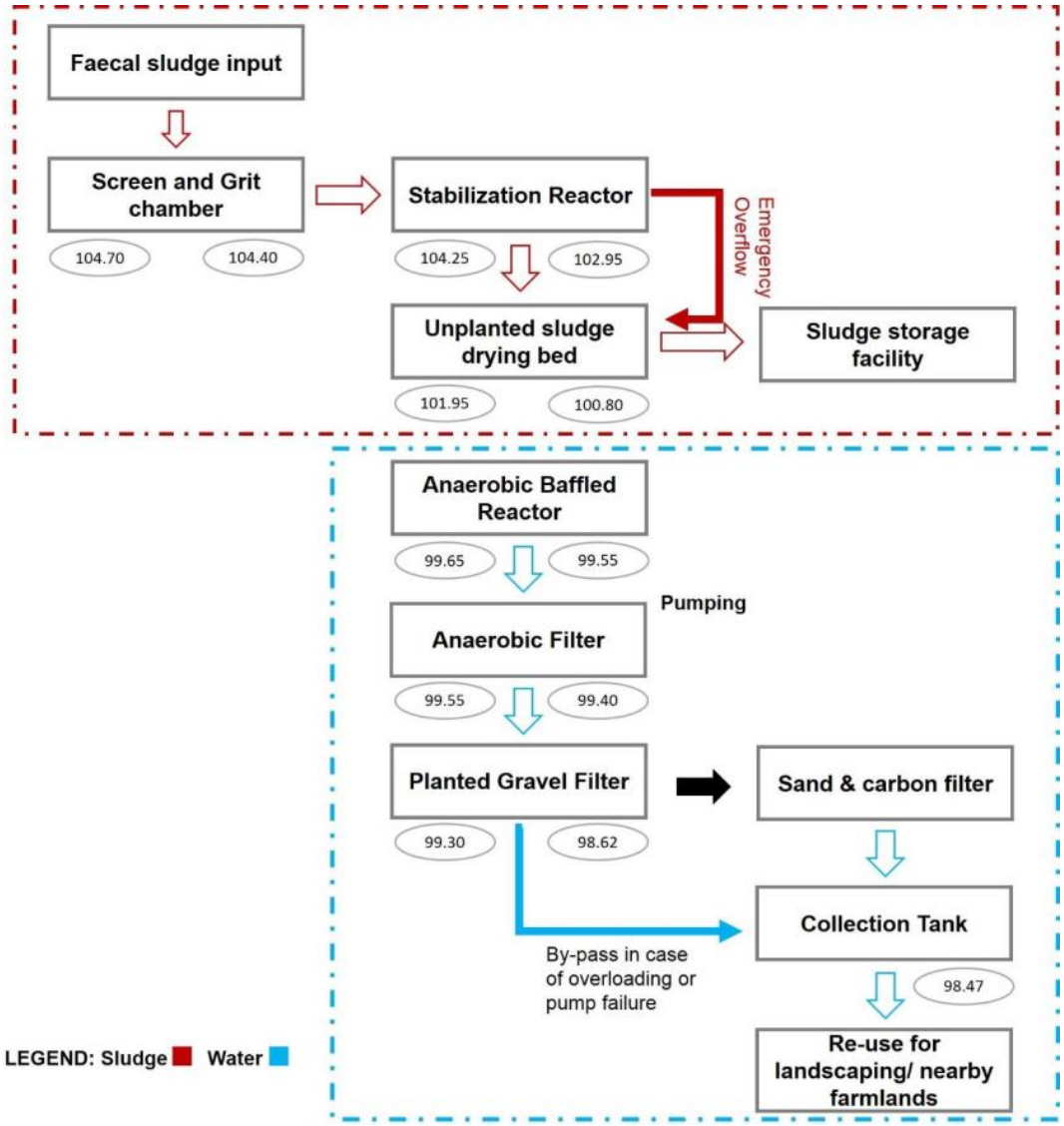
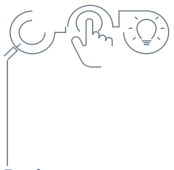


Figure 9: Proposed process flow for the FSTP at Angul



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