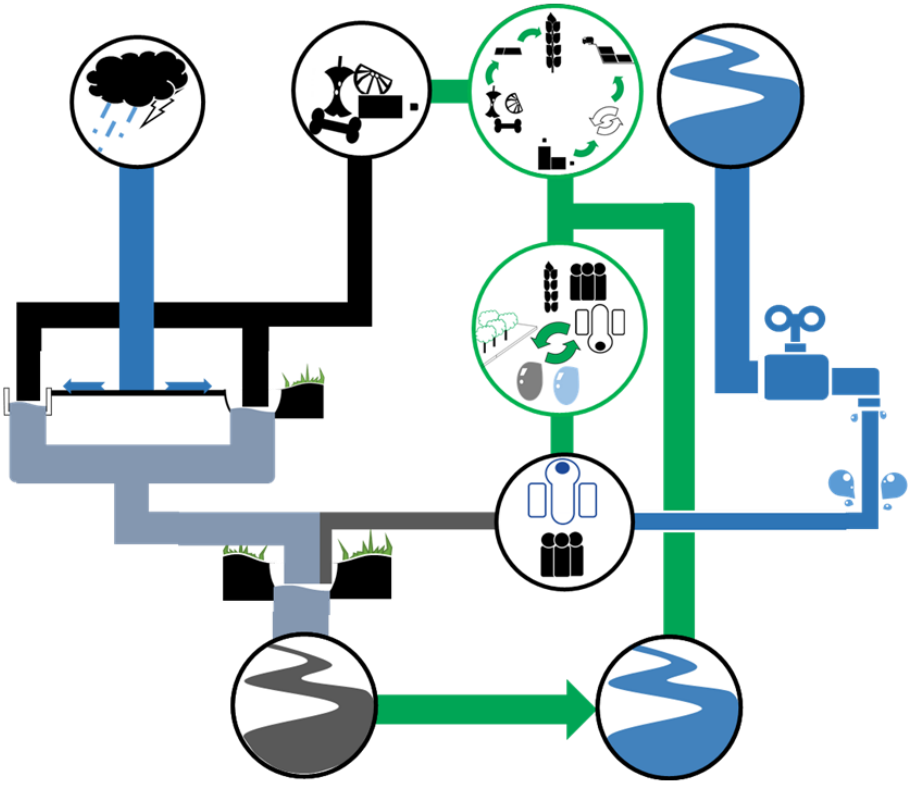
Sanitation Capacity Building Platform

City Sanitation Plan for BARIPADA



Preparation of CSPs for Cities of Odisha

Sanitation Action Plan

2017

Prepared By:

Consortium for DEWATS Dissemination Society

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NATIONAL INSTITUTE OF URBAN AFFAIRS

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1 MOUD CSP Self Review Checklist

1 MOUD CSP SELF REVIEW CHECKLIST

The checklist below shows all the sections that are required to be covered under the City Sanitation Planning process. The checklist, as developed by Ministry of Urban Development (MoUD), helps in the assessment of the scope of the City Sanitation Plan (CSP). The indicators in the Checklist are drawn to measure whether the key dimensions of sanitation are addressed in the contents; and ensure that the process followed in the preparation of the CSP was consultative and has full ownership of the city stakeholders.

TABLE (1): CSP CONTENT SELF-ASSESSMENT

No	Item	Yes/No	Remarks/Status
I. Baseline Data Collection & Situational Analysis in terms of identification of short term or mid – term or long term measures			
1.	Has the city carried out a baseline data collection (secondary and primary) and Situation Analysis of different aspects of sanitation viz:	**Yes**	**Stakeholder consultations and field visits were conducted during the following periods:** • 3rd Feb 2017 (Project Inception Meeting) • 17th of March 2017 (Stakeholder consultation and field visits) • 23rd March 2017 Meeting with SBM State PMU, Bhubaneswar • 20th and 21st Apr 2017 (Stakeholder consultation, field visits, surveys,)
i.	Access to household level sanitation arrangements in general residential and slum areas	**Yes**	**SBM Data for number of applications for new toilets and 2011 Census Data** Information sources include • Data from SBM Cell of the city and • Census 2011 data (The city also uses the 2011 data for all its decision making) • Note: The Swachh Sarvekshan Survey was underway during the course of the project. The data once received as an outcome of this project needs to be collated with the supply demand gap calculated within the CSP. This will provide the additional demand for toilets among the population that has grown between 2016 and 2017.
ii.	Community and Public Toilets – location and status	**Yes**	• Information source- SBM Cell. • location available for existing CTs, no location for new CTs (Demand for new CTs have been calculated);

			location are available for existing PTs • Toilet gap has been assessed.
iii.	Safe collection and conveyance of human excreta (on-site and sewerage) –infrastructure and management (including status of de-sludging services)	**Yes**	• Information for toilet containment units is sourced from Census 2011 • Officials and Mr. Santhosh Mohanty, Sanitary Inspector • Details and gaps in OSS and desludging services have been covered.
iv.	Treatment and safe disposal of human excreta	**Yes**	• Information source- DPR shared for upcoming Fecal Sludge Treatment Plant
v.	Solid waste collection, transport and safe disposal	**Yes**	All details on Human Resources, waste collection and conveyance assets, treatment site details collected from Solid waste specialist, SBM Cell
vi.	Drainage and flooding	**Yes**	Information sourced from Dilip Singh, Drainage division of Municipal Corporation • Drain length • Water logged and low lying areas
vii.	Drinking water quantity, quality and coverage	**Yes**	• Information Source- PHED • The focus on Water Supply sector is only to the extent that it has a bearing on the sanitation of the city. Technical inputs in this sector will be limited (and this has traditionally been the case). • These three data sets were collected and presented in the Situation Assessment reports. All these 3 points are covered here.
viii.	Institutional arrangements and finances for capital creation and O&M management of environmental services (water, sanitation, solid waste, drainage)	**Yes**	• Information source- Baripada Municipality • Staffing situation is presented in the Situation Assessment report as well as institutional arrangements; • Municipal budget has been assessed.
ix.	Current population and socio-economic categories; and projections by different categories	**Yes**	Population data used in 2011 data; However existing situation of services were studied for all sectors
x.	Arrangements and practices of commercial, public and other institutions in respect of sanitation and solid wastes	**Yes**	Public Toilets data have been collected along with sample surveys at selected units to understand their O&M arrangements. Specific focus on commercial establishments was not placed in the CSP. The focus of the report was holistic and citywide.

xi.	Maps and physical features of settlements (wards, slums, etc.) and key city infrastructure (water, sewerage, drainage, roads, treatment plants, water and sewage pumping stations, etc.)	**Yes**	Map source GIS shape files from Baripada Municipality .These have been used in the relevant sections.
xii.	Data on health-related indicators of sanitation and water supply	**No**	Health related indicators have not been evaluated in the study. However, solutions for solid waste and wastewater management have been sensitive to the public health situation in the city.
xiii.	Other important and locally relevant details (specify)	**Yes**	• Storm water flow and quality was studied. • Reuse potential was assessed and suggestions provided for FSM and SWM.
2.	Has the draft CSP identified specific data gaps and developed a plan for detailed data collection?	**Yes**	Supply demand gap assessment has been incorporated.
II. Institutional Roles and Issues			
3.	Has the city identified an institutional home/s for sanitation planning, implementation, monitoring and regulation?	**Yes**	The ULB anchors the implementation of CSP
4.	Has the draft CSP proposed specific actions to resolve institutional gaps and overlaps for:	**(Score overall "Yes" if at least five indicators below score "Yes", else "No")**	
i.	Planning and financing		• Plan has been provided with action points and their prioritization over a time frame • Costs for the same has also been highlighted in the action plan
ii.	Creation of physical infrastructure	**Yes**	Infrastructure assets to be built have been identified (costs and O&M considerations) for solid waste processing, wastewater conveyance, treatment and FS reuse
iii.	O&M Management	**Yes**	
iv.	Training and Capacity Building	**Yes**	Training and capacity building has been highlighted for toilet creation, FSM and SWM related activities.
v.	Monitoring of Outcomes	**Yes**	Monitoring activities have been suggested for water quality in the drains and solid waste management.
vi.	Communications	**Yes**	IEC activities to be undertaken have been provided for all the sectors.
vii.	Regulation	**Yes**	Regulatory provisions for FSM and SWM have been included.
III. City-wide Sanitation Campaign			
5.	Does the draft CSP contain a plan for the launch of a 100% Sanitation Campaign in the city?	**Yes**	The ancillary activities such as IEC campaigns and training programs have also been suggested within the action plan.

IV. Technology Options and City-wide design			
6.	Has draft CSP detailed and evaluated different technology options (on or offsite as well for collection, transport and safe disposal – i.e. full-cycle) for sanitation?	**Yes**	Different technology options have been evaluated for: • Wastewater conveyance and treatment options • Solid waste processing facilities
7.	Do the proposed sanitation interventions (rehabilitation, retrofitting or new investments) consider the whole city? (not just a part thereof)	**Yes**	For conversion of insanitary to sanitary toilets
V. Urban Poor and Unreached			
8.	Has the draft CSP identified the locations or settlements of the urban poor and other unreached population segments with have no or limited access to sanitation?	**Yes**	Slum locations have been identified
9.	Does the draft CSP identify actions for assisting unreached/poor households with individual, community or public sanitation facilities (in that order); and efficient disposal from these facilities?	**Yes**	Information on the number of slums and their access to sanitation has been included.
10.	Has the draft CSP identified or proposed sources of financing the CSP (schemes, grants, loans, etc.) for extending access to sanitation and related behaviour change communication activities?	**Yes**	• Costs have been identified for all action points (involving asset creation, capacity creation and awareness generation) and funds available from AMRUT and SBM are known. Additional avenues for funding have not been identified.
VI. Financing and O&M Management			
11.	Does the draft CSP consider an appropriate time-frame and spatial and demographic dimensions to remain relevant (at least for the 12th Five Year Plan period, even if investment numbers are indicative or work-in process)?	**Yes**	A short term, medium term and long term timeframe has been considered while providing solutions Spatial dimension has been considered wherever necessary, such as while locating the citywide composting unit. For HH level interventions, the ULB will have to do site level feasibility to exactly determine space availability for implementations. Funds available from the SAAP and municipal budget are known for meeting the costs of the actions (involving asset creation, capacity creation and awareness generation) identified in the plan.
12.	Were the different sanitation options (hardware plus software) evaluated on the basis of financial viability? (i.e. Cost Benefit Analysis done)	**Yes**	Cost comparison and pros and cons have been reflected for different technology options meant for toilet installation, solid waste treatment options and wastewater conveyance and treatment options
13.	Whether O&M implications of each of the investment options evaluated i.e. implications on tariff increases and	**Yes**	

	willingness to pay for services; personnel number and capacities etc.?		
14.	Has the draft CSP considered options for partnering with private sector, NGOs etc. for implementation or O&M management of sanitation facilities?	**Yes**	• For toilets and wastewater management operations, the options for partnering with private sector are being indicated in Action Plan. • The O&M of 2 of the 4 FSM trucks is already on the verge of being outsourced to private agencies. • For SWM, collection is outsourced already to private agencies. • Outsourcing of biomedial waste treatment plant, C&D plant, biogas plants and material recovery facilities has been suggested.
VII. Expedient and Other Actions			
15.	Has the draft CSP identified the steps for implementing improved enforcement of existing laws and provisions? (e.g. prohibiting hazardous discharge of untreated sewage, scrutiny about sanitation arrangements before issue of building permits)	**Yes**	Enforcement frameworks have been suggested for effective SWM and FSM
16.	Have gaps and overlaps in existing regulations identified for resolution? (e.g. provisions in development regulations or building bye-laws to promote sanitation including safe disposal)	**Yes**	Gaps and overlaps are identified for toilets, FSM and SWM.
17.	Does the draft CSP have a plan for improving septage management?	**Yes**	See **FSM section**
18.	Whether the draft CSP includes an Implementation Plan and Timeline?	**Yes**	Action plan
19.	Whether the draft CSP has a disaster preparedness component?	**No**	
20.	Whether the draft CSP identifies Short term/Medium Term/Long Term Measures to achieve identified outcomes?	**Yes**	Action plan
21.	Does this draft CSP leads to improvement of service levels with respect of SLB related to MSW/Storm Water Drainage/Solid Waste Management?	**Yes**	If the ULB works in alignment with the action plan temporally and incrementally it will leads to improvement in service levels across the whole of the sanitation sector.
22.	Outline of expected improvements on rating as per NUSP?	**Yes**	The Action Plan reflects the expected improvements.

TABLE (2): CSP PROCESS SELF-ASSESSMENT			
No.	**Item**	**Yes/No**	**Remarks**
I. Stakeholder Participation			
1.	A multi-stakeholder City Sanitation Task Force has been formed and has met at least sufficient consultations have been held?	**Yes**	• Discussions were conducted with executive members of the CSTF individually
2.	All agencies working in the City (ULB, State Government, NGOs, private sector involved in planning, implementation, management or regulation of environmental services (water, sanitation, solid waste, drainage), representatives of different community groups, and key waste-generating segments have been consulted in the process of preparation of the draft CSP?	**Yes**	Unstructured interviews were conducted across stakeholders for assessing all sectors.
3.	Number of Area Sabhas/Mohallas/RWA's etc. consulted?	**No**	Discussions were limited to the executive members of the municipal corporation, OWSSB, other project consultants and PHED
4.	Whether sufficient consultations have been held with urban poor groups in the city? Indicate the number.	**Yes**	Field visits at slum settlements and community toilets
II. Ownership of the Draft CSP			
5.	Has the draft CSP gone through an appropriate process of "appraisal" or "agreement" at the ULB and the City Sanitation Task Force?	**Yes**	Shared with the ULB. No adverse comments received.
6.	Is the draft CSP aligned to other plans of the city (CDP, Master-plan, Development Plan, etc.) and differences if any, highlighted for resolution in the CSP?	**Yes**	
7.	Are there are any current or pending/ proposed projects (under various schemes) that are in conflict with the recommendations and decisions in the CSP? Have these been highlighted for resolution?	**No**	
III. Communications			
8.	Has the CSP process formally recognized the importance of communicating with stakeholders, right from the beginning of the process, and drawn up as a Communications Plan?	**Yes**	• A project inception and stakeholder consultation was conducted across three meetings; Additionally a implementation support meeting is also envisaged • Discussions also conducted with E&Y who serve as

			TSU (Tech Support Unit) and activities and analysis shared with TSU. However, no citizen level communication was done.
9.	Have the basic steps of the communication plan started being implemented?	**Yes**	• A project inception was conducted with the executive staff • Implementation support envisaged beyond the CSP submission
10.	Level of awareness in the city about CSP (Indicate Yes/No)?	**Yes**	
IV. Links with Related Exercises			
11.	If the city is participating in the Service Level Benchmarking (SLB) exercise, have the relevant indicators been measured and uniformity ensured between that and the CSP?	**Yes**	SLB data has been considered while analysing the sectors

2 Introduction

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2.1 Background

The National Institute of Urban Affairs (NIUA) with support of Consortium for DEWATS Dissemination (CDD) Society under its Sanitation Capacity Building Platform (SCBP) is assisting the Government of Odisha to revise the City Sanitation Plans for the 4 (four) cities and towns- Bhubaneswar, Cuttack, Puri, and Baripada. City Sanitation Plans were formulated for these respective cities in overall conformity to the framework proposed within the National Urban Sanitation Policy (NUSP). The plan documents will also align the sanitation priorities of the cities with the National Missions such as Swachh Bharat Mission (SBM) & Atal Mission for Rejuvenation and Urban Transformation (AMRUT). The CSPs will be prepared and submitted within a time period of 4 months by the end of the month of May.

2.2 Approach and Methodology

The preparation of the CSP will be organised to capture information across all segments of the sanitation value chain, for which all sanitation services will be evaluated. As such, the project will undertake following activities:

I. Stakeholder consultations with officials concerning sanitation from the city:
   A. State Government personnel including Joint Secretary, Project Team Leader and other key State Government Officials
   B. Municipality Officials, mainly responsible for solid waste management. The engagement includes discussions with the Chief Health Officer[1], City Engineer, Sanitary Inspector, Chief Finance Officer, Town Planner
   C. Officials from the Swachh Bharat Mission cell within the municipality- who are responsible for IHHL and solid waste management
   D. Officials from the Odisha Water Supply & Sewerage Board (OWSSB), who are mandated with the responsibility for septage and sewerage management in the project cities
   E. Officials from the Public Health Engineering Department (PHED), who are responsible for the supply of water in the project cities.
   F. Accounts department for assessment of municipal budgets for the latest three years
   G. Elected representatives from all project cities

II. Rapid feasibility studies for solid waste management, FSM and wastewater management across all segments of the value chain:
   A. Sector wise detailed engagements (for FSM) will include:
      i. Toilets from households, community, public toilets were surveyed to get an understanding of the user charges, O&M expenditure, service level agreement and issues faced.

[1] Note: The Chief Health Officer is the main nodal officer at the municipality for managing the mandate of solid waste

ii. Understanding of the containment systems: Sample households from low-income areas (slums) and public, community and hybrid toilets were surveyed for their desludging practices and user demand
iii. Discussions with masons to assess construction practices for toilets and containment systems
iv. Discussions with mechanical sludge emptying operators to assess their activities and frequency
v. Discussion with sewage treatment plant operators to assess treatment processes within plant, O&M practices and costs
vi. Discussions with farmers to assess reuse potential of faecal sludge/septage
vii. Discussion with brick and cement industries for the reuse potential of faecal sludge/ septage

B. Evaluate Infrastructure availability within city (for FSM)
   i. Technology and capacity of existing wastewater/ faecal sludge treatment facility
   ii. Identifying the following for prospective plants:
      - Technology concept
      - Site assessment
      - Site identification
      - Soil Testing

C. The project will adopt a micro pocket planning approach[2] to optimize the systems (human resource, infrastructure assets and processes in place) for the existing solid waste value chain in the respective cities. The sector wise detailed engagements (for SWM) will be to assess activities, frequencies and resources deployed across all segments of the chain. This will include the following study activities:
   i. The project will undertake household surveys only to validate information on solid waste disposal and collection practices retrieved from the municipality
   ii. Discussion with waste collectors to assess waste collection quantities, activities and frequencies of waste collection routines
   iii. Survey of dry resource collection units
   iv. Survey of transfer stations (if any)
   v. Survey of solid waste processing units
   vi. Exploring recycling potential for dry solid waste resources (plastics, glass etc.)
   vii. Discussion with the municipal officials for setting up composting units in large market complexes

D. Evaluate Infrastructure availability within city (for SWM)
   i. Details of existing sanitary land fill
   ii. Technology and Capacity for existing solid waste processing unit

[2] The Micro Pocket planning approach is a planning methodology pioneered in Andhra Pradesh under the provisions of the A.P. State's Government Order 279

iii. New technologies that can be incorporated, i.e. identifying prospects for improving treatment processes. Different technology concepts will be explored in this regard.

III. Secondary data collection (old CSP document, policy documents, DPRs etc.) and review from the cities on service levels and sectoral situation for the aforementioned sectors
IV. Rapid city level surveys (at sewage outfalls, topographic analysis of city, visits to sanitary landfills and solid waste processing site) specifically to map environmental and public health issues associated with sanitation
V. Flow assessment at main outfalls were also undertaken (in Bhubaneswar, Cuttack and Puri) to understand the quality of wastewater being conveyed out of the town.
VI. Undertaking situation assessments across water supply and Storm water management in the respective cities
VII. Identifying potential technical feasibility interventions for storm water management in the project cities
VIII. Preparing financing and business models for different components of the selected interventions for access to toilets, SWM and FSM. CAPEX and OPEX should both be considered for the business model to ensure sustainability. Recommend any incentives needed for contractors and/ or waste haulers to guarantee safe disposal of sludge and solid waste
IX. Evaluating the Municipal Budgets, State Annual Action Plan (SAAP) and the Service Level Improvement Plans (SLIP) and organizing the investment planning for sanitation in the project cities in alignment with these plans

2.3 Scope of the Report

The report focusses on solutions for each of the sections. Key issues and gaps are highlighted for the complete sanitation value chain, which includes access to toilets, sewerage and FSM, storm water drainage, and solid waste management. The demand supply gap in the infrastructure provided is also assessed through for each of the sectors. Specific on-site details have also been covered in this section. The key issues for each of the sectors in sanitation are given solutions through an action plan in the short term (within 2 years), medium (3-5 years), and long term (5-10 years). The solutions would also follow an incremental approach to improvements in all the sectors of sanitation. This would mean interventions and investments which can be sustained- technically, environmentally and socio- economically over a period of time, with a gradual improvement over the three terms.

The components that have been covered under each of the sectors are as follows:

2.3.1 Access to Toilets

The section focusses on the infrastructure required for providing access to toilets to all households. The following aspects were covered to provide solution to access to toilets.

- The demand supply gap in individual, community and public toilets are assessed for the population of Baripada.
- The location of the public and community toilets (including Project Samman toilets for Bhubaneswar and Cuttack) are also provided for this section. Details of some of the public and community toilets which were assessed in detail during the site visits have

also been incorporated in the report. The details include information about the number of seats, user charges collected, septic tank dimensions, cleaning and desludging frequencies, and issues faced by the toilets. The selection of the toilets has been done to cover all income segments within the municipality, and also in different areas of the city.

- The current situation and the issues/ gaps are highlighted for each type of toilet. The issues would include gaps in infrastructure, service level issues and future demand projections.
- The demand supply gap is assessed at a quantitative number where the number of toilets required is estimated. Based on the incremental approach of infrastructure provision, households with no toilets were estimated to be provided with community/ public toilets, and households with existing access to public/ community toilets were estimated to be provided with individual toilets. However, the actual number of toilets to be provided is to be finalised based on feasibility studies undertaken in the city/ town.
- An action plan for the provision of toilets is to be provided. Interventions were planned for the short, medium and long terms along the following areas- technical/ infrastructure interventions, operations, IEC and policy measures.

2.3.2 Sewerage and Storm water Drainage

- In sewerage, the current situation in generation of wastewater, conveyance and treatment are assessed. Both the existing infrastructure and upcoming projects are detailed in this section, and the gaps from each of the segments of the value chain are estimated.
- The location of the existing sewerage treatment plants (if any) are provided through a map.
- The key issues in the sewerage system are highlighted and interventions are provided for the short, medium and long terms. Since all the towns/ cities have sewerage or FSM systems or a combination of both, solutions are provided both for FSM and wastewater management in the city/ town. Cross cutting interventions are also planned out for wastewater and FSM- such as IEC campaigns to be undertaken, floating of tenders for detailed projects and the preparation of DPRs.
- For storm water drainage, the major concern areas are mapped out through the waterlogged areas. Other aspects of storm water drainage, such as coverage, major natural drains and rivers, and outfall points are mapped out in the map.
- The length of the drainage network, their slope, and the direction of the course of the storm water drains are provided to give a holistic view of the storm water drainage system in the city/ town. The details of the catchment area are also provided to give an idea of the major outfall points and waterbodies which convey greywater (or wastewater) from the town/ city.
- Water quality is assessed at various outfall points for each of the towns to provide an estimate of the chemical levels and nutrient content in the major drains conveying the wastewater from the city/ town.
- Solutions for the provision of sanitation systems in the city/ town are provided in the next part of the section. The details of implementation of decentralised systems, small bore

systems, simplified sewer and conventional sewer line systems are provided through their main features, pros and cons of implementation. The capital cost, the water quality after treatment and the O&M costing after implementation of the various systems are provided for each of the treatment technologies.

- Key issues in storm water management are then resolved through an action plan for short, medium and long terms, which would include both infrastructure development and also cross-cutting measures, such as IEC campaigns, policy mechanisms and the kind.

2.3.3 Faecal Sludge Management

- Since there has been an increased dependency on FSM in the project cities/ towns. The report provides an assessment of the faecal sludge management situation in the city/ town. The current situation is assessed across the FSM value chain- including containment, collection and conveyance, disposal and treatment, and reuse.
- The possible recommendation for each segment of the value chain is estimated from the assessment of the current situation and gaps.
- The action plan for faecal sludge management would include the highlighting of the key issues in FSM, definition of the major goals to be achieved for each of the issues, and the action plan over short, medium and long terms. Technical, operational, IEC and policy interventions are defined for solving each of the issues.

2.3.4 Solid Waste Management

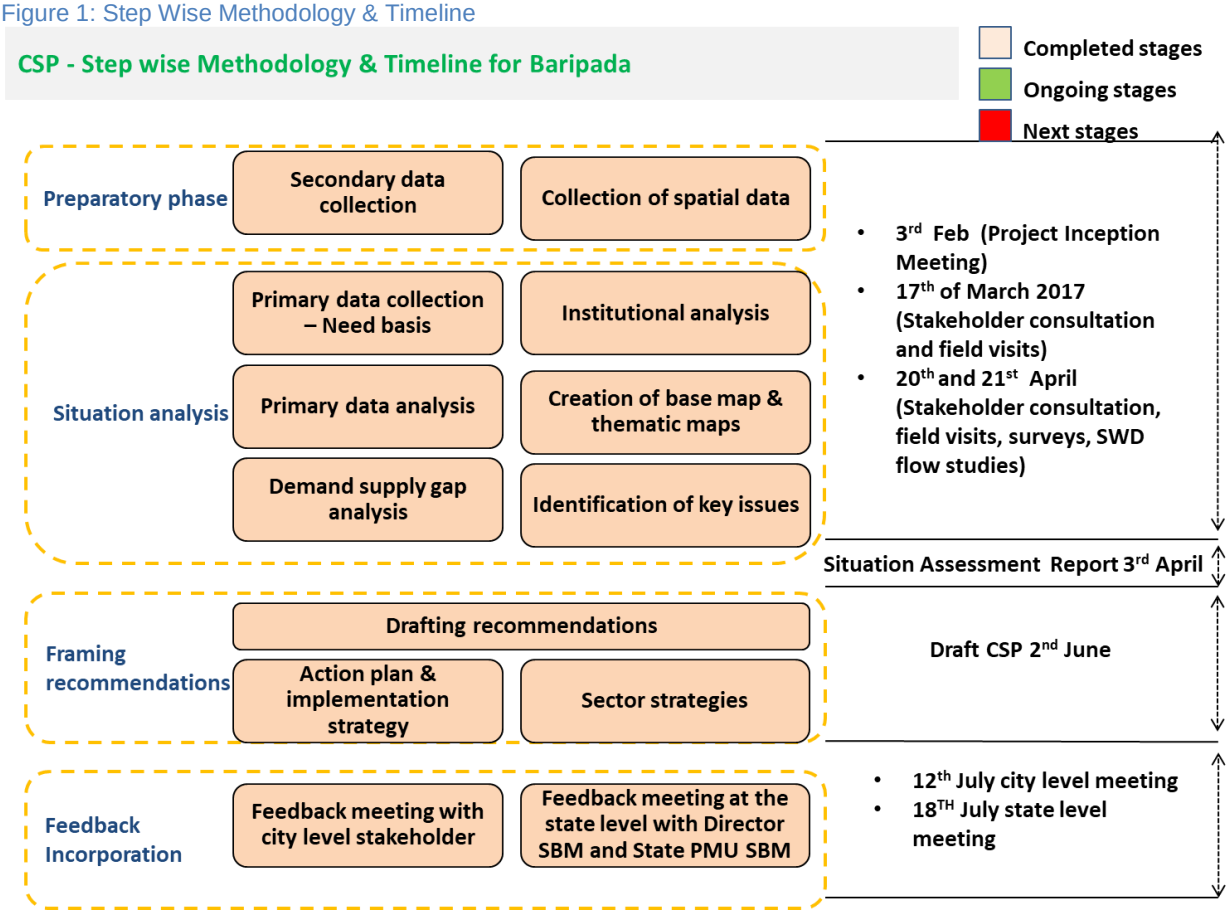
- The report highlights the current situation based on the various components of the value chain in solid waste management.
- This would include the total amount of waste generated, amount of waste collected from households, road sweeping and drain cleaning. Details regarding the municipal and private operators responsible for the management of the solid waste are also given in the section.
- Conveyance details are provided through the number of vehicles and machines that are utilised for collection and conveying solid waste in the city/ town.
- Ward wise details of operational service providers, manpower engaged, number of dustbins utilised and the vehicle details are also provided in this section.
- Transfer station details, amount of waste treated and ultimately disposed are also provided in the section.
- Based on the above assessment, the gaps/ issues are highlighted for each segment of the value chain in SWM, followed by the possible recommendations. Gaps in policies related to SWM are also covered in this section.
- The major issues are highlighted, and goals are provided for resolution of the issues. Measures are undertaken in short, medium and long terms along the following aspects- technical, operational, IEC and policy mechanisms.
- Technical details of various technologies for the treatment of waste are also provided in the section. The feasibility of implementation of any of the solutions is to be further assessed by the town/ city.

2.3.5 Institutional and Financial Interventions

- The report provides information on the responsibilities for water supply and sanitation sectors in the state of Odisha and the city/ town.
- The organogram of the municipal body is also provided, showing the responsible departments for water supply and sanitation related sectors.
- The section also provides the vacancies in the sanitation related departments, and in the overall municipal structure, allowing an estimate of the departments where capacities are to be immediately strengthened.
- The municipal budget assessment shows the financial capacity in the overall and sanitation related budgets.

2.4 Project Activities and Timeline

Figure 1: Step Wise Methodology & Timeline



The dates for the various project stages will be as follows:

- Project Inception: Feb 1st
- Project data collection: Up to March 20th
- Completion of Situation Assessment: April 3rd
- Defining solutions and technology options: By April 25th

- First Draft of CSP: 2nd June
- Final round of feedback meetings on draft CSP with city and the state-level with Director SBM and State SBM-PMU: completed on 12th and 18th July respectively

Tasks completed:

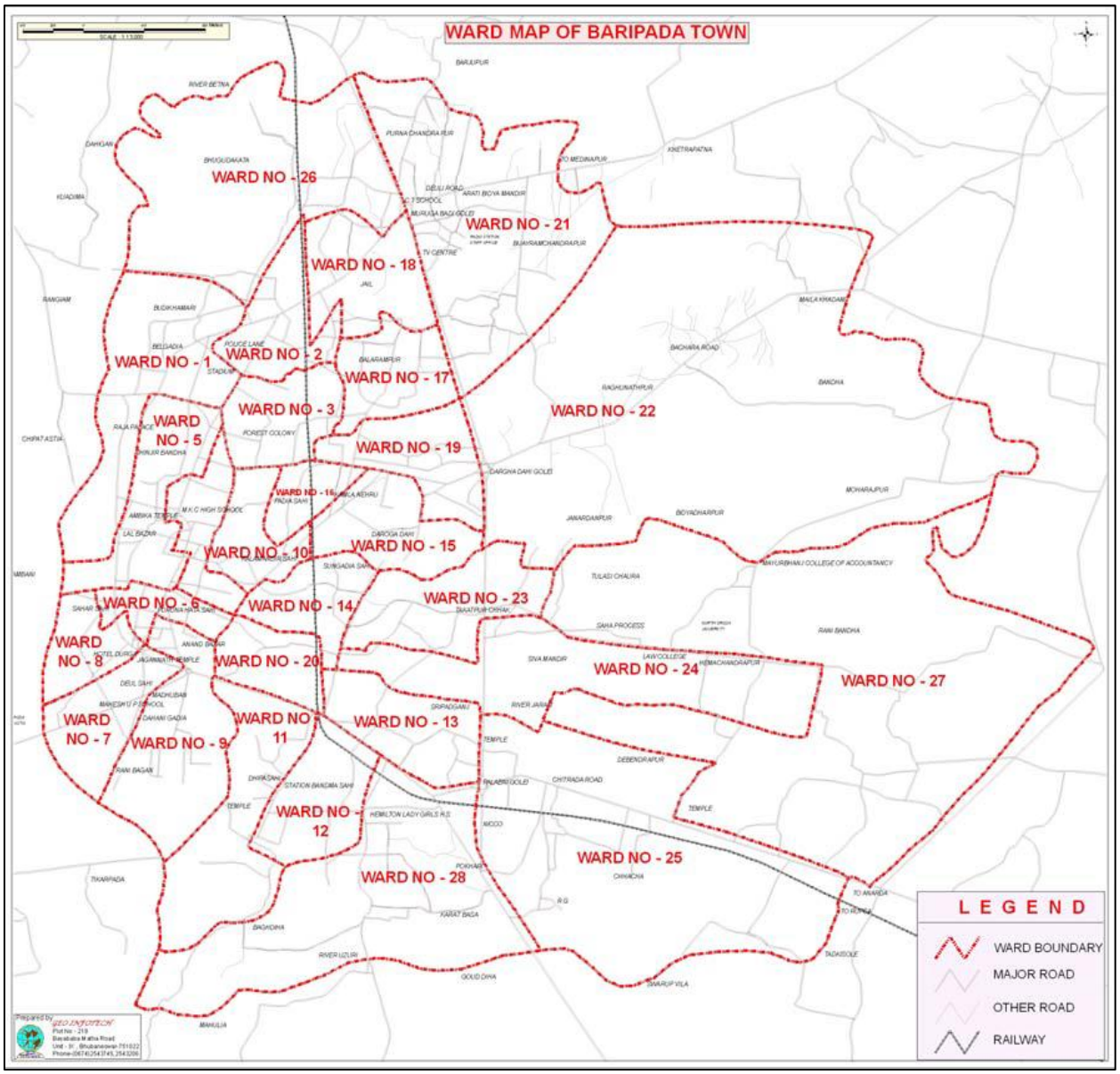
- Project Inception Meeting (NIUA)
- 1st city stakeholder meetings:
  - Bhubaneswar (1st Feb), Cuttack (2nd Feb) and Puri (3rd Feb)
  - Balasore (2nd Feb) and Baripada (3rd Feb)
- 2nd city stakeholder meetings:
  - Bhubaneswar (23rd Feb) and Puri (23rd Feb)
  - Cuttack (27th Feb)
- 3rd city (detailed city level consultations): 5th March to 20th March
- 4th city level consultations and completion of fieldwork: 17th April to 30th April
- 5th city level feedback meetings on the 1st draft of CSP : 12th July
- State Level meeting to get feedback on the 1st draft of CSP :18TH July

3 City Profile

3 CITY PROFILE

3.1 About the City

Figure 2: Baripada Municipal Council- Ward Map



Source: Baripada Municipal Council (2017)

Table 1: City Profile- Baripada Municipal Corporation

District	Mayurbhanj
Demography	
Total Population 2001 (nos.)	95004
Total Population 2011 (nos.)	1,09,743
Population Density (persons per km²)	5487
Number of Households (nos.)	26, 196 (Baseline data on ODF, 2017)
Avg. Household Size (nos.)[3]	4
Sex Ratio[4]	932
Slum Information	
Number of Slum settlements (nos.)	36
Slum Population (nos.)	32390
Slum Population as a percentage of total population (%)	29%
Location, Climate & Topography	
Area (km²)	20
Agro Climatic Zone	Tropical savanna climate
Soil Characteristics	Alfisols, Ultisols, Entisols
Ground Water Table (below ground level) (m)	10 m below ground level
Avg. max Temperature (°C)	50°C
Avg. min Temperature (°C)	13.4°C
Annual mean Rainfall (mm)	1540

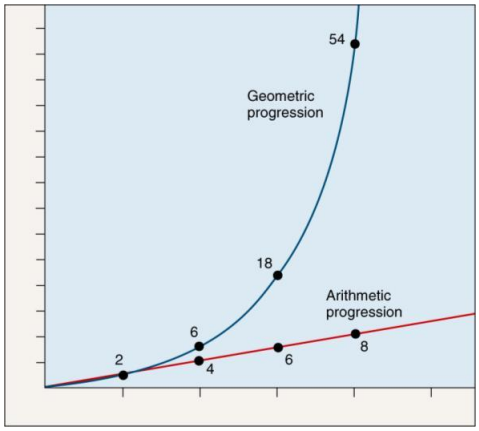
Table 2 Population Projection for Baripada

Population Projection (nos)			
Progression Method	**Year**	**Population**	**Households**
Census 2011 Population	2011	109743	24718
Swachh City Plan	2019	131691	29662
	2025	158029	39507
Exponential	2019	115365	25985
	2025	119769	26977

Towards making the population projections, the numbers available from the Swachh City Plan were taken into consideration. The exponential progression of population was also reflected on. Two reasons for adopting an exponential projection of population over the arithmetic or geometric progression methods are:

[3] Calculated from the Census 2011 population and households
[4] Based on Census 2011 information

Figure 3Graphical Representation of arithmetic and geometric projections

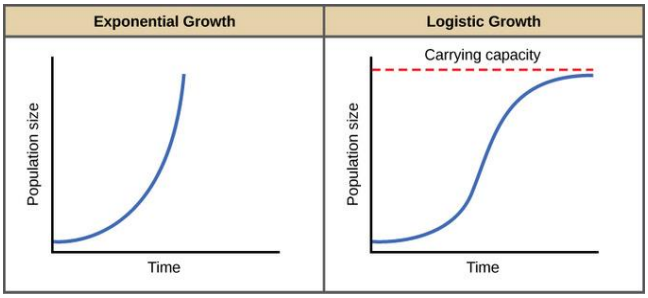


Source: McGraw Hill Companies Inc. (McGraw-Hill Online Learning Center Test)

- In a Geometric progression, the sequence of population increase for each term is by a fixed multiplier growth rate.
- In Arithmetic progression, the sequence of population increase is in a linear manner, where the same amount of population gets added to the base population every year.

Both the above cases of population projections would provide an unrealistic portrayal of the future increase in population. However, in an exponential population progression, the city's future population is proportional to the amount already present.

Figure 4 Exponential and Logical Growth



Source: (Socratic organisation)

Although growth may initially be exponential, the modelled phenomena will eventually enter a region in which previously ignored negative feedback factors like lack of regional resources become significant (leading to a logistic growth model). Moreover, there are not enough data to adopt the logistic growth model and calculate accordingly. For a logistic model, the carrying capacity of the region needs to be known after which the population growth rate becomes stagnant.

Taking all these aspects into account, the exponential approach is the most realistic approach to be adopted in this project case.

4 Sanitation Interventions

Water Supply

15.8 MLD

Supply: GW 11MLD; SW 4.8 MLD

31% lost

Non-revenue water

28 municipal wards

5 of which are partially covered

Future Projections

In 2019: **22** MLD
In 2025: **27** MLD

4 SANITATION INTERVENTIONS

4.1 Water Supply[5]

- The Source of water supply is both surface and ground water; the River Chipat is the source of surface water supply.
- Number of pumping wells and open wells: 55
- Total water demand (MLD) at the rate of 155 LPCD (including 15% loss): 18.33 MLD
- Total supply of water: 15.80 MLD
    - Ground water supply: 11 MLD
    - Surface water supply: 4.8 MLD
- Rate of supply: 134 lpcd
- Total number of stand posts: 456
- Wards fully covered under piped water supply: 23
- Wards partially covered under piped water supply: 5
- Total number of service connections: 11,092
- Non revenue water constitutes 31% of the total water supplied
- Quality[6] of water supplied is 100%

4.1.1 Future Projects

There are a number of projects which have been planned for Baripada under AMRUT funding. The projects are as follows:

1. **Improvement in water metering:** Improvement in metering of water supply connections in Baripada at a cost of 896 lakhs in the year 2015-16
2. **Water supply in exigency situations:** Installation of 12 solar pumps including hospitals at a cost of 1 crore in the year 2017-18.

4.1.2 Projection for Water Supply Demand

Table 3 Projection for water supply demand

Progression Method	Year	Population	Water supply demand in MLD (approx.)	Existing supply (MLD)	Gap in water supply approx. (MLD)
Census 2011 Population	2011	109743	19	15.80	4
Swachh City Plan	2019	131691	22		7
	2025	158029	27		12
Exponential	2019	115365	20		5
	2025	119769	21		6

[5] The information shared on the water supply sector have been sourced from the Service Level Benchmarks and the consultation with officials from the Public Health Engineering Organization

[6] The quality of water supplied is as important a performance indicator as other service delivery indicators. Poor water quality can pose serious public health hazards. Water-borne diseases are quite common in Indian cities, par-ticularly among the urban poor. Although, in most cases, the source of water that causes such diseases/epidemics is not the municipal piped water supply, it is very important to monitor the supply. Therefore, this performance indicator must be regularly monitored, the benchmark value for which is 100 percent

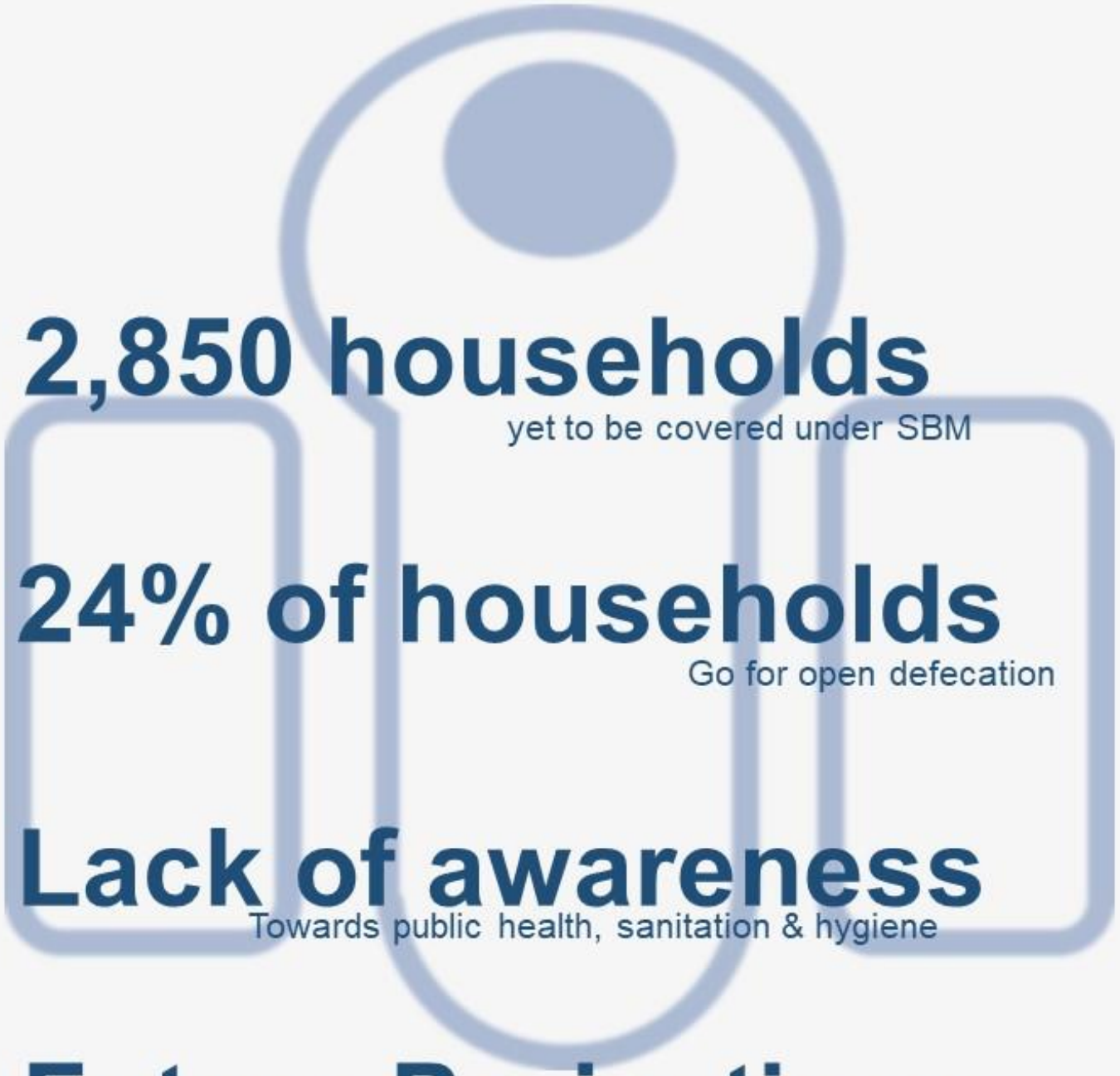
For the purpose of projection, we are using exponential projections. (see Population Projection for Baripadafor details)

As per Swachh City Plan in 2019, the projected population of Baripada will be 131691 and the consequent water supply demand will be 22 MLD. In 2025, the population is projected to increase to 158029 and the consequent water supply demand will be 27 MLD.

As per exponential projections, in 2019, the projected population of Baripada will be 115365 and the consequent water supply demand will be 20 MLD. In 2025, the population is projected to increase to 119769 and the consequent water supply demand will be 21 MLD.

The availability of supply water in Baripada is less than total demand (4 MLD Gap). In order to fill this gap, currently groundwater is extracted using private wells. This gap will be **7 MLD** (as per Swachh City Plan) **or 5 MLD** (as per exponential projection) in 2019. If the gap is not addressed by 2019, it will further increase to **12 MLD** (as per Swachh City Plan) or **6 MLD** (as per exponential projection) in 2025. This would put greater pressure on groundwater as the supply gap will be compensated using groundwater extraction. In order to avoid that, the supply gap can be met by means of reuse of treated wastewater, especially for toilet flushing, gardening, industrial and agricultural demand; and rainwater harvesting systems.

Access to Toilet



2,850 households

yet to be covered under SBM

24% of households

Go for open defecation

Lack of awareness

Towards public health, sanitation & hygiene

Future Projections

Gap in 2019: **4556** (Exponential)

Gap in 2025: **3111**(Exponential)

4.2 Access to Toilets

This section focuses on the solutions proposed at the user interface to address the following:

- Access to household toilets; in terms of provision of individual and community toilets
- Refurbishing existing infrastructure; this includes provision of super structure and containment structure
- Access to public sanitary infrastructure like public toilets

Individual toilets are used by the members of one household. Community toilets are shared by a group of households, primary in low income and/ or informal settlements/ slums, where space and/ or land are constraints in providing a household toilet.

Figure 5 Ward-wise Baseline Data for ODF

BARIPADA MUNICIPALITY

ULB Name: Baripada(M) — Ward-wise baseline data for ODF — Date:25.07.2017

Ward No.	Total Household	Individual Household Latrine (IHHL)						Community Toilet		Public Toilet				
		Number of Household without IHHL	Number of Household with Insanitary Latrine	Total IHHL required	Number of households willing and have required space to build IHHL	Number of households already applied for IHHL / construction going on	Number of households yet to apply for IHHL	Number of seats available	Number of seats Functional	Any places of floating population (e.g. market place) (Yes/No)	If Yes, approx. number of footfalls/ day	Number of seats available	Number of seats Functional	Number of urinal seats available
(a)	(b)	(c)	(d)	(e)=(c)+(d)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
1	841	275	13	288	288	220	68	-	-	-	-	-	-	-
2	685	115	18	133	133	54	79	-	-	Yes	800	-	-	-
3	885	138	14	152	152	91	61	-	-	-	-	-	-	-
4	538	0	0	0	0	0	0	-	-	Yes	2000	20+10	30	3
5	913	117	5	122	122	89	33	-	-	-	-	-	-	-
6	603	32	0	32	32	29	3	-	-	Yes	1500	10	10	-
7	1013	565	49	614	527	297	230	-	-	-	-	-	-	-
8	659	29	4	33	33	4	29	-	-	-	-	-	-	-
9	796	132	18	150	134	49	85	-	-	-	-	10+10	20	-
10	844	21	0	21	21	16	5	-	-	-	-	-	-	-
11	983	352	28	380	361	116	245	-	-	-	-	-	-	-
12	1014	191	7	198	198	82	116	-	-	Yes	1200	-	-	-
13	919	266	24	290	267	146	121	-	-	-	-	-	-	-
14	1036	214	9	223	223	202	21	-	-	-	-	-	-	-
15	1185	264	5	269	246	153	93	-	-	-	-	-	-	-
16	861	189	12	201	201	77	124	-	-	-	-	-	-	-
17	972	182	22	204	193	114	79	-	-	-	-	-	-	-
18	784	170	3	173	173	111	62	-	-	-	-	-	-	-
19	998	161	15	176	176	122	54	-	-	-	-	-	-	-
20	938	375	14	389	335	110	225	-	-	-	-	-	-	-
21	1108	161	10	171	171	108	63	-	-	-	-	-	-	-
22	1284	489	45	534	515	466	49	-	-	-	-	-	-	-
23	979	403	34	437	413	284	129	-	-	-	-	-	-	-
24	1171	263	11	274	263	130	133	-	-	-	-	-	-	-
25	1249	256	23	279	279	238	41	-	-	-	-	-	-	-
26	1094	320	4	324	298	188	110	-	-	-	-	-	-	-
27	1234	535	37	572	541	406	135	-	-	-	-	-	-	-
28	610	273	17	290	290	177	113	-	-	-	-	-	-	-
Total	26196	6488	441	6929	6585	4079	2506	-	-		5500	60	60	3

Source: Baripada Municipality, 2017

4.2.1 Public Toilets

Baripada doesn't have community toilets. It has a total of 60 functional public toilet seats. Apart from this, there are 3 urinals functional. (Baseline data on ODF, 2017). All public toilets are owned and constructed by the municipal corporation and then leased out privately through Sulabh, who are then responsible for the operation and maintenance.

Some of the public and community toilets were surveyed as a part of the surveying exercise. The details of the survey are as follows:

Public Toilets

Figure 6: Public Toilet in Baripada

1. **Biju Patnaik Chak**

   It was constructed and is maintained by Sulabh Sauchalaya in 1987. The daily foot fall in the toilet is around 30-50 people. It has 5 toilets seats for gents and 5 toilet seats for ladies. In each section, there is an area for bathing. In addition to this, they also have 3 urinals for men. Toilet usage is charged at Rs 3 for the special category toilets and Rs 2 for common toilet seat. The daily collection is Rs 200-250. The toilet was constructed and maintained by Sulabh International. The facility is maintained by 6 staff. Of these, 2 are caretakers earning a monthly salary of Rs 4500 and 3 cleaner earning a monthly salary of Rs 4000. The public toilet is connected to a septic tank which was cleaned 3 months backs cleaned. The dimensions of the tank are 30 feet length by 12 feet breadth by 30 feet depth or 9.14 feet length by 3.65 feet breadth by 9.14 feet depth. 4 trips of the municipal cesspool vehicle were required to clean the tank. It was charged Rs 8000 (Rs 2000 per trip).

2. **District HQ Hospital**

   The daily foot fall in the toilet is 60-100 people. It has 5 toilets for gents and 3 toilet seats for ladies. In each section, there is an area for bathing. The daily collection is Rs 300-500. The toilet was constructed and maintained by Sulabh International. The facility is maintained by 3 staff. Of these, 2 are caretakers earning a monthly salary of Rs 4500 and 1 cleaner earning a monthly salary of Rs 4000. Every month 10L phenyl and 25kg bleaching powder is received from Sulabh headquarters for the maintenance of the toilet. The public toilet is connected to a septic tank which was cleaned 3-4 months backs cleaned. Considering that 4-5 trips of the municipal cesspool vehicle was required to clean the tank, the volume of the tank would be between 15,000 to 20,000 litres.

During field visits it was observed that though the outward maintenance of the toilets seemed adequate for the water closets, the urinals in most locations were inadequately maintained and badly designed. Hence, the focus should be on proper maintenance of public toilets.

4.2.2 Current Situation and Gaps

The gaps in the total number of toilets are calculated from Baseline data on ODF provided by the Municipality (see Ward-wise Baseline Data for ODF) information which includes the total percentage of households with access to individual toilets (75.2% of total households), percentage of population with access to insanitary toilets (1.68% of total households) and percentage of population with open defecation (24.7& of total households).

4.2.2.1 *IHHL Gap*

For the purpose of IHHL construction the Municipality is calculated from the Baseline data of ODF provided by the Baripada Municipality (see Ward-wise Baseline Data for ODF). According to this document, 6488 households resorted to open defecation and 441 households have insanitary toilets. Thus, 6929 households needed access to sanitary toilets. Of this, 6585 are willing to construct IHHL and have the space to do the same. Of this, 4079 have been approved under SBM. Thus 2506 households that can build IHHL are yet to be covered. The remaining 344 households either don't want to construct an IHHL or don't have space to do so. Therefore, they will be catered to under the community toilet or hybrid toilet. Thus, **2506 is the gap for IHHL** after the SBM interventions, as on 8th of August 2017.

4.2.2.2 *Community Toilet Seats Gap*

As mentioned above, 344 households need to be catered to under community toilet. This amounts 1720 persons as calculated from the slum population data provided by the municipality. (see Slum list of Baripada Municipality as per 2011 Census). Assuming that the ratio of male to female in this population is 1:1, the demand has been calculated as 1 toilet seats every 35 men and 1 toilet seat for every 25 women. From this we arrive at a requirement of 40 PT seats (5 for men and 35 for women).

4.2.2.3 *Public Toilet Seats Gap*

The floating population for Baripada is 5487, as per 2011 Census. Assuming the male to female ratio in the floating population is 1:1, 14 CT seats for male (1 per 100 persons up to 400 persons; for over 400 persons, adding at the rate of one per 250 persons or part thereof) and 30 CT seats for female (2 for 100 persons up to 200 persons; over 200 persons, add at the rate of one per 100 persons or part thereof) will be required. There are 60 PT seats. So Baripada may not require more PT seats. However, there maintenance is of foremost importance.

Table 4 Access to Toilet: Situation, gaps and recommendations

Current Situation	Issues/ Gaps	Possible Recommendations
• 6488 households resorted to open defecation and 441 households have insanitary toilets. Thus, 6929 households needed access to sanitary toilets. • Of this, 6585 are willing to construct IHHL and have the space to do the same. Of this, 4079 have been approved under SBM. Thus 2506 households that can build IHHL are yet to be covered. • The remaining 344 households either don't want to construct an IHHL or don't have space to do so. Therefore, they will be catered to under the community toilet or hybrid toilet. • Open defecation is common in slum areas, as evident from the visits to Bagicha Sahi slum in HUDCO Colony and Budharaula Garoni. • Additionally the ULB is setting up community and hybrid toilets and outsources the operation and maintenance of those toilets • There are 60 functional PT seats in Baripada.	• **2506 is the gap for IHHL** after the SBM interventions. • **344 households** need to be covered under community toilet • Beneficiaries receive full amount i.e. Rs. 5300 only after the toilet and containment system is fully constructed by beneficiary. The amount as subsidy is very less when compared to the expenditure that is incurred in construction of toilet and septic tank/pits. • Public lacks awareness towards sanitation, public health and hygiene. In most of the cases people, mostly male population prefer to defecate in open even if they have individual toilet at home. This was validated based on discussions with municipal officials and during visits to slum settlements.	• Provision of IHHL to **2850 households** • Provision of community toilets for 344 households. • 344 households are either not having space or are unwilling to construct an IHHL. For this segment, community toilets along with IEC campaigns are the first step towards improving toilet usage. • IEC campaigns for household communities on the importance of usage of toilets, and health and hygiene • Also it was noted that, presently the use of urinals is not charged. If the urinals are cleaner, then the use of the same can be charged and in this case the number of users is adequate to create a viable business model for the O&M of public toilets at least in these central locations. • All Public Toilets constructed under SBM must have a minimum 5 year maintenance contract. • Increase the incentive given to households in order to meet the expenditure incurred in building toilets through other sources of funding. (Refer Fund Mobilisation for IHHL)

4.2.2 Requirement based on population projection

For the purpose of projection, we are using exponential projections. (see Population Projection for Baripada for details)

4.2.2.1 Gap projection for IHHL[7]

Table 5 Projection for IHHL Gap

Progression Method	Year	Population	Household	Households with either no toilet and dependent on PT/CT	Insanitary Toilets	SBM Coverage till 2017	Gap for IHHL (if SBM coverage doesn't increase beyond 2017)	SBM Coverage till 2019 (End of SBM)	Gap for IHHL (if SBM coverage increases at 8754 IHHL per year till 2019- end of SBM)
Census 2011 Population	2011	109743	24718	6488	441	4079	2850		
	2019	131691	29662				3421	6799	701
Swachh City Plan	2025	158029	39507				4556		934
	2019	115365	25985				2997		277
Exponential	2025	119769	26977				3111		252

As per Swachh City Plan in 2019, the projected population of Baripada will be 131691 and the number of households will be 29662. In 2025, the population is projected to increase to 158029 and the number of households will be 39507

As per exponential projections, in 2019, the projected population of Baripada will be 115365 and the number of households will be 26985. In 2025, the population is projected to increase to 119769 and the number of households will be 26977.

For calculating the gap two approaches have been used:

1. If IHHL approvals under SBM continue till 2017

[7] The number might vary depending of the actual changes on the ground such as people taking initiative to construct individual household latrines owing to increased awareness.

2. If IHHL approvals under SBM continue upto 2019 (the terminating year of SBM) at the same rate.

If the IHHL approval continue only till 2017, the number of households lacking access to **sanitary IHHL** (this includes households with insanitary toilets) **will be 3421** (as per Swachh City Plan) **or 2997** (as per exponential projection) in 2019. If the gap is not addressed by 2019, it will further increase to **4556**(as per Swachh City Plan) or **3111** (as per exponential projection) in 2025.

If the IHHL approval continues at the same rate till 2019, **701** (as per Swachh City Plan) **or 277** (as per exponential projection) households will still lack access to **sanitary IHHL** (this includes households with insanitary toilets) in 2019. The gap will further increase to **934** (as per Swachh City Plan) or **252** (as per exponential projection) in 2025. .

4.2.2.2 Gap projection for Community Toilet Seats[8]

Table 6 Progression for CT seats

Progression Method	Year	Population	Population to be covered by CT	Requirement for CT seats male	Requirement for CT seats female	Total Requirement for CT seats
Census 2011 Population	2011	109743	1720	5	35	40
	2019	131691	1930	6	39	45
Swachh City Plan	2025	158029	2320	7	47	54
	2019	115365	1695	5	34	39
Exponential	2025	119769	1760	6	36	42

Assuming the male to female ratio in the slum population is 1:1, the number of CT seats is calculated as 1 community toilet seat for 35 male and 1 community toilet seat for 25 female. The total of these seats gives the total requirement of CT seats. (Guidelines for Swachch Bharat Mission-urban, 2017). There is a requirement of **45** (as per Swachh City Plan) **or 39** (as per exponential projection) community toilet seats 2019. This will further increase to **54**(as per Swachh City Plan) or **42** (as per exponential projection) in 2025.

[8] The number will vary depending of the actual changes on the ground such as construction of more community toilet seats and change in slum population.

4.2.2.3 Gap projection for Public Toilet Seats[9]

Table 7 Projection for PT seat gap

Progression Method	Year	Population	Floating population	Requirement for PT seats male	Requirement for PT seats female	Total Requirement for PT seats	Existing PT Seats	Gap in PT Seats
Census 2011 Population	2011	109743	5487	14	30	44	60	-16
	2019	131691	6585	16	35	51		-9
Swachh City Plan	2025	158029	7902	19	42	61		1
	2019	115365	5769	14	31	45		-15
Exponential	2025	119769	5989	15	32	47		-13

As per the Swachh City Plan, the floating population will be **6585** in 2019 and **6585** in 2025.

For calculating the exponential projection, it is assumed that the floating population as a percentage of total population remains constant at 5%. Hence, the floating population will be **5769** in 2019 and **5989** in 2025.

Assuming the male to female ratio in the slum population is 1:1, the number of PT seats is calculated as 1 per 100 persons up to 400 persons; for over 400 persons, adding at the rate of one per 250 persons or part thereof and PT seats for female has been calculated 2 for 100 persons up to 200 persons; over 200 persons, add at the rate of one per 100 persons or part thereof. The total of these seats gives the total requirement of PT seats. From this number, the number of existing PT seats is to be deducted to arrive at the gap. (Guidelines for Swachch Bharat Mission-urban, 2017)

From the above table it is evident that the existing number of PT will be sufficient till 2025, except if the population grows as per the Swachh City Plan. Even then, only **1** additional seat will be needed.

[9] The above projections will vary depending of the actual changes on the ground such as the increase in number of high footfall areas in the cities and construction of more public toilet seats.

4.2.3 Fund Mobilisation for IHHL

With regard to the public funding for individual toilets, it is largely left to the SBM Funds. That apart, there are various approaches for making available the investment towards construction of new toilets have been explored in this part of the report. The selection of the investment strategy is the discretion of the Baripada Municipality. To begin with, 3 possibilities of funding toilet construction can be considered:

Table 8 Funding Models for financing Construction of Toilets

Financing Source	Options
Bipartite Model	Municipality's contribution
	Government of Odisha's contribution
Tripartite Model	Beneficiary Contribution
	Municipality's contribution
	Government of Odisha's contribution
Quadripartite model	Beneficiary Contribution
	Municipality's contribution
	Government of Odisha's contribution
	Aid Organisation/ Not-for-Profit that can bring funding and/or for-profit entities involved in Corporate Social Responsibility

Note: Within these models also, BC could range from 12% to 50% depending on the income segments.

The following aid organisations and for-profit organisations involved in Corporate Social Responsibility should be contacted by the Municipality for mobilizing funds for increasing the incentives for construction of IHHL.

Table 9 Aid agencies

Name	Scope of work	Relavance
Sulabh International Social Service Organisation	Cost-effective sanitation, liberation of scavengers, social transformation of society, prevention of environmental pollution and development of non-conventional sources of energy.	They undertake CSR activities of various organisations like SAIL, IOCL, etc. for household level, community level toilets.
Gram Vikas	water and Sanitation, Livelihoods, Social Housing, Community Health, Education, Renewable Energy	Initiated as a support volunteer group during the cyclone in Odisha, and since then, has been one of the NGOs that get things done; lead by Joe Madiath who's known in the sanitation sector
WaterAid	Safe water, sanitation, hygiene, Menstrual hygiene, Urban WASH, School WASH, WASH in health, CC & DRR	An international aid agency in WASH sector
CareToday	Construction of Clean toilets	It is a part of India Today group and has been active in construction of household toilets under Clean Toilet Initiative

Table 10 For-profit entities involved in Corporate Social Responsibility

S.N	Name	Scope of Work	Relavance
1	**Mahanadi Coalfields Limited**	Healthcare;, Sanitation	They have done similar kind of projects based on water supply as well as building toilets in the schools.
2	**National Aluminium co. Ltd.**	Drinking water; Sanitation & Health	They have been involved actively involved in SBM in Korapat and Angul districts; in setting up drinking water treatment plant in villages etc.
3	**M/S Indian Farmers Fertilisers Co Op.Ltd**	Building toilets, cleaning of ponds, providing water cooler/ filter	They are very active in constructing the bio-toilets in villages and also care about water purification
4	**Paradeep Phosphates Ltd.**	Health, Drinking water & sanitation	Their objective and work focuses on providing healthcare and sanitation.
5	**M/S. Jindal Stainless Limited**	Health care, Rural Development	They have been focusing on health care and being part of Swatch Bharat Mission
6	**Infosys Limited**	Healthcare, Sanitation, safe drinking water	Their focus areas include promoting healthcare and sanitation as per their CSR policy
7	**M/S Cybertech Software and Multimedia Pvt Ltd**	Sanitation	One of their project include working under Swachh Bharat Mission
8	**M/S Hindustan Aeronautics Limited**	Drinking water, Healthcare, Developing Infrastructure	They have installed BioToilets on ,any public spaces in Koratpur district
9	**M/S Sail Rourkela Steel Plant**	Water Sanitation Project	SAIL has actively involved in Swachh Vidhyalaya
10	**OCL India Ltd Rajgangpur**	Health, Drinking water	Have spent 34 Lakhs in making a village ODF in Sundergadh district
11	**Tata Sponge Iron Ltd**	Health, Drinking Water	Have invested in water and sanitation projects

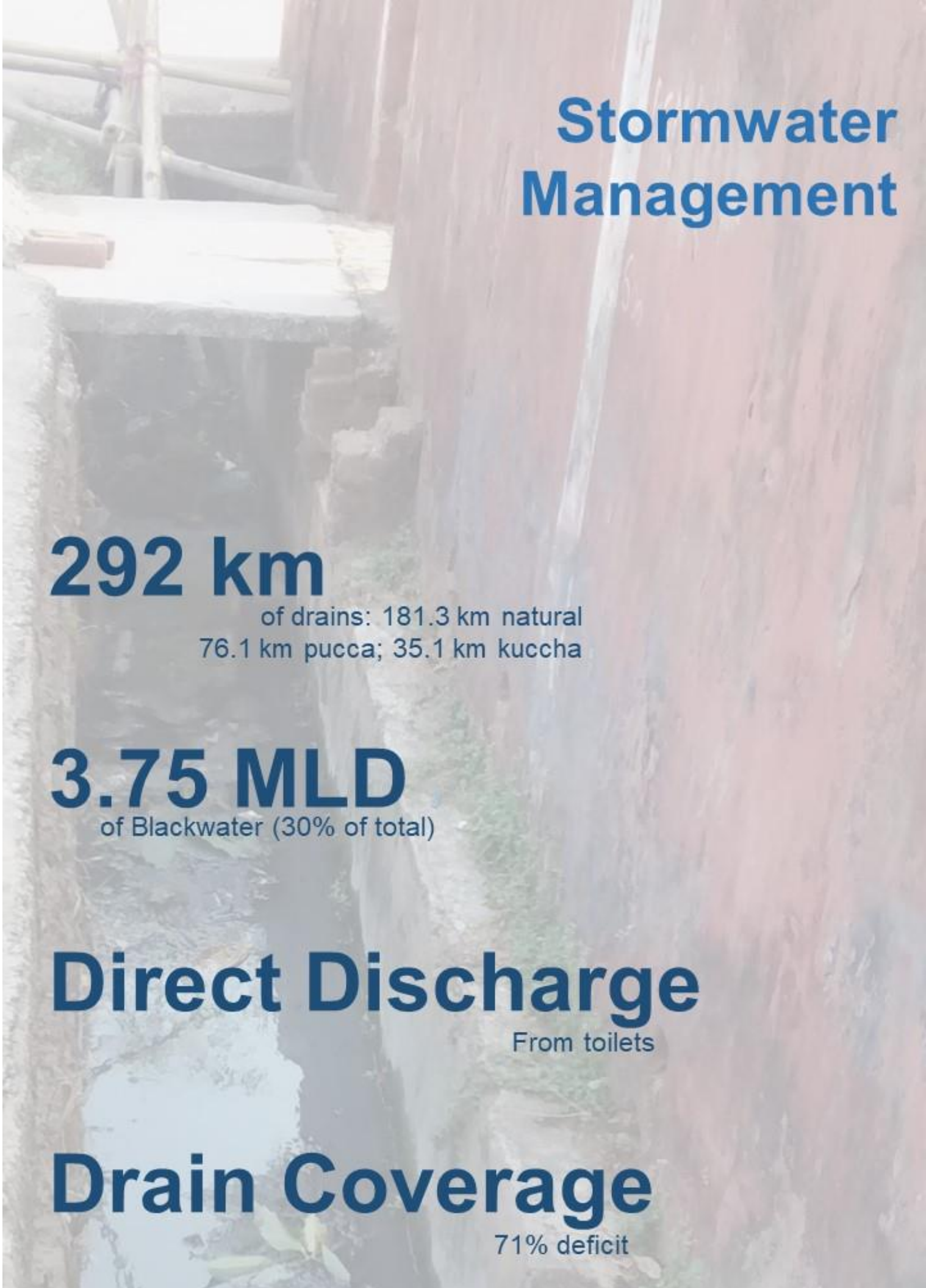
4.2.4 Action Plan

The key action points to improve access to toilets is in terms of construction of new toilets (both individual latrines and community, public toilets and mobile toilet) and upgrading the insanitary toilets to sanitary toilets; creating a policy mechanism for scheduled desludging and IEC campaign for improving toilet usage.

Table 11 Action Plan for Access to Toilets

Issue 1		**Individual Toilets**
Key Issue		• To provide toilets to those who either have access to community toilets or have no toilets; or upgrade household toilets of those having insanitary latrines. • Behavioural block of resorting to open defecation even when toilets are there.
Goal		➢ To provide 100% toilet access to the city ➢ To improve the understanding of health and hygiene amongst individuals and communities
Actions	**Short term (within 2 years)**	• The focus on improving access to toilets is not only to construct new toilets but also upgrade insanitary toilets to sanitary toilets. • Constructing **3421 IHHL** (as per Swachh City Plan projection) **or 2997 IHHL** (as per exponential projection) by 2019. • The cost of construction of one individual toilet connected to septic tank and soak pits. In such cases, regular deluding of the septic tanks need to be done tanks at least once every 2 or 3 years and transported off-site for treatment prior to disposal. Municipal utility or private contractors are required for desludging of septic tanks and to ensure safe disposal of septage at a treatment plant. However the responsibility for O&M of the septic tank itself lies with the owner of the property. • Detailed design of the individual toilets are given in Toilet Designs • Increase the incentive given to households in order to meet the expenditure incurred in building toilets through other sources of funding. (Refer Fund Mobilisation for IHHL) • **IEC** • Households and community members should be made aware for the need for the use of toilets. Awareness programs focussed on the environmental and health issues faced due to open defecation should be highlighted. • Training should be conducted on the O&M mechanisms for individual toilets. **Policy** • Policy measures which would discourage individuals to go for open defecation should be formalised- this would include penalties, incentives for construction of individual toilets, and others.
	Medium term (3- 5 years)	• Upgradation of households with using public toilets individual toilets. If funds and conditions are viable, households should be encouraged to construct individual toilets.
	Long term (5-10 years)	Constructing **1135 IHHL** (as per Swachh City Plan projection) **or 114 IHHL** (as per exponential projection) by 2019.

<table>
<tr><td colspan="2">Issue 2</td><td>Community Toilets</td></tr>
<tr><td colspan="2">Key Issue</td><td>344 households.</td></tr>
<tr><td colspan="2">Goal</td><td>➢ Providing access to toilets to 344 households.
➢ To improve the understanding of health and hygiene amongst individuals and communities</td></tr>
<tr><td rowspan="2">Actions</td><td>Short term (within 2 years) To Medium term (3- 5 years)</td><td>Construction of 45 CT seats (as per Swachh City Plan projection) or 39 CT seats (as per exponential projection) by 2019.
Recommended sizes of septic tanks for community/ public toilets (up to 300 users) is given in the table below
<table>
<tr><th rowspan="2">No. of Users</th><th rowspan="2">Length (m)</th><th rowspan="2">Breadth</th><th colspan="2">Liquid depth (Cleaning Interval of)</th></tr>
<tr><th>2 years</th><th>3 years</th></tr>
<tr><td>50</td><td>5.0</td><td>2.00</td><td>1.0</td><td>1.24</td></tr>
<tr><td>100</td><td>7.5</td><td>2.65</td><td>1.0</td><td>1.24</td></tr>
<tr><td>150</td><td>10.0</td><td>3.00</td><td>1.0</td><td>1.24</td></tr>
<tr><td>200</td><td>12.0</td><td>3.30</td><td>1.0</td><td>1.24</td></tr>
<tr><td>300</td><td>15.0</td><td>4.00</td><td>1.0</td><td>1.24</td></tr>
</table>
Source: Manual on Sewerage and Sewage Treatment Systems, 2013 Part A Engineering
Note 1: A provision of 300 mm should be made for free board.
Note 2: The sizes of septic tanks are based on certain assumptions on peak discharges, as estimated in IS: 2470 (Part 1) and while choosing the size of septic tank exact calculations shall be made.
Note 3: For population over 100, the tank may be divided into independent parallel chambers of maintenance and cleaning
<u>IEC</u>
Awareness programs focussed on the environmental and health issues faced due to open defecation should be highlighted.
<u>Training</u>
• Training should be conducted on the O&M mechanisms for community toilets.
• Training should be conducted for the O&M of public toilets within the sanitation staff members of the municipality, if the public toilets are maintained by the Municipality itself.
<u>Policy</u>
• Policy measures which would discourage individuals to go for open defecation should be formalised- this would include penalties, and others.
• There should be policy directives for the regular maintenance of community toilets by the users of the community toilets.
Upgradation of households with public toilets to community toilets. If funds and conditions are viable, households with access to public toilets should be given access to community toilets, so that the operations would be with the users themselves.</td></tr>
<tr><td>Long term (5-10 years)</td><td>Construction of 9 CT seats (as per Swachh City Plan projection) or 3 CT seats (as per exponential projection) by 2019.</td></tr>
</table>



Stormwater Management

292 km

of drains: 181.3 km natural
76.1 km pucca; 35.1 km kuccha

3.75 MLD

of Blackwater (30% of total)

Direct Discharge

From toilets

Drain Coverage

71% deficit

4.3 Storm water Management

Figure 7 Contour Pofile Baripada

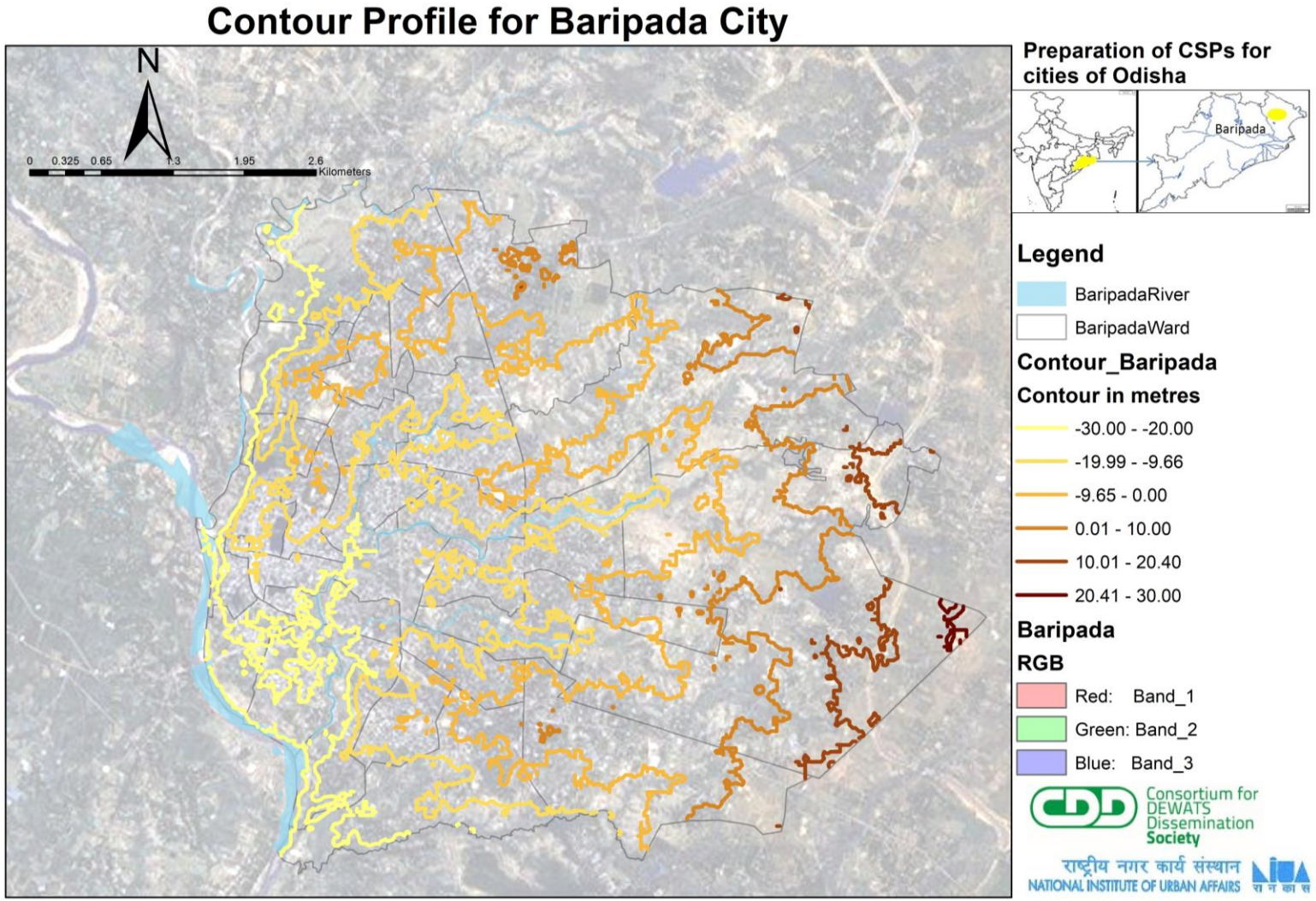
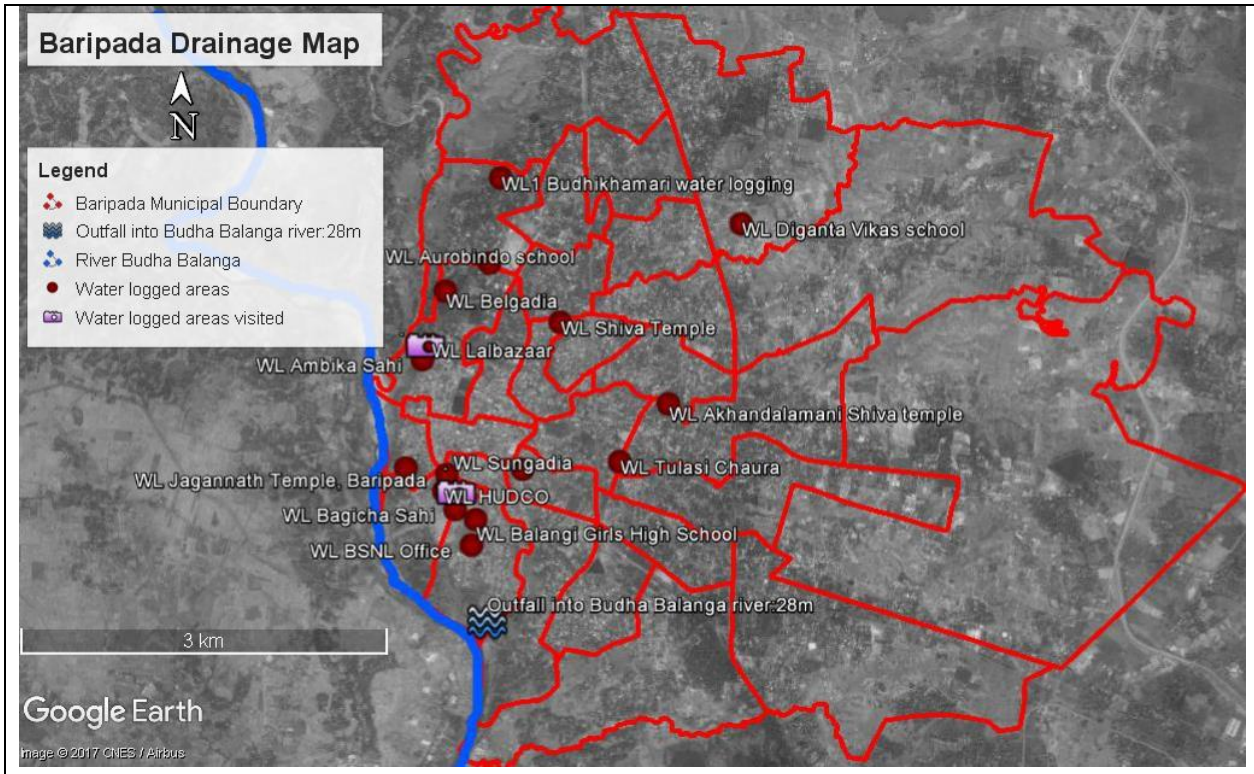
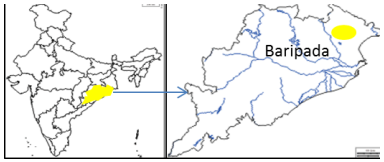


Figure 8: Drainage Map- Baripada Municipal Council



Preparation of CSPs for Cities of Odisha



Consortium for DEWATS Dissemination Society

राष्ट्रीय नगर कार्य संस्थान
NATIONAL INSTITUTE OF URBAN AFFAIRS

Source: CDD Society (2017); Prepared from site visits and OWSSB offices

4.3.1 Drainage network

- Currently, there are 292 km of drains, out of which 76.1 km is constructed pucca drains, 181.3 km is natural drains and 35.1 km is constructed kuccha drains.
- Total drain (both kuchcha and pucca included) is 56.5%[10] when compared to the road network of 258.33 km.

4.3.2 Catchment area- Issues and Recommendations

- The outfalls of drains joins into River Budha Balanga (as shown in the map) located within the city.

4.3.3 Natural Drains of Baripada

Bariapda has 257.4 km of constructed kuchha and natural drain. Natural drains of the city and the vegetation and wetland around them are playing a key role in naturally treating the wastewater in the drains. The vegetation in these system not only take up the nutrients in the water, but also slow down the velocity of water thereby controlling flooding in the downstream areas. However, these systems are constantly under threat from human activities like construction and littering. Therefore, these natural systems need to be protected.

Solutions

- Demarcating drain using pillars or fencing and protecting them from encroachment by maintaining buffer zones (such as 50m, 25m and 15m from the primary drains, secondary and tertiary drains respectively) as mentioned in the Wetland Rules (Conservation and Management) 2010. (National Green Tribunal)
- Bush cutting along the drains and clearing the vegetation in the drain at the beginning of monsoons in order to increase the water carrying capacity of the drains for the season.
- Letting the vegetation in the drain to grow towards the end of the monsoon so that it can treat the dry season flow.
- Clearing solid waste at regular intervals from the drains.
- Concretisation of natural drains should be avoided.

It was informed that the natural drains in many parts of the cities may be concretised owning to lack of space necessitating water to drain out fast. However, it was agreed in the feedback meetings that there should be minimum concretisation in the peripheral areas and outskirts. Besides this, the OWSSB is taking measures like recharge pits and sand traps for better maintenance of the storm water drains.

4.3.4 Water Quality in Storm water drains- Issues and Recommendations

About 29.71% of the estimated 12.64 MLD[11] wastewater generation of Baripada is flowing through the storm water drains. This amounts to 3.75 MLD of wastewater. This includes overflows from septic tanks in the absence of soak pits (28.81%[12] i.e. fifty percent of the 57.62 % of toilets

[10] Most of the areas in Baripada have drains on both the sides. Therefore, the total length of drain is divided by double the size of road to arrive at the figure.

[11] This number is calculated based on 80% of the water supply of 15.58 MLD.

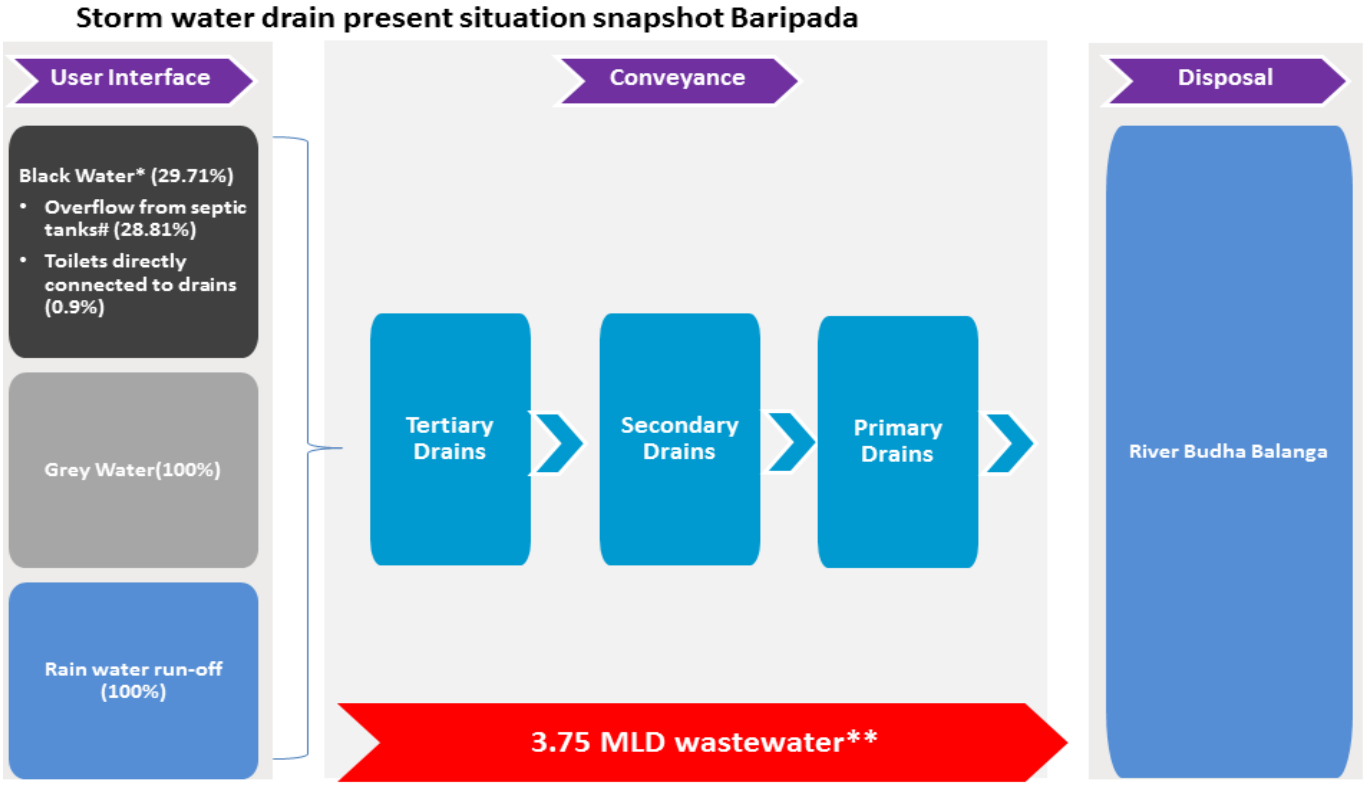
[12] This figure has been arrived at based on the assumption that 50% of septic tanks do not have soak pits. This is supported by the field observations and coversations with the sanitation staff of urban local bodies. The Census definition of toilets with septic

connected to septic tanks); and black water from toilets directly connected to drains (0.9%). (District Census Handbook Mayurbhanj Part XII B, 2011).

Greywater is entirely conveyed through the drains.

However, the final flow noticed at the outfall was minimal. Therefore, flow test couldn't be conducted using the equipments available for flow measurements.

Figure 9: Storm water Drainage snapshot- Baripada Municipal Council



*As a percentage of total household black water generated.
**This figure has been arrived at given that total sewage generation of the city is 12.64 MLD
#Assuming that 50% of the overflow from septic tanks get into open drain due to absence of soak pits, this number has been arrived at.

tanks refers to only the containment system and doesn't distinguish between septic tank with soakpit and septic tank without one (Latrine facility, 2017) . However, it is well known that overeflows from septic tanks is one of the key reasons for pollution of water bodies. (Biswas & Jamwal, 2017). This number doesn't include unhygienic/ insanitary toilets. A detailed survey of the containment systems of the toilets should be undertaken to get the percentage of toilets with soakpits

Table 12: Outfall details- Baripada Municipal Council

Place	Description	Pictures
Drain water into River Budha Balanga	Minimal flow	 Red arrow shows the direction of water flow towards from the drain to the river

4.3.4.1 *Recommendations*

1. **Stopping entry of wastewater into storm water drains**:
   A major portion of wastewater in storm water drain comes from domestic wastewater. In order to keep this wastewater out of the drains, all the domestic wastewater should be safely disposed. Monitoring of septic tank and soak pit construction issue can be addressed by mandating construction of septic tanks with soak pits. .
2. **Maintaining the natural drains of Baripada:**
   As said in section Natural Drains of Baripada, natural drain due to their ecosystem act as a treatment system to treat limited quantities of wastewater. Maintaining the drain ecosystem is the major part of this. The vegetation in the drains should be minimised at the beginning of monsoons in order to increase the water carrying capacity of the drains for the season. Thereafter, the vegetation should be allowed to grow towards the end of the monsoon so that it can treat a limited dry season flow.
   There are 216 km of kutcha drains in Baripada out of 292 km of total drains i. This is an asset to the city for natural drains and the vegetation and wetland around them are playing a key role in naturally treating the water in the drains. Hence, this asset must be maintained.

4.3.5 Water logging areas

- Visit to areas prone to water logging was made. This included- Bagicha Sahi, HUDCO (marked as WL HUDCO in the Fig1) and Ambika Sahi (marked as WL Ambika Sahi in the map).
- The key issue in these areas was that they were in low-lying areas with drains full of wastewater. Also, drains were choked with solid wastes at many places. At places, water supply connection into the house lied across the drains thereby posing the risk of wastewater entering into water supply.
- **Gaps-** Solid waste in drains; and wastewater into drains

Table 13 Water logged areas

SN	Area Name	Issue	Photo
1	Bagicha Sahi, HUDCO (marked as WL HUDCO in Fig1)	This is a low-lying area with drains full of wastewater. Also, drains were choked with solid wastes at many places. Water supply connections into the house lied across the drains thereby posing the risk of wastewater entering into water supply	 Encircled in red water supply connection
2	Ambika Sahi (marked as WL Ambika Sahi in Fig1	This is a low-lying slum sloping into the flood-plain of river Budha Balanga. Also, drains were choked with solid wastes at many places.	 Yellow arrow is the direction of the slope. 

4.2.2.4 Recommendations

1. **Improving inlets into the existing drains**- This can be done by using alternative options while dealing with covered drains such as mesh covers (see Drain Mesh); keeping the inlet pipes into covered concrete drains free of solid waste; and managing solid waste in the drains.

Figure 10Drain Mesh

Source: (Steel mesh)

2. **Increasing drain coverage and constructing new drains as constructed kuchha drains.** The vegetation in the natural drains (kuchcha drains) helps in controlling flooding as referred to in Natural Drains of Baripada
3. **Water sensitive urban design using swales and raingardens**
   "Water Sensitive Urban Design" or WSUD for short is an approach that recognizes the adverse impact of traditional urban forms have on the urban water cycle. (Water Sensitive Urban Design in UK, 2013) Hence WSUD takes the approach of finding opportunities to renew and redesign existing urban forms so they may positively enhance the urban water cycle. Examples of such redesigning of roadside to include incorporation of permeable surfaces as well as vegetated and landscaped areas (such as raingardens and swales see Diagrammatic representation of roadside swales and rain garden) that are specially designed to slow down the flow of the storm water run-off from road and other paved surfaces, retain and treat the pollutants that is often picked up by the first flush of the storm water run-off and discharge cleaner water to the discharge point. Such WSUD elements provide other multiple benefits such as enhancement of the aesthetics of the urban areas and reduced flooding and water logging following rains. This means the City of Bhubaneshwar, swales can be constructed in the roadsides as shown in Diagrammatic representation of roadside swales and rain garden and incorporate a program of building raingardens in public premises in partnership with the agency responsible for road and storm water; as well as in private premises in partnership with private landowners.

4.2.2.4.1 Diagrammatic representation of roadside swales and rain garden

Figure 11 Roadside swale

Source: (Swale, 2017)

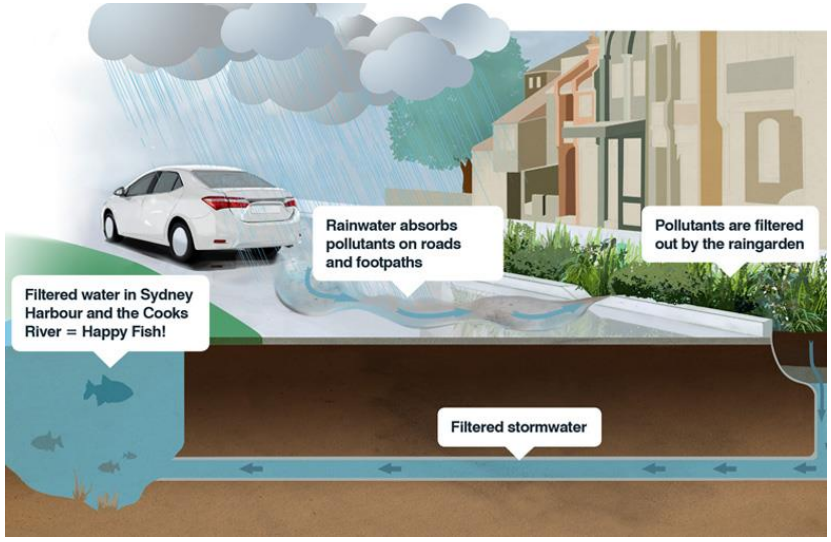
Figure 12 Roadside swales installation

1. Road patch without swale

2. Road patch with swale

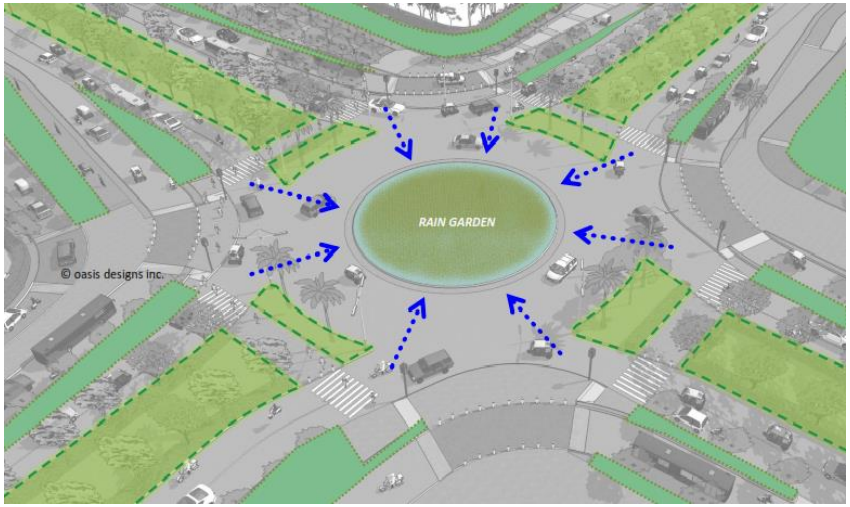
Source: (Storm Water Management, Uttipec, Delhi Development Authority, 2012)

Figure 13 Representation of working of a rain garden and swale



Source: (Rain gardens)

Figure 14 Representation of rain garden at roundabouts for Delhi



Source:(Storm Water Management, Uttipec, Delhi Development Authority, 2012)

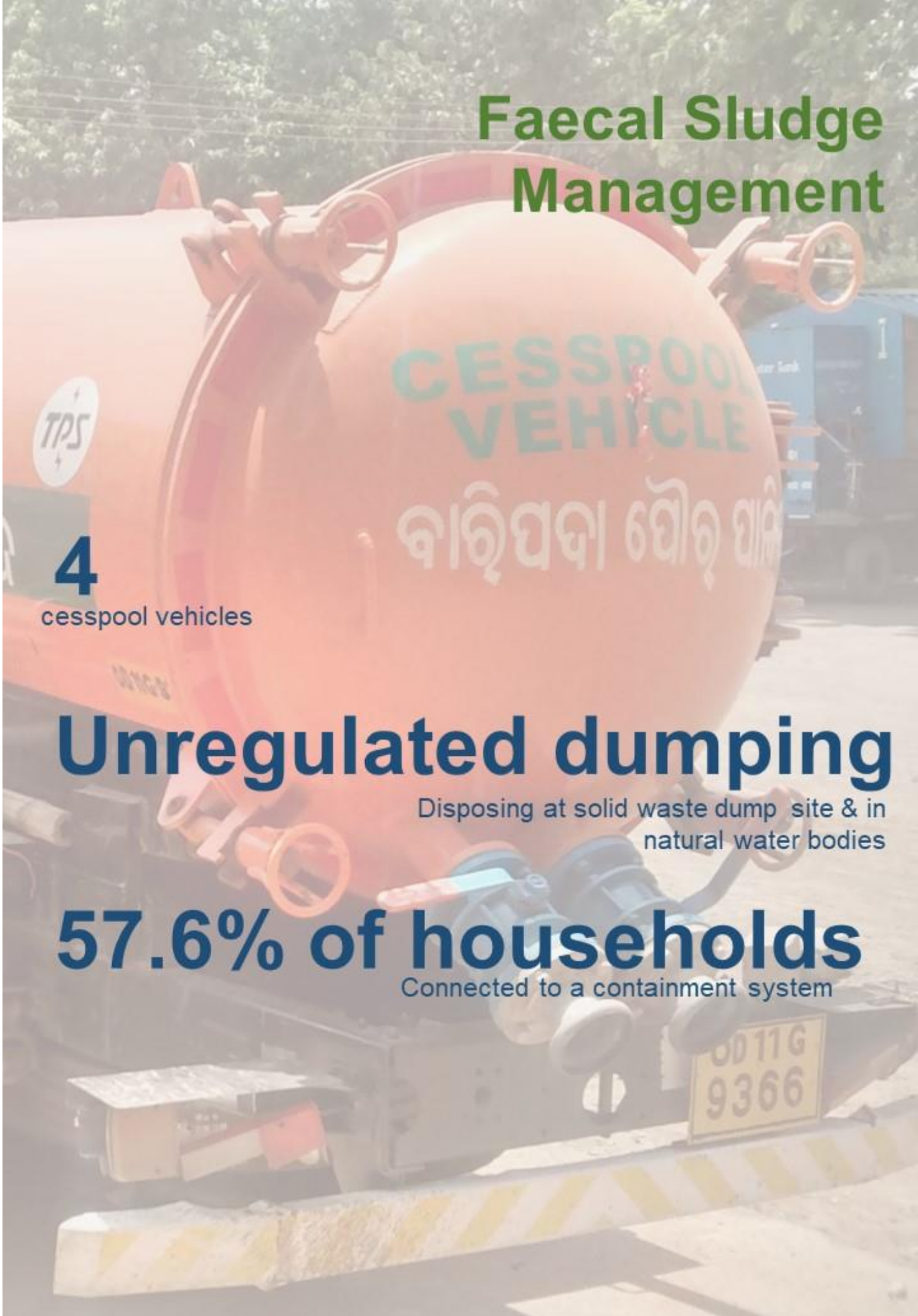
4.3.6 Action Plan

The key action points for improvement in storm water drainage are in terms of construction of water sensitive drainage in order to address multiple challenges of drain coverage, control the problems of inundation and letting maximum water to seep into the ground in order to improve the ground water levels. Maintaining and increasing the coverage of natural drains and constructed kuchcha drains and construction of swales and raingardens are central to this idea of water sensitive urban design. Also, stopping wastewater from entering the drains and regular maintenance of drains in terms of solid waste management and maintaining the vegetation in the drains are essential to improve upon storm water drainage system.

Table 14: Action Plan for Storm water Management

Issue 1		**Inundation issues**
Key Issue		Drain design issues- covered drains and related issues
Goal		To create new drain designs using water sensitive urban design approach.
Actions	**Short term (within 2 years) To Medium term (3- 5 years)**	• **Improving inlets into the existing drains by unclogging inlet pipes; and switching to alternate covering such as mesh cover.** • **Increased coverage of natural drains.** • **Water sensitive urban design using swales and raingardens** (See Diagrammatic representation of roadside swales and rain garden)
Issue 2		Wastewater into storm water drains
Goal		To improve the water quality in the drains
Actions	**Short term (within 2 years)**	• **Stopping the entry of sewage into the storm water drain** • **Maintaining and increasing the number of natural drains**

Faecal Sludge Management



4
cesspool vehicles

Unregulated dumping

Disposing at solid waste dump site & in natural water bodies

57.6% of households

Connected to a containment system

4.4 Faecal Sludge Management

4.4.1 Faecal Sludge Management- Current Situation, Gaps and Possible Recommendations

Table 15Faecal Sludge Management- Current Situation, Gaps and Possible Recommendations

Faecal Sludge Management cycle in Baripada Containment → Collection and Conveyance → Disposal and treatment → Reuse				Possible recommendations
Aspect/Parameter		**Current Situation**	**Gaps**	
1	**Containment**	On-site sanitation systems in Baripada are prevalent. The share between different containment systems is according to the 2011 census as follows: • Households connected to Septic Tanks (with and without soak pits): 57.6% • Households connected to Pits: 10.5% • Households connected to other kinds of containment Units: 2.4% • There are not many containment units connected to drains in Baripada, as there is no underground drainage system, only storm water drains.) • The average size of the containment systems that were found during the household survey in Baripada is 2.5-3m^3.The average filling time for the containment units is about 8 years and the desludging frequency is generally 8-12 years.[13]	- No standard size and mostly depends on space available within the house - Very less incentive for building the standard containment structures. - Unhygienic Toilets (Super Structure) - Pits/Septic Tanks are un-scientifically constructed resulting in frequent overflow and leakages - Lack of understanding - O&M of containment units. - Septic tanks are broken and are of inadequate size, - Grey water is entering the septic tanks in few households - Many times, absence of secondary treatment systems (eg. soak pits) for disposal of grey water & septic tank effluent.	- Enforcement of standard containment size code regulations strictly - Increasing the incentive mechanisms/amount for converting the insanitary to sanitary • Awareness/IEC campaigns on open defecation and other aspects

[13] These are based on the field visits and may not be indicative for the entire city.

2	**Collection and Conveyance**	• There is only government desludging service and there is no presence of private desludging service providers. • Most of the areas in Baripada are accessible for the cesspool vehicles and containment systems get desludged about every 8-12 years. • They have 4 vehicles in total. There are two old cesspool vehicles with 3000 and 4000 litres capacity operational. Apart from this, two other vehicles with a capacity of 3500 litres capacity are given by OWSSB but they are not operational as they are planned to be outsourced to third party through PPP mode. • The cesspool operators charge Rs 1500 for one trip up to 5km outside the municipal boundary and Rs 800 for one trip within the municipal boundary. • The average distance covered by the truck for one desludging is 6 to 7 km, depending on the disposal site and a total of 4-5 trips per day are made in Baripada. • The ULB used to not maintain their records of cesspool vehicles which makes the proper understanding of the situation harder. But now the E&Y City	- There is no proper mechanism for monitoring and tracking the cesspool vehicle collection and disposal. - Lack of data on cesspool day to day activities like log book etc. - Framework for private operators to enter/operate in the future because the city is developing. - Using of Proper safety gears during the desludging operations is absent	- Make GPS and other ICT interventions mandatory for both private and government vehicles. - Framework for the private operators to operate in the town if they operate in future. - Form to be filled by the customer availing the desludging service which has to be submitted at the Municipality/during the disposal by integrating ICT technology into the operations - Separate account for handling cesspool vehicles account.

		Coordinator is maintaining those records in the form of an excel sheet, that clearly improves the situation. The ULB planned to outsource the new trucks to private operators		
3	**Disposal and treatment**	• Currently, disposing of the faecal sludge is at the designated solid waste dumpsite and in natural water bodies. • There is a SeTP construction taking place and which would be the designated treatment and disposal site. The capacity of the SeTP process and which would cater to around 14-18 wards(nearly 20% of the town)	- Unsafe faecal sludge/septage disposal practices currently (SeTP is due in Oct,2017) - Incentive mechanism/regulation to promote the disposal at treatment site is not yet available.	- Disposal at the designated dumping site to be made compulsory and need to be constantly monoitored using ICT. - Disposal at the SeTP to be mandatory • IEC campaign with the cesspool operators both private and government
4	**Reuse**	• No reuse/reuse plan is present in the form of usage of waste water and sludge in few areas in the agriculture	There were agricultual fields near to the city. One should explore the potential of reuse of dried sludge/co-compost.	- Reuse plan for selling the dried FS - Converting the dried FS into co-compost for enriching the nutrient content - Exploring it to sell for cement industries/ brick factories To encourage reuse among the farmers through IEC campaigns

4.4.2 Progress of Septage Projects under AMRUT in Odisha (2017):

Table 16 Septage Projects under AMRUT

Planning and Design	Construction/ Implementation	O&M
• Planning and design of the Faecal Sludge Treatment Plant (FSTP) is undertaken by OWSSB • Procurement of the cess pool vehicles is however done by the Municipality.	• Construction/Implementation of the Faecal Sludge Treatment Plant (FSTP) is undertaken by OWSSB • Regarding the operationalization of the FSTP, the following are the Work Order details: 1. Agency: M/s Ionex Envirotech Pvt. Ltd., Mumbai 2. Agreement cost: Rs. 2,15,00,000 3. Scheduled Date of Completion: 10th October 2017 4. Status of FSTP Construction and implementation : ▪ The land has been physically handed over to the agency on the 7th of Jan 2017. ▪ The Topographical surveys have been completed. ▪ Geotechnical Surveys have to be taken up. ▪ General Agreement and Site technical drawings (Hydraulic Flow Diagrams) not submitted to OWSSB (coordinating the implementation). • Status of truck procurement: Trucks procured by OWSSB and tendered out by the Municipality. The tender allotment is in process.	• The overall responsibility of operation and maintenance of the FSTP is the responsibility of the Baripada Municipality. • Though the trucks are procured by OWSSB, they will be owned and managed by the ULB. • As such, the O&M of cess pool vehicles will be under the supervision of the Municipality

4.4.3 Action Plan

To implement a holistic faecal sludge management program spread across 3 years targeting construction of FSTP in 2017 and alongside streamlining collection and conveyance of faecal sludge operations.

Table 17 Action Plan for FSM

Issue 1		Containment	Costs
Key Issue		• No enforcement of standard pit/septic tank design and size (mostly depends on space available within the house) • Unhygienic Toilets, i.e. pits/Septic Tanks are un-scientifically constructed resulting in frequent overflow and leakages • Lack of understanding - O&M of containment units. • Grey water is entering the septic tanks in few households.	
Goal		• Complete conversion of existing insanitary toilets to sanitary toilets • New constructions or toilets construction in the pipeline are to be completely standardized following the Building Code • Creating capacities to undertake O&M of containment units • Implementation of rules and regulations which would standardize the existing and upcoming containment systems	
Actions	**Short term (within 2 years)**	**Technical** • Enforcement of standard size/designs of the pits/septic tanks which needs to be incorporated in the house construction design which needs to be in accordance with the provisions of the ○ National Building Code of India, 2005; ○ Bureau of Indian Standards, Code of Practice for Installation of Septic Tanks; ○ Manual on Sewerage and sewage treatment systems, CPHEEO, 2013; ○ Swachh Bharat Mission Guidelines, 2014 **IEC** • Awareness/IEC campaigns on open defecation and other aspects • Masons training for building the containment systems **Policy** Enforcement of Odisha Urban Septage Management Guidelines, 2016.	
	Medium term	**Operations** • Increasing the incentive mechanisms/amount for converting the insanitary to	• Rs 8,000 – Rs 10,000 increase in incentive for every toilet converted

	(3- 5 years)	sanitary **IEC** • Behaviour change campaigns and workshops periodically in the newly developing areas	from insanitary to sanitary toilet (based on other states implementation of incentives under SBM plan)
Issue 2		**Collection and Conveyance**	
Key Issue		• There is no proper mechanism for monitoring and tracking the cesspool vehicle esp. the private players. • Accessibility is an issue in few areas and unscientific method • Manual handling of faecal sludge is a significant issue (as per the discussion with private cesspool operators) • The private operators are not regulated. Lack of data on private operators involved in desludging. • Desludging of septic tanks is not carried out regularly (once in every 2-3 years). • 3 trucks will be operated by Baripada Municipality and 5 trucks are outsourced to private parties. The monitoring would be difficult because certain vehicles O&M are outsourced and few of them are controlled by Baripada Municipality. • Proper safety gears are not used while desludging both by government and private operators	
Goal		➢ 100% collection of FS/Septage generated in the city and 100% conveyance to the treatment/disposal site ➢ No manual scavenging/ manual handling of FS ➢ Use of safety gears and proper equipment while desludging ➢ Regulating the private operators through licensing and periodic renewal	
Actions	**Short term (within 2 years)**	**Technical** - Make GPS and other ICT interventions mandatory for both private and government vehicles. - Safety gears to be given to government operators and are to be made compulsory for the government and private operators **Operations** - Separate account for handling cesspool vehicles account. - Establishing the feedback mechanism for loadging the complaint/redressal mechanism - Mechanisms to fill the form by the customer availing the desludging service which has to be submitted at the Municipality during the disposal.	• For ICT technology interventions : CapEX and OpEx is approx. Rs 120000 per vehicle per year

		- Make operations plan for the 2 cesspool vehicles to be operated by municipality. **Training** - Training of the operators on standard practices and safety measures for collection and conveyance - Training of ULB officials on monitoring of cesspool vehicles **Policy** - Enforcement of Odisha Urban Septage Management Guidelines, 2016.	
	Medium term (3- 5 years)	**Technical** • Procure a Gulper machine /small cesspool vehicle where the existing cesspool vehicles cannot access **Operations** • Regulating and Maintain the database of private operators if they enter into operations in Baripada **IEC** • Behaviour change campaigns and workshops periodically in the newly developing areas **Policy** • Policy resolution passing for regulating and monitoring the private operators	**For Gulpur machines/small cesspool vehicles:** - Rs 16,00,000 for 2 vehicles as CapEx and Rs 1,20,000 for OpEx of vehicles(which will not include the fuel costs) - HR salaries will be around Rs 7,20,000 per year for 4 people employed(2 per vehicle)
	Long term (5-10 years)	**Operations** • Assess between the demand generated for collection and supply of FS collection in the city and accordingly procure cesspool vehicles if necessary **Policy** - Scheduled desludging should be implemented by incorporating user fee or property tax incorporation	**For procuring of new cesspool vehicles:** Rs 28,00,000 for 1 cesspool of 4.5 Kld Rs 20,00,000 for 1 cesspool of 3 Kld **Planning, designing of tender and tendering of scheduled desludging:** Rs 2.5 Lakh- 3.5 Lakh
Issue 3	**Disposal and treatment**		
Key Issue	• Unsafe faecal sludge/septage disposal practices currently(SeTP is under construction but there is delay in the commencement as per the SI, the site has been handed over for construction but the construction is yet to begin) • Incentive mechanism/regulation to promote the disposal at treatment site is not yet available.		
Goal	➢ 100 % disposal of FS generated at the treatment plant ➢ 100% of the FS generated is to be treated		

		➢ Scientific disposal sites are made available till the SeTP has been	
Actions	Short term (within 2 years)	**Capacity Building** - Capacity building of ULB and operators for handling the SeTP IEC campaign with the cesspool operators for behaviour change regarding the disposal **Policy** • Enforcement of Odisha Urban Septage Management Guidelines, 2016.	• Rs 2410000 approx. as the OpEx of the SeTP which is under construction[14].
	Medium term (3-5 years)	**Technical** Different business models assessment for the SeTP and work on sustainability of the operations of treatment plant **Operations** Outsourcing of O&M of the plant to third party by releasing tenders **Policy** Inclusion of property tax as part of making the operations of SeTP sustainable	• Tender Handling charges: Rs 2,50,000 approx. for design of tender • Business models for possible reuse options are provided in Business Models for FSM
	Long term (5-10 years)	**Policy** Policy resolution leading to 100% disposal and treatment of the FS generated	
Issue 4		**Reuse**	
Key Issue		• No reuse is present or formally institutionalized in the city	
Goal		• 100% reuse of the treated sludge	
Actions	Short term (within 2 years)	**Technical** • Co-compost plan for enhancing the nutient value • Explore other technologies for reuse **Operations** • Collaborate with chemical fertilisers companies • Reuse plan for selling the dried FS and to be outsourced	• Cost of setting up co-composting unit = Rs 0.6 Crore/60 Lakhs[15] • The OpEx costs would be approx. = Rs 6 Lakh per year[16] • For the compost to be sold in the market, it should pass the FCO (2013)[17] norms.

[14] Based on case study of FSTP Devanahalli, the OpEx costs of FSTP is about 10% of the CapEx.
[15] Based on case study of FSTP Devenahalli, the Co-composting unit CapEx will cost 25% of the FSTP cost
[16] Based on case study of FSTP Devanahalli, the OpEx costs of FSTP is about 10% of the CapEx.
[17] Fertiliser (Control) Order 2013 Norms, brought out by the Department of Agriculture and Cooperation

		• Converting the dried FS into co-compost for enriching the nutrient content **IEC** • To encourage reuse among the farmers through IEC campaigns **Policy** • Reuse policy to be formulated for the city	
	Medium term (3-5 years)	Technical Black soldier flies/usage of solar energy for running the SeTP Operations Exploring it to sell for cement industries/ brick factories	

Solid Waste Management

16 MT

of MSW generated

83% collection

D2D collection done by both municipal corporation & pvt. contractor

Future Projections

In 2019: **20** MT
In 2025: **24** MT

4.5 Solid Waste Management

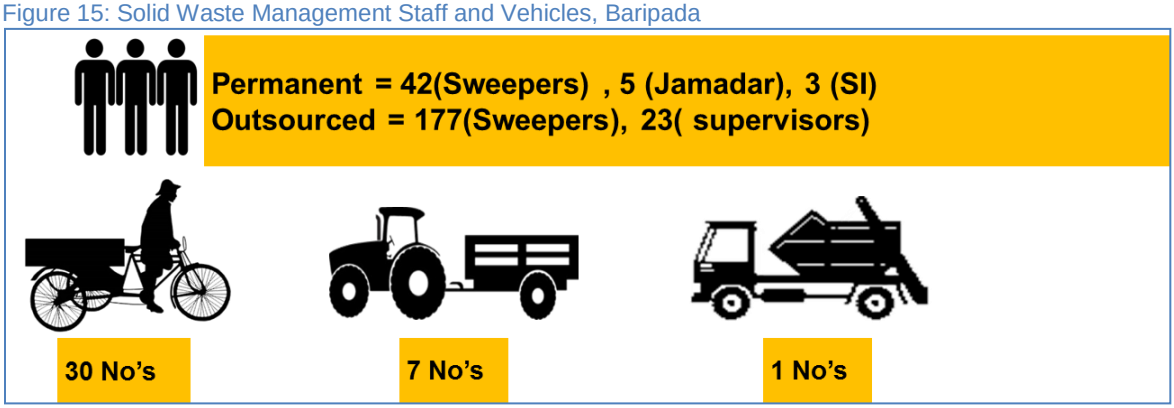
4.5.1 Generation of Municipal Solid Waste

AS per Swachha City Plan, Baripada generates around 16.02 MT of municipal solid waste per day. Composition of wet waste is 57.7 % and that of wet waste is 42.3%.

Household collection - In Baripada, solid waste is collected through both door to door collection and collection from secondary and community bins. As per discussions with the Sanitary Inspector, all the wards are covered under door to door collection. But during site visit to slums, open dumping and open burning of solid waste was seen. Door to door waste collection is carried out through both Municipal and private service provider i.e. M/s Suraj. Out of 28 municipal wards, 23 municipal wards are outsourced to private service provider and 5 wards are serviced by municipality. The biomedical waste is collected and transported to the dumping site along with other wastes without any form of segregation.[18]

Waste conveyance - 7 tractors and 1 dumper placer vehicle are used for collection and transportation of mixed waste to dumping site at Maila Kadam. As per Swachha Bharat city plan out of 16.02 MT generated on daily basis, 14.6 MT is collected per day (91%). [19]

Figure 15: Solid Waste Management Staff and Vehicles, Baripada



4.5.2 Solid Waste Treatment & Disposal

There is no solid waste treatment plant available in Baripada. All the waste from the city is transported to Maila Kadam dumping yard which is spread across 42 acres of land. There is no treatment carried out on waste. 100% of the waste collected is haphazardly dumped at that dumping yard. There are schools located at a distance of 100m from the dump site.[20]

[18] Baripada Municipality (2017)
[19] Baripada Municipality (2017)
[20] Baripada Municipality (2017)

4.5.3 Salient features of current Solid waste system

Solid waste Management cycle in Baripada

Generation → Collection → Transportation to Transfer station → Transportation to dumping site at Maila Kadam

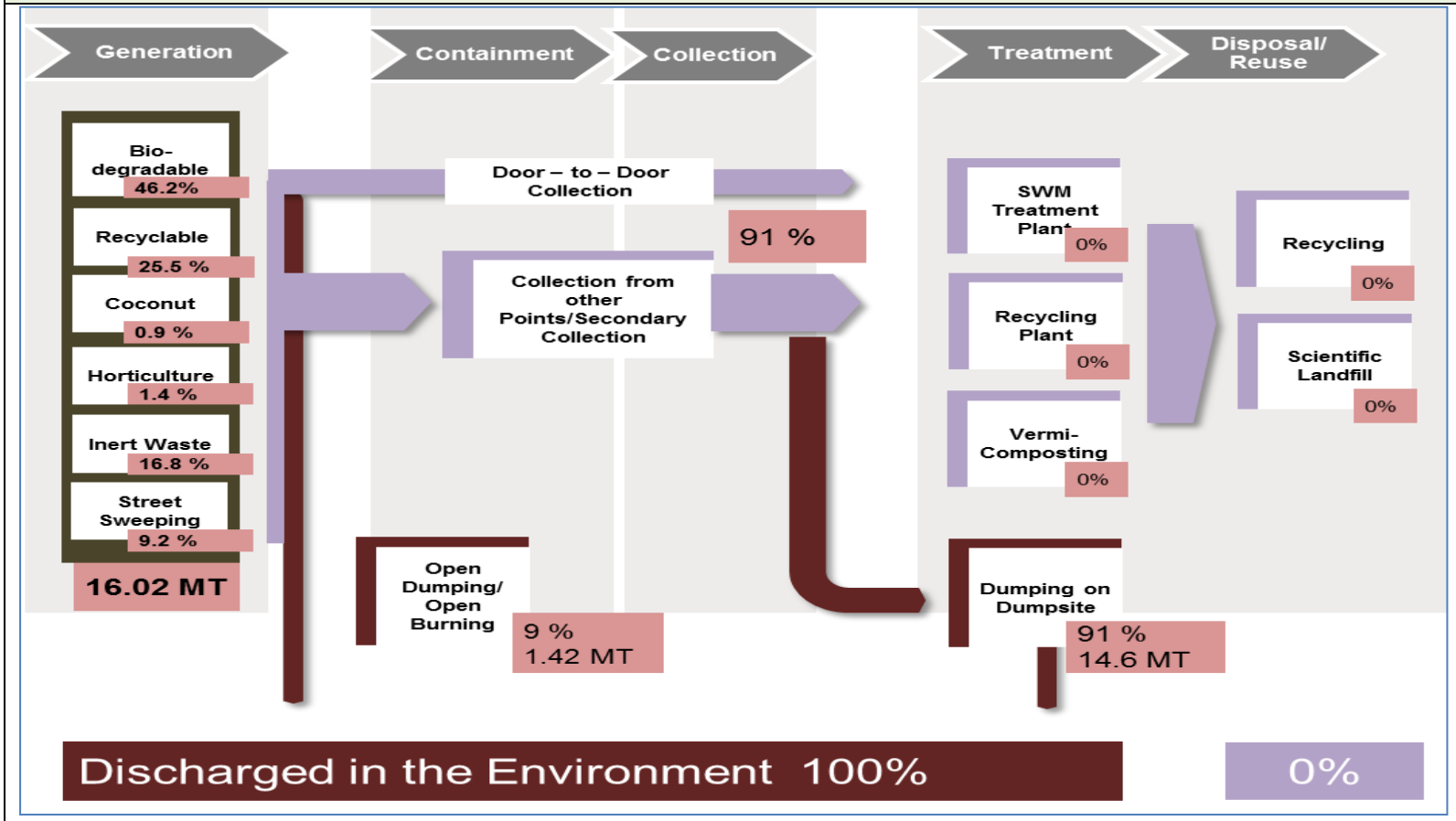


Table 18 Solid Waste Management: Current Situation, Gaps and Recommendations

	Aspects/ parameters	Current situation	Pictures	Issues/ Gaps	Possible Recommendations
1	Generation	Total waste generated= 16.02 MT per day			
2	Collection and transportation	• Waste collection is carried out by both Municipal Corporation and Private Service providers. • As per Swacch Bharat City plan, out of 16.02MT waste generated only 14.6 MT (91%) of waste is collected.		1. Collection of waste is not 100% 2. Segregation of waste is not managed at source 3. Labourures are differentiated for door to door waste collection, street sweeping and drain cleaning. 4. Increase in collection cost due to collection of unsegregated waste	**Solid Waste collection using Micro-pocket planning approach.** For efficient handling of the sanitation and solid waste management function, Municipality is required to bundle the related activities (door to door collection, into three major work units based on the size and work load quantities. Work packages can be classified as follows:- •Residential Micro Pocket •Commercial and Bulk Solid Waste Handling •Mechanical Sweeping of Main Roads The SWM activities within one micro-pocket is supposed to be handled by one or two set of dedicated personnel who will work as a team and takecare of all the activities in the given micropocket.

					(Refer **Micro Planning**)
3	**Segregation**	No household segregation happening		No incentives given to promote segregation at source	• Provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle. • IEC campaign for awareness generation towards segregation of waste.
4	**Treatment/ Processing**	• No treatment of waste is happening at present. • All collected waste is dumped at dumping yard at Maila Kadam.		• All the 14.6 MT of waste collected is dumped without any treatment and processing • Increase in garbage heaps affects environment due to release to greenhouse gases • Loss of resources in the form of recyclable materials (plastic, metals, glass, paper etc.) and compostable materials. • No scientific landfill for safe disposal of inert materials • No separate treatment happening for Bio medical waste and sanitary waste.	• **Source treatment for bulk generators** • Material Recovery facility for recovering recyclable materials • Biogas plant at source reduction for bulk waste generatorslike vegetable Market • Windrow composting of wet waste for reovering compostable materials. • Separate incineration treatment facility for Bio medical and sanitary waste to be constructed under PPP mode[21]. • Installation of Organic waste Converter (OWC) machine at public parks for source reduction of waste

[21] All the above waste technologies are suggested based on general characteristics of Municipal Solid Waste in India. Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Page-43, Government of India.

4.5.4 Projections for Solid Waste Generation

Table 19 Projection for solid waste generation

Progression Method	Year	Population	Solid waste generation (MT)
Census 2011 Population	2011	109743	16.02
Swachh City Plan	2019	131691	20
	2025	158029	24
Exponential	2019	115365	17
	2025	119769	18

For the purpose of projection, we are using exponential projections. (see Population Projection for Baripada for details)

The solid waste generation has been calculated with the assumption that the per capita waste generation of the city will remain constant. Currently, all the solid waste of the city is going into the dump yard at Maila Kadam. Since in future the waste generation is going to increase further, therefore, **it is important that maximum amount of waste is retrieved locally and sent through the reuse and recycle channels.** Therefore, the action plan focusses on maximum segregation to promote recycle and localised management of

4.5.5 Action Plan

The key action points for improvement in solid waste management pertain to improvements in various segments in the value chain. At the user interface, policy and IEC interventions for household segregation are suggested. For the collection system, micro-pocket approach in which the city is divided into multiple micro-pockets and all the solid waste collection activities - door-to-door collection, road sweeping and drain cleaning- is assigned to one or two individual workers who will take care of all the activities. This will lead to increased accountability of workers and easy monitoring of their work. For treatment, it is suggested that the city must have dry resource collection centre/s in order to ensure that there is a place where the segregated dry waste collected is received and processed (or sent for processing from this facility). For bulk generator of wet waste, it is suggested that treatment units are made mandatory in order to manage the solid waste at source itself.

Table 20 Action Plan SWM

Issue 1		Collection of waste	Cost estimates
Key Issue		• Collection of waste is not 100%. • Segregation of waste is not managed at source • Labourures are differentiated for door to door waste collection, street sweeping and drain cleaning.	
Goal		➢ 100% collection of solid waste generated in the city and 100% conveyance to the treatment/disposal site. ➢ To achieve 80% source segregation of waste	
Actio	**Short term (within**	**Micro-pocket planning approach.** For efficient handling of the sanitation and solid waste	

	2 years)	management function, Municipaity is required to bundle the related activities (door to door collection, drain cleaning and road sweeping) into three major work units based on the size and work load quantities. Work packages can be classified as follows:- •Residential Micro Pocket •Commercial and Bulk Solid Waste Handling •Mechanical Sweeping of Main Roads The SWM activities within one micro-pocket is supposed to be handled by one or two set of dedicated personnel who will work as a team and takecare of all the activities in the given micropocket. (refer **Micro Planning**) Steps involved: I. Clear demarcation of residential, commercial and main road sweeping pockets for carrying out the sanitation and solid waste management activities II. Clearly defining of job responsibilities and key performance indicators for the service providers III. Making realistic estimates of resource requirements in rationalized and standardized manner (manpower, transportation vehicles, tools, implements and conservancy materials) IV. Develop clear resource inputs and results-outputs correlations to achieve standard service delivery results across the ULBs in a uniform manner. V. Identifying and developing clear wok quantities, key performance indicators and performance monitoring mechanisms, in the event of outsourcing complete work packages to private agenciesClear demarcation of areas and tasks for waste collectors. VI. Calculating total human resource requirements. It can be calculated as per 2 workers per micropocket who would undertake all the activities such as door to door waste collection, road sweeping and drain cleaning inside designated micropocket. (Refer to **Micro Planning**) VII. For the micro-planning approach to succeed secondary bins should be removed from all the areas except high floating population areas.	

		Training • Training for solid waste collection workforce for both Govt. and private waste collectors about waste collection process in micro pockets **IEC** • Household awareness campaigns about segregation of waste to be carried out by waste collectors **Policy** • Policy amendment for Provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle.[22]	
Issue 2		**Treatment/ Processing of waste**	
Key Issue		1. All the 14.6 MT of waste collected is dumped without any treatment and processing 2. Increase in garbage heaps affects environment due to release to greenhouse gases 3. Loss of resources in the form of recyclable materials (plastic, metals, glass, paper etc.) and compostable materials. 4. No separate treatment happening for Bio medical waste and sanitary waste. 5. No scientific landfill for safe disposal of inert materials	
Goal		**Management of waste at source by bulk generators**	
Actions	**Short term (within 2 years)**	• Carry out waste composition study to know the actual content of wet and dry waste and composition of different materials like, biodegradable, paper, metals, glass etc. [23] • Mandating all bulk waste generators whose waste characteristics are mainly wet waste eg vegetable market, public parks etc. to treat waste at source by means of using technology opetions such as bio gas digestors and Organic waste converter to be outsourced to private service providers	- Carring out Prefeasibity study, waste compostion study, and a preparation of holistic solid waste management DPR= **Rs.7.5 lakhs** - Biogas digestor= **Rs.15-16 Lakhs per tonne** - Onsite composting (windrow)= **Rs.3-4 lakhs per tonne** - Onsite Composting (Vermicompostin

[22] This model is being implemented In State of Andhra Pradesh.

[23] Waste composition study should be carried out according to this given reference- Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Page-47, Government of India.

			g)= **Rs. 5 lakhs per tonne** - Organic waste converter machine = Rs.4-5 lakhs per unit
Goal		100% treatment of waste generated in Baripada.	
Actions	**Short term (within 2 years) To Medium terms (within 3-5 years)**	• Construction of new treatment facilities at city level: ○ Material Recovery Facility ○ Windrow composting facility for processing wet waste of small residential units collectively at the city level ○ C & D Waste Plant Exisiting SWM facility such as Maila Kadam Dumpsite can be used to locate the plants. **<u>Operation</u>** • For windrow composting operations, there shold be 2 full time supervisor, 4 helpers permanently stationed at windrow composting site. **<u>Training</u>** Training for supervisors and helpers.	Windrow composting= Assuming 60% of total waste generated is wet waste Total waste to be treated is= 9.6 MT Capital cost = Rs.0.3- 0.4 Crore
Goal		100% treatment of Bio-medical and domestic sanitary waste.	
Actions	**Short term (within 2 years)**	**<u>Technical</u>** • Construction of incinaration facility to treat biomedical and sanitary waste. Exisiting SWM facility such as the Maila Kadam can be used to locate the plants. **<u>Financial</u>** • To be constructed on BOOT mode. • O & M cost to be recovered from hospitals and clinics depending upon no. of beds.	Bio medical waste treatment plant= Rs. 40 Lakhs per tonne
Goal		➢ To achieve 100 % scientific disposal of inert waste by 2020.	
Actions	**Short term (within 2 years)**	**<u>Technical</u>** • Construction of construction of scientific landfill. **<u>Operational</u>** • For operations, there shold be 1 full time technical person, 2 supervisors, 4 helpers permanently	

		stationed at sanitary landfill site. **Financial** • SBM, 14th Finance Commission Grants, State Government Grants. **Training** • Training for supervisors and helpers.	

5 MT Treatment plant

Following are 3 technological options for treatment of 5 MT of waste to be installed at bulk waste generators, to achieve treatment of waste at source:

Table 21 Treatment Options for 5MT Solid Waste Treatment Plant

Technology options	Cost assumption	CapEx	OpEx	Odour issues	Space required
Biogas digestor	Rs.15-16 Lakhs per tonne	Rs.15-16 Lakhs (1 tonne) Rs.45-48 Lakhs (3 tonne) Rs.75-80 Lakhs (5 tonne)	O & M operations to be outsourced.	Low	9 sq.mt for 1-5 MT (System can be also buried under ground in places of space constraints.)
Onsite composting (windrow)	Rs.3-4 lakhs per tonne	Rs.3-4 Lakhs (1 tonne) Rs.9-12 Lakhs (3 tonne) Rs.15-20 Lakhs (5 tonne)	Less than Rs.2 per kg	High	6- 10 sq.mt for 1 – 5 MT (depends on height of the windrow)
Onsite Composting (Vermicomposting)	Rs.5 lakhs per tonne	Rs.5 Lakhs (1 tonne) Rs.15 Lakhs (3 tonne) Rs.25 Lakhs (5 tonne)	Less than Rs.2 per kg	Medium	5 Sq.mt(1 tonne) 15 sq.mt (3 tonne) 25 sq.mt (5 tonne)

- The above costs are calculated for a prototype facility of 1 tonne, 3 tonne and 5 tonne capacities for one bulk waste generator like vegetable market, Hotels, Hostels etc.
- Technology option should be selected based on space availability, odour issues and availability of funds.
- Advantages of biogas over windrow and vermicomposting is low space requirements, low odour issues and biogas generated can be converted into electricity and used for lighting of market premises and for cooking in case of bulk generators like hotels, hostels and restaurants.
- Total cost of installation of below 5 MT treatment plants should be calculated depending upon type of technology selected and number of bulk waste generators at which these facilities will be installed.

Table 22: Investment Plan for SWM interventions

Proposed Work	Cost assumption	Amount (CapEx)	Amount (OpEx)
Carrying out Prefeasibity study, waste compostion study, and a preparation of holistic solid waste management DPR		7.5 Lakhs	
Biogas digestor	Rs.15-16 Lakhs per tonne	Rs.15-16 Lakh (1 tonne) Rs.45-48 Lakh (3 tonne) Rs.75-80 Lakh (5 tonne)	O & M operations to be outsourced.
Onsite composting (windrow)=	Rs.3-4 lakhs per tonne	Rs.3-4 Lakhs (1 tonne) Rs.9-12 Lakh (3 tonne) Rs.15-20 Lakh (5 tonne)	Less than Rs.2 per kg[24]
Onsite Composting (Vermicomposting)	Rs.5 lakhs per tonne	Rs.5 Lakhs (1 tonne) Rs.15 Lakhs (3 tonne) Rs.25 Lakhs (5 tonne)	Less than Rs.2 per kg[25]
Organic waste converter machine		Rs.4- 5 lakhs (per unit)	Rs.0.1 lakhs per year
Material Recovery Facility (6 MT dry waste)		Rs. 30-40 Lakhs	O & M cost to be borne by private agencies
Windrow composting (9.6 MT wet waste)	Rs.3-4 lakhs per tonne	Rs.0.3-0.4 Crore	Less than Rs.2 per kg
Bio medical waste treatment plant	Rs.40 lakhs per tonne	To be calculated as per requirements.	O & M cost to be borne by private agencies

4.5.6 Contractual amendments to solid waste service contracts for incorporating advantages of micro-pocketing planning approach in the collection and conveyance process

1. **Outsourcing of work as opposed to outsourcing of labourers**: This implies that the contract with private agencies for collection and conveyance of solid waste should be based on the work that needs to be done. The supervision and management of the labourers should be with the private agency and not the

[24] Amount may change according to place.
[25] Amount may change according to place.

municipality. The municipality would be monitoring and evaluating only the work under taken.

2. **Different the pockets for solid-waste collection based on area wise and not on activities i.e. collection of waste, street sweeping and drain cleaning.** Refer to 7.3 for the detailed micro-pocket plan

3. **Incentivizing segregation process** – Building an incentive structure in the contract for waste collectors to advocate and push for more segregation at the HH level
4. **Waste collector has to double up as advocates for segregation in their respective micro-pockets**. For this appropriate capacity building has to done to enable this.

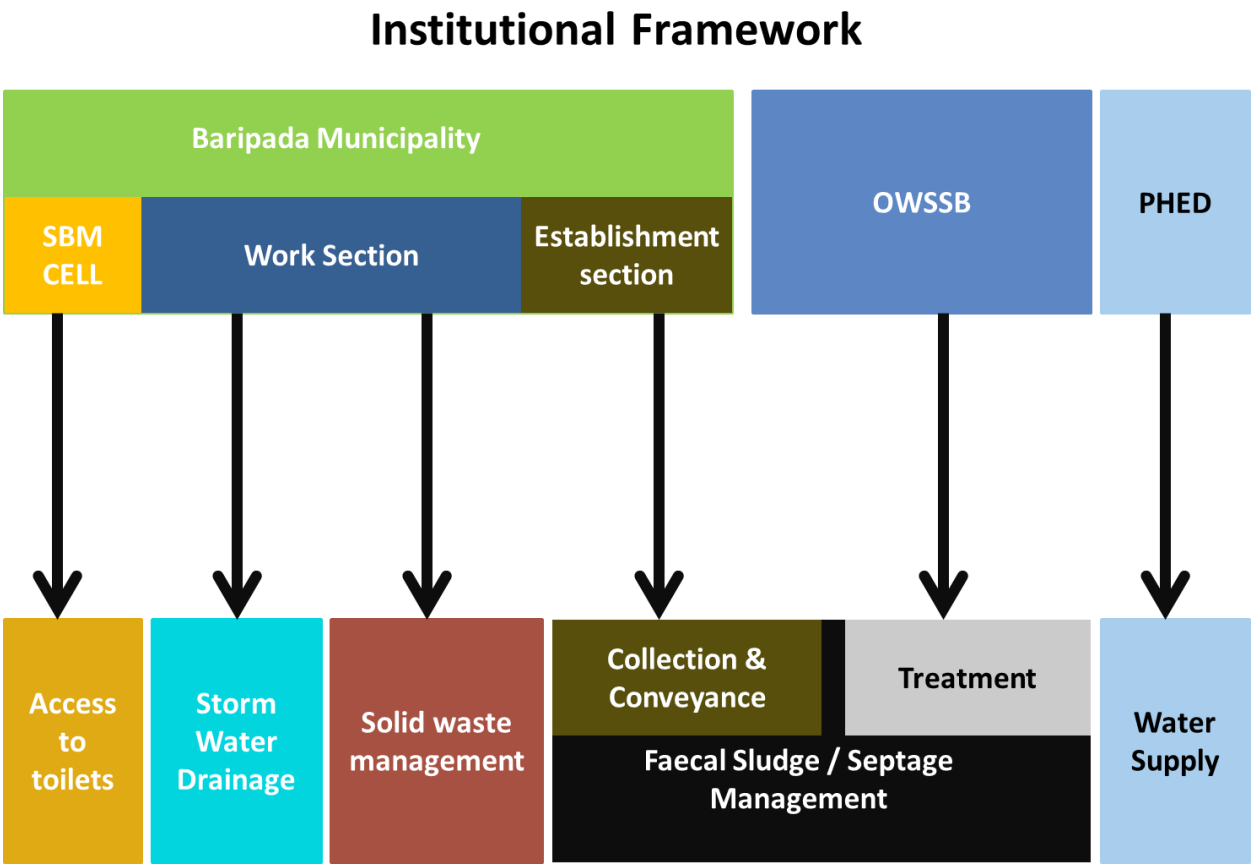
5

Institutional & Financial Capacity

5 INSTITUTIONAL & FINANCIAL CAPACITY GAPS

5.1 Institutional Framework

The institutional framework for sanitation sectors in Baripada is illustrated below:



Source: Baripada City Sanitation Plan (2012)

Baripada Municipality handles toilet construction (IHHL, CTs and PTs) through the SBM Cell. Solid waste management and storm water drainage is handled by Work Section of the municipality.
The Establishment section is managing the operations of the cesspool vehicles maintained by the Baripada Municipality.

Orissa Water Supply and Sewerage Board (OWSSB) is currently handling the treatment of faecal sludge since the construction of the Faecal Sludge/Septage Treatment Plant (FSTP/ SeTP) is with them.

Public Health Engineering Department is responsible for water supply (construction of sewer network and water treatment plants; managing household connections to the water supply; and connections to public stand posts).

5.2 Capacity Assessment

There are 223 establishment positions in Baripada, out of which 101 positions are vacant, which accounts for 45.29% of the positions. In sanitation related positions, there are 1 health officer, 3 sanitary inspectors and 7 sanitary supervisors. Currently there are 49 sanitation workers of the Municipality and 178 outsourced sanitation workers in the Municipality.

5.2.1 Capacity Building Interventions

5.2.1.1 *Access to Toilets*

Workshop on introduction on hygienic sanitation

The one day workshop would be planned to provide a basic understanding of access to toilets to the officials of the cities. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to current sanitation situation in India
- ✓ Importance of Swachh Bharat Mission and access to toilets
- ✓ Importance of Public health and hygiene
- ✓ Benchmarks
- ✓ Hygienic and unhygienic user interface
- ✓ Types of containment units.
- ✓ Public and community access to sanitation.

Target Group: Commissioners, Municipal Engineers, health officer, public representatives who are involved in provision of sanitation services and improvement in access to sanitation.

Workshop on Training for Toilet Builders on Onsite Sanitation Systems

Masons play a vital role in the overall faecal sludge value chain in construction of toilets and containment systems for the individual users in every city. The success of faecal sludge management in any city relies heavily on its on –site sanitation systems which includes the toilets, septic tanks, pits, etc. To ensure the sustainability of the activities, capacity building of the masons who are responsible for the construction of these facilities is mandatory.

The workshop is planned to create awareness on the significance of toilets in sanitation and its impact on environmental protection, to provide Mason's with technical knowledge and skills on the design and principles of the Onsite Sanitation Systems (OSS) as specified under Swachh Bharat Mission, to familiarise the participants with the construction norms and the specific requirements for construction of OSS Systems and to stress on the importance of O& M of these OSS Systems in order to understand the role played by the elements of the OSS relevant to O&M.

Target Group: Masons working in Baripada who have been building toilets under the Swachh Bharat Mission

5.2.1.2 *Faecal Sludge Management*

Appropriate and adequate management of faecal sludge from on-site containment systems is imperative for the protection of human and environmental health. Through these various capacity building activities, we intend to strengthen the knowledge and skills of the officials working with the various town municipalities on various aspects of Faecal Sludge Management.

We propose various capacity building activities through workshops which would address the current knowledge elements of this rapidly evolving field, and present an integrated solutions approach that includes technology, management and planning. It will focus on the planning and organisation of the entire faecal sludge management service chain, from the collection and transport of sludge and treatment options, to the final end-use or disposal of treated sludge.

In addition to providing fundamentals and an overview of technologies, the workshop will go into details of operational, institutional and financial aspects, and will provide guidance on how to plan a city-level faecal sludge management project with the involvement of all stakeholders.

The objectives of these proposed workshops is to:

- To provide participants with technical and practical knowledge and skills on the concept and principles of design and implementation of FSM in Indian context.
- To enable participants to gain knowledge and skills for systematic planning and implementation of a series of activities for collection, containment, transportation, treatment and safe disposal/reuse in FSM.

3 workshops are proposed as part of capacity building activities and both of them have different target groups and are aimed to achieve the objectives. The details of the workshops are discussed below.

Introduction on FSM

The one day workshop would be planned to provide a basic understanding of FSM to the officials of the cities. Upon completion of the one day workshop the participants will be able to appreciate the need of FSM in their city.

Target Group: Commissioners, Engineers & Planners of the cities who are involved in the management of sanitation infrastructures.

Introductory Workshop & Exposure visit on FSM

The two day workshop is planned to provide customised inputs towards the potential of the FSM activities in the city. The workshop would provide in-depth understanding of the methodology involved in planning FSM for a city and the participants will be able to get first-hand experience about operations of a FSTP.

Target Group: City Commissioners and State level officials who are involved in the planning of sanitation in state and city levels.

Location: Bangalore

Training for cesspool vehicle operators on using of technology integrated with faecal sludge transport and conveyance

A good quality, reliable faecal sludge transport and conveyance systems are required to ensure end-to-end Faecal Sludge Management services are provided by the city. The cesspool vehicle operators play an important role in the faecal sludge management.

The two day workshop is planned to provide overview of the technology integrated with faecal sludge transport and conveyance. The activities are designed in such a way that the cesspool operators get hands on experience with the technology which would strengthen the faecal sludge management. They will be provided with customised inputs towards the potential of the FSM activities in the city and how using the technology will help in addressing the key issues faced. The workshop would provide in-depth understanding of the technology and various aspects of undertaking a business/service in the form of desludging services for Baripada.

Target Group: Cesspool operators working in Baripada who have been handling desludging services and also potential desludging services in order to develop the team.

5.2.1.3 *Solid Waste Management*

Suitable and acceptable solid waste management techniques are necessary for the protection of human and environmental health. Through these various capacity building activities, we intend to strengthen the knowledge and skills of the officials working with the various town municipalities on various aspects of solid waste management right from waste collection to waste treatment and reuse.

We propose various capacity building activities through workshops which would address the current knowledge elements of this rapidly evolving field, and present an integrated solutions approach that includes technology, management and planning. It will focus on the planning and organisation of the entire solid waste management service chain, from the waste collection to waste treatment and reuse options.

Training should be carried out for following groups

1. Public representatives (ward counsellors, corporators, ward members)
2. Engineers, health officers and managers
3. Sanitary supervisors, sanitary inspectors and contractors supervisors
4. PH workers, sweepers and waste collectors
5. Household and commercial waste generators

Workshop on Introduction on Solid waste Management

The one day workshop would be planned to provide a basic understanding of SWM to the officials of the cities. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016
- ✓ Best Practices in SWM
- ✓ SWM System -Implementation STEPS
- ✓ Infrastructure requirements for the short-term and long-term ISWM
- ✓ Benchmarks
- ✓ Ensuring proper records of daily work output
- ✓ Maintaining Cordial Relations with community
- ✓ Maintain complaints and feedback for waste generators.
- ✓ Handling the Workforce (Labour Management – challenges – welfare)

Target Group: Commissioners, Municipal Engineers, health officer, public representatives who are involved in the management of Solid waste infrastructures.

Training for waste collectors on sanitation and public health awareness.

The one day workshop would be planned to provide a basic understanding of SWM to the solid waste collectors. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016
- ✓ Best Practices in SWM
- ✓ Trainings on proper waste collection process.
- ✓ Trainings on micro pocketing, steps to increase efficiency of waste collection.
- ✓ Training on handling different types of wastes.

Target group- Sanitary supervisors, sanitary inspectors, contractor's supervisors, PH workers, sweepers and waste collectors responsible for collection and transportation of waste.

Training for waste generators on sanitation and public health awareness.

The one day workshop would be planned to provide a basic understanding of SWM to the solid waste generators i.e. general public and commercial establishment owners. Workshop should me aimed to complete following training modules:-

- ✓ Introduction to SWM in India
- ✓ Importance of SWM Rules 2016
- ✓ Best Practices in SWM
- ✓ Awareness creation about solid waste management and public health.
- ✓ Trainings on process of segregation of waste, storage of waste and handing over of waste to waste collectors in prescribed manner.

- ✓ Trainings of household treatment of waste eg. Composting, biogas etc.

Target group- General public, commercial establishment owners, and bulk waste generators.

5.3 Financial Capacity

This section provides a measure of the financial capacity of Baripada to maintain the new infrastructure built in Baripada. In maintaining new facilities like Public Toilets, and operating a city FSM, or water supply related activities such as increasing metering or the number of connections, the MC would have to undertake the operating expenses related to running these infrastructures, and so the existing gap in the water supply and sanitation budget is bound to increase. As such, the new interventions are proposed to make the MC as self-sufficient as possible.

The income and expenditure patterns under sanitation have been calculated for Baripada Municipality by analysing the revised budgets for the years of 2014-15, 2014-15 and 2015-16 respectively[26]. The revenue and grant budgets have been taken into consideration for the budget assessment. It has been observed that Baripada registers a **surplus** of about 84.56% in 2013-14, 7.89% in 2014-15 and 18.96% in 2015-16.

In Baripada, provision of water supply is the responsibility of the Public Health Engineer Organisation (PHEO), who handles the construction of the water supply related infrastructure, and is also responsible for the provision of connections and collection of revenue from the consumers. Storm water drainage is the responsibility of the Drainage Department of the Municipality. Execution of sewerage projects are the responsibility of the OWSSB. However, maintenance of existing sewerage projects is the responsibility of the Municipality. Solid waste management is the responsibility of the Municipality.

Table 23 and Table 24 show the details of income and expenditure for all the sectors of water supply and sanitation for Baripada Municipality. These includes the components of water supply, storm water drainage, wastewater and septage, and solid waste management. Budget heads which clearly specify investments or expenditure in the above sections have been taken into consideration.

In Income Heads and Percentage for Water supply and Sanitation **(all figures in INR)**, it can be observed that grants for renovation of dying water bodies form the major income component from water supply and sanitation for 2014-15, while income from water taxes form the major component under 2014-15. For 2015-16, it has been observed that grants for SBM forms the major income component under water supply and sanitation.

Table 23: Income Heads and Percentage for Water supply and Sanitation (all figures in INR)

Income Heads for Water supply and Drainage	2013-14	2014-15	2015-16
Septic tank cleaning charges	3,38,124 *(6.82%)*	93,790 *(27.93%)*	10,74,014 *(4.91%)*

[26] Source: Assessment of the Municipal Budgets for MC Baripada (2013-14, 2014-15 and 2015-16))

Conservancy/ Latrine Tax	55 *(0.001%)*	-	776.40 *(0.004%)*
Water Tax Receivable	6,20,997 *(12.52%)*	2,41,985 *(72.07%)*	8,69,938 *(3.98%)*
Grant for Renovation of Dying Water Bodies	40,00,000 *(80.66%)*	-	80,459 *(0.37%)*
Sewerage/ Drainage Tax	-	-	1,372 *(0.01%)*
Pay and Use Toilets	-	-	3,000 *(0.01%)*
Sale of water by water tankers	-	-	2,000 *(0.01%)*
JnNURM Piped water supply	-	-	20,00,000 *(9.14%)*
Grant for SBM	-	-	1,50,73,841 *(68.91%)*
Grant for Construction of Public Toilets	-	-	27,70,200 *(12.66%)*
Total Income	**49,59,176**	**3,35,775**	**2,18,75,600.40**

Source: Assessment of the Municipal Budgets for Baripada Municipality (2013-14, 2014-15, 2015-16)

In Expenditure Heads and Percentage for Water supply and Sanitation- Baripada Municipality (all figures in INR), it can be observed that capital work expenditure on sewerage and drainage form the major expenditure component for water supply and sanitation for 2014-15. Expenditure on grants from SWM form the major expenditure component in 2015-16.

Table 24: Expenditure Heads and Percentage for Water supply and Sanitation- Baripada Municipality (all figures in INR)

Expenditure Heads for Water Supply and Drainage	2013-14	2014-15	2015-16
Underground Drains	-	15,01,523 *(27.59%)*	-
CWIP- Sewerage and Drainage	-	38,46,139 *(70.67%)*	-
Grant- SWD Project	-	94,983 *(1.75%)*	-
Grant for SWM- State Grant	**-**	-	2,00,000 *(100%)*
Total Expenditure	**-**	**54,42,645**	**2,00,000**

Source: Assessment of the Municipal Budgets for Baripada Municipality (2013-14, 2014-15, 2015-16)

The Baripada Municipality budget calculates revenue and capital budget accounts. The revenue income budget has heads on taxes and fees, rent, own source income. The developmental income budget includes SFC and grants awarded to the municipality. The revenue expenditure budget has heads on own income expenditure, delegated functions, maintenance/repair / depreciation of assets and other expenditure heads. The developmental expenditure budget has expenditure from the SFC and grants awarded. As observed from the above tables, there is a high disparity between the surplus and deficit figures for Baripada. This can be solved by maintaining different budget heads for all sectors under water supply and sanitation, including solid waste management. Different organisations such as PHEO and OWSSB who are responsible in water supply and sanitation should also be involved to bring about a joint budget account for easy assessment of revenue and expenditure in each of their accounts.

The following table provides a comparison of the income in the municipal budget for the various components of sanitation, and the total SAAP amount planned for the year 2015-16. Depending on this budget, the various options given in the earlier sections of the report would be finalised. The municipal income figures of 2015-16 have been used for the assessment.

Table 25: Comparison of Municipal Income across sectors

Sector	Income in Municipal Budget
Access to Toilets	Rs 2,18,75,600
Storm water management	
Wastewater management	
Solid waste management	

Source: Assessment of the municipal budgets of Baripada

In the above table, the municipal budget of 2015-16 shows the total income for all the sanitation sectors as Rs. 2.19 crores. The total allocation under SAAP is Rs. 10.94 crores. Therefore, depending on the discretion of the municipality and suitability of technological options, interventions can be planned for Baripada.

6 Implementation & Rollout Plan

6 IMPLEMENTATION AND ROLL-OUT PLAN

Table 26: Indication of Phases

Phase	Time Period	Characteristics
Short Term	Upto 2 years	Urgent improvements that require some planning steps
Medium Term	3- 5 years	Recommendations with a significant impact; needs more elaborate planning steps and requires substantial funding
Long Term	5- 10 years	Recommendations for the sustainable functioning of the system and adaptation to future developments

Table 27: Phase-wise Implementation of Actions

Phase	Activity
Water Supply	
Short Term	• Implementation of the ongoing projects to improve water supply
Improvements in Toilet Access	
Short Term	• Constructing **3421 IHHL** (as per Swachh City Plan projection) **or 2997 IHHL** (as per exponential projection) by 2019. • Construction of **45 CT seats** (as per Swachh City Plan projection) or **39 CT seats** (as per exponential projection) by 2019. • The cost of construction of one individual toilet connected to septic tank and soak pits. In such cases, regular deluding of the septic tanks need to be done tanks at least once every 2 or 3 years and transported off-site for treatment prior to disposal. Municipal utility or private contractors are required for desludging of septic tanks and to ensure safe disposal of septage at a treatment plant. However the responsibility for O&M of the septic tank itself lies with the owner of the property. • Increase the incentive given to households in order to meet the expenditure incurred in building toilets through other sources of funding. (Refer Fund Mobilisation for IHHL) • **Awareness programs** focussed on the environmental and health issues faced due to open defecation for households and other communities. • Policy measures discouraging individuals to go for open defecation should be formalised- this would include penalties, incentives for construction of individual toilets, and others
Medium Term	• Upgradation of households with public/ community toilets to individual toilets. If funds and conditions are viable, households should be encouraged to construct individual toilets.
Long Term	• Constructing **1135 IHHL** (as per Swachh City Plan projection) **or 114 IHHL** (as per exponential projection) by 2019. • Construction of **9 CT seats** (as per Swachh City Plan projection) or **3 CT seats** (as per exponential projection) by 2019.

Improvements in Stormwater Management	
Short Term	**Waterlogging issues** • **Improving inlets into the existing drains by unclogging inlet pipes; and switching to alternate covering such as mesh cover.** • **Increased coverage of natural drains.** • **Water sensitive urban design using swales and raingardens** (See Diagrammatic representation of roadside swales and rain garden) **Wastewater in drains** • **Stopping the entry of sewage into the storm water drain** • **Maintaining and increasing the number of natural drains** since it would enable the drain ecosystem can then handle small quantities of wastewater
Improvements in Faecal Sludge Management	
Short Term	• **Implementation of standard containment size code regulations** • **Awareness/IEC campaigns on open defecation** and other aspects, training the operators on standard practices and safety measures for collection and conveyance • **Masons training** for building the containment systems • Adhering to **Odisha Urban Septage Management Guidelines, 2016.** • **Monitoring of private and government cesspool vehicles** by mandating **GPS and other ICT** interventions. • **Mandating safety gears** to be given to government operators private operators • Separate account for handling government cesspool vehicles. • Maintain the database of private operators, if they start operations in Baripada. • Mechanisms to fill the form by the customer availing the desludging service which has to be submitted at the MC/during the disposal. • **Licensing the private operators** and periodic renewal • **Capacity building of ULB and operators for handling the SeTP** • **IEC campaign with the cesspool operators** both private and government for behaviour change regarding the disposal • Co-compost plan for enhancing the nutrient value • **Plan for selling the dried and co-composted FS to farmers** and through collaboration chemical fertilisers companies to sell it as a part of their product. • Converting the dried FS into co-compost for enriching the nutrient content • To encourage reuse among the farmers through IEC campaigns • **Treated FS Reuse policy** to be formulated for the city
Medium Term	• **Procure 3-4 Gulpur machines /small cesspool** vehicles where the existing cesspool vehicles cannot access • **Different business models assessment for financial sustainability** of the SeTP. • **Inclusion of property tax as part of making the operations of SeTP sustainable** • **Policy resolution leading to 100% disposal and treatment of the FS generated** • Exploring possibilities of using Black soldier flies usage of solar energy at the SeTP

	• Exploring possibilities to sell for cement industries/ brick factories
Long Term	• **Scheduled desludging should be implemented** by incorporating user fee or property tax incorporation
Improvements in Solid Waste Management	

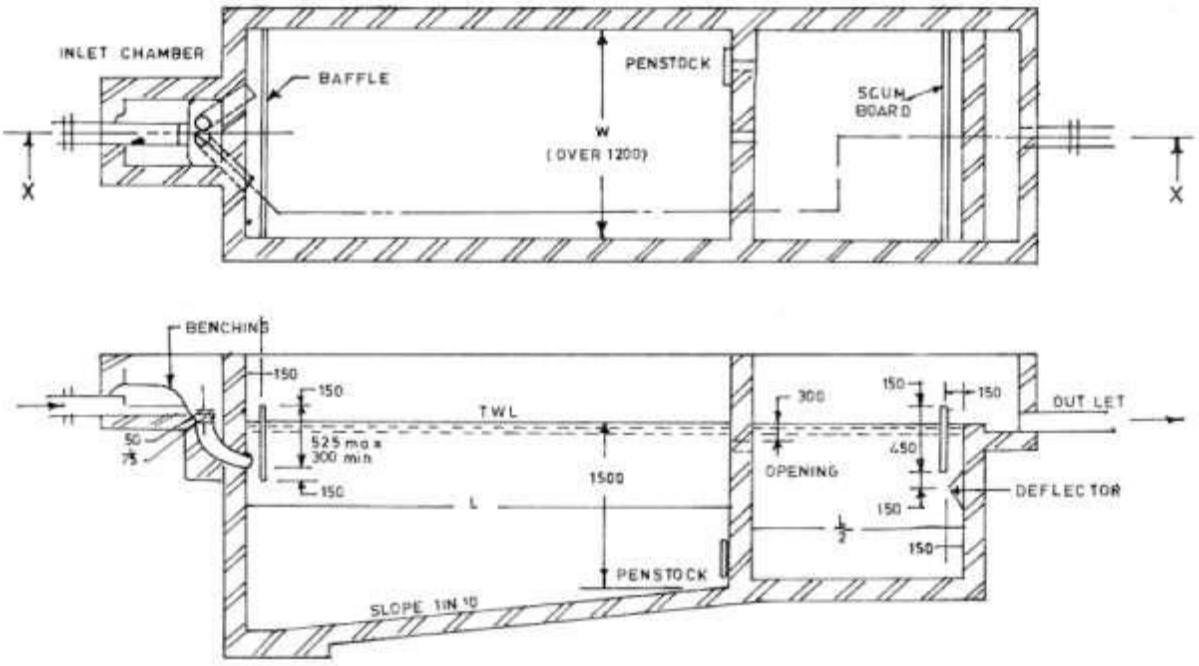
Short Term to medium term	• Implementation of **Micro-pocketing approach** for solid waste collection (Refer to Micro Planning)
	• **Household awareness campaigns about segregation of waste** to be carried out by waste collectors
	• Policy amendments for provision of incentives in the form of property tax rebates or rebate on solid waste collection charges under polluters pay principle.
	• Carry out waste composition study to know the actual content of wet and dry waste and composition of different materials like, biodegradable, paper, metals, glass etc.
	• **Mandating all bulk waste generators** whose waste characteristics are mainly wet waste eg vegetable market, public parks etc. **to treat waste at source** by means of installation of biogas digester/ onsite composting system/ Organic waste Converter (OWC) machines in the bulk waste generation sites.
	• Identify and Demarcate land parcel for construction of Material Recovery Facility (MRF) for recyclable dry waste, composting for wet waste and C & D waste plant at Balia Panda dumpyard.
	• **Construction of new treatment facilities at city level**:
	  ○ Composting Unit
	  ○ Material Recovery Facility
	  ○ C & D Waste Plant
	  ○ Incineration facility for biomedical waste
	  ○ Scientific landfill for inert waste
	• **Training for solid waste management personnels-** from the gound level worker to the officials implementing the systems.

7 Annexure

7 ANNEXURE

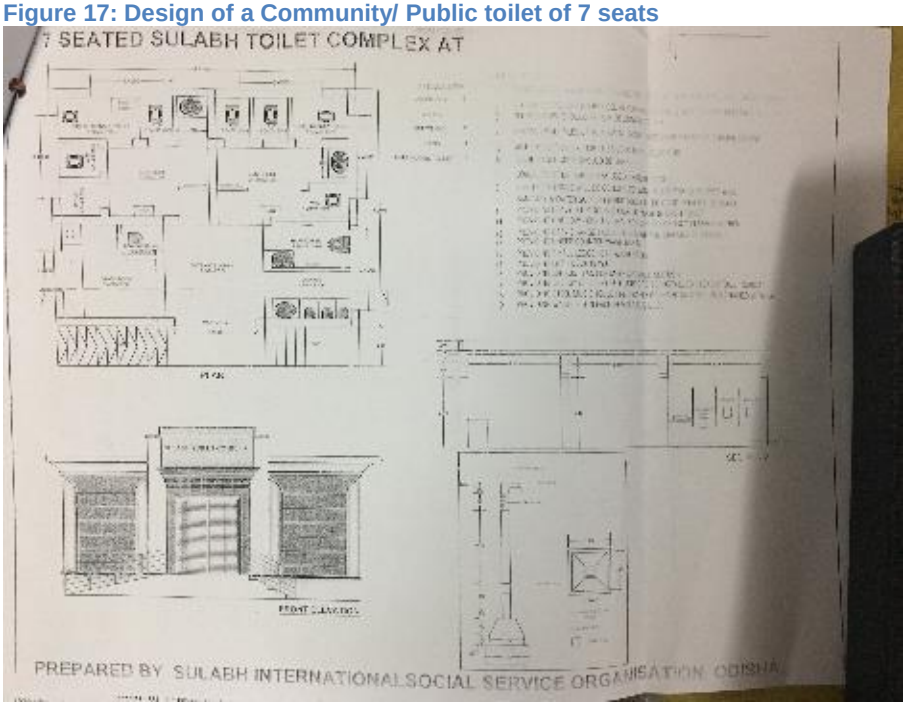
7.1 Toilet Designs

Figure 16: Typical sketch of a two- compartment septic tank for 5 users (dimensions in mm)



Source: Manual on Sewerage and Sewage Treatment Systems, 2013, Part A: Engineering

Figure 17: Design of a Community/ Public toilet of 7 seats



Source: Sulabh International Social Service Organisation, Odisha

7.2 Slum list of Baripada

Table 28 Slum list of Baripada Municipality as per 2011 Census (Slum list of Baripada Municipality, 2017)

SLUM LIST OF BARIPADA MUNICIPALITY AS PER 2011 CENSUS							
Data Received							
Notified Slum							
Sl.No	Name of the Slum	W.No	E.B Tagged	N0. of H.H	Total Population Male	Female	Total
	Belgodia		81	123	266	243	509
1	Tankisahi	1	82	141	305	273	578
2	Chakrasahi	2	27	71	193	169	362
3	Walliganj	3	70	77	174	192	366
4	Babusasi	5	225	225	362	332	694
			165	120	326	303	629
			166-1	139	312	288	600
5	Madhuban	7	166-2	86	197	189	386
	Sankhapata		163	94	173	189	362
6	Saharsahi	8	162	104	556	251	807
7	Madhuban(Ranibag)	9	177	44	86	83	169
	Naharpada		182	181	402	358	760
8	Bhudansahi	11	186	81	185	167	352
	Prafullanager(Dutusahi)		189	143	283	275	558
9	Sunamuhin	12	194	127	266	260	526
			137	79	171	139	310
10	Sripadganj	13	140	108	218	233	451
			103	100	238	221	459
11	Tulasichoura	14	108	102	257	251	508
			54	199	415	449	864
			56	141	317	382	599
			57-1	144	303	295	598
			57-2	95	208	204	412
12	Purnachandrapur	15	60	186	388	384	772
13	Sriramchandrapu (Baghraroad)	16	62	173	359	487	846
	Balarampur		31	110	245	244	489
	Bijayramch.pur		37	85	161	164	325
14		17	38	87	192	186	378
	Jamunadeipur		19	158	399	418	817
	B.R.C/Pur		21	93	221	199	420
15		18	22	168	401	374	775

	Balarampur		43	140	321	303	624
16	P.C.Pur	19	46	130	339	313	652
			145	63	137	116	253
			146-1	162	329	333	662
			146-2	61	123	140	263
	Sungodia	20	147	46	120	118	238
			13	138	316	296	612
18	Bijayramch.Pur	21	15	197	453	425	878
			47	196	486	389	875
			48	123	298	272	570
	Raghunathpur		224	88	208	119	327
			51-1	170	340	307	647
19	Janardanour	22	51-2	114	271	264	535
			114.1	133	296	262	558
			114.2	66	137	141	278
20	Tulasichoura	23	115	52	112	84	196
			134	159	349	354	703
			135	118	281	251	532
21	Kalikapur	24	136	181	383	366	749
	Tadki		208	98	273	226	499
	Chancha		209	89	176	171	347
22	Debendrapur	25	210	144	298	262	560
			1	157	341	334	675
			2	148	315	335	650
23	Bhugudakata	26	3	145	334	305	639
	Moharajpur		121	78	184	207	391
	Debendrapur		125	121	256	243	499
			126	121	293	268	561
24	Takatpur	27	124	82	166	169	335
	Bagdiha		198	34	74	73	147
25	Karatbasa	28	199	59	135	119	254
	TOTAL			7397	16723	15767	32390
Non-Notified							
1	Purunahatsahi	6	154	155	342	351	693
2	Lalbazer	4	96	188	409	411	820
3	Lalbazer	10	102	116	244	217	461
4	Maharaipur	27	122	55	159	217	376
				514	1154	1196	2350

7.3 Solid Waste Management Technology Options

7.3.1 Micro Planning

For efficient handling of the sanitation and solid waste management function, MC Baripada is required to bundle the related activities into three major work units based on the size and work load quantities. Work packages can be classified as follows:-

- Residential Micro Pocket
- Commercial and Bulk Solid Waste Handling
- Mechanical Sweeping of Main Roads

Further all these above packages should include sweeping of streets and cleaning of drains within the package boundary.

Steps involved:

I. Clear demarcation of residential, commercial and main road sweeping pockets for carrying out the sanitation and solid waste management activities
II. Clearly defining of job responsibilities and key performance indicators for the service providers
III. Making realistic estimates of resource requirements in rationalized and standardized manner (manpower, transportation vehicles, tools, implements and conservancy materials)
IV. Develop clear resource inputs and results-outputs correlations to achieve standard service delivery results across the ULBs in a uniform manner.
V. Identifying and developing clear wok quantities, key performance indicators and performance monitoring mechanisms, in the event of outsourcing complete work packages to private agencies

Strategies for handling work packages:

1. Residential micro package

A household is defined as a domestic living accommodation of any type such as: a) any type of a dwelling structure; b) a slum house; c) a multi-floor housing complex of not more than 20 units and also small shops and petty commercial units situated in residential areas. For solid waste collection purpose, each of these households will be counted as one unit. Single residential micro package should consist of a continuous area with 300- 350 of waste generating units.

Residential micro packaging include:-

i. Collection of source segregated solid waste (wet, dry and hazardous waste separately) at the gates / doors of the households, shops, vendors and public places - Daily
ii. Manual sweeping of streets, footpaths, pavements and open spaces and removal of any litter in these areas, and removal of animal carcasses - Daily
iii. Cleaning of and removal of garbage, litter, silt or blocks from the street side shallow surface drains – Daily
iv. Sweeping of main and arterial roads and all the abutting road surfaces, foot paths and

paved areas – Daily

v. Sweeping and Litter Collection in Parking Lots, Foot Over Bridges, Bus Shelters, Sub Ways, Traffic Islands, and any other structure abutting the main roads – Daily
vi. Cleaning of Shallow Surface and Storm Water Drains (other than underground sewerage drains)
vii. Observe the places of water logging and water stagnation and clear the clogging garbage and silt for ensuing free flow of water.
viii. Disinfectant spraying, shrubs cutting, removing earthen heaps and or any other vector control activities as specified by the ULB.
ix. Transfer of the collected waste from all the above activities to the points of designated locations such as Transfer Stations, Compost or Material Recovery Yard, Landfill Facility - Daily

2. Commercial and bulk waste handling package

A Bulk Waste Generating Unit is an independent building structure or a building complex which houses a Commercial or Institutional unit(s); a high rise building or a gated community of more than 20 units used for either residential, commercial or mixed purposes. For example, any entity such as a restaurant, bank, chit fund office, educational institution, government or private office, religious place, hostel, hotel, training institute, function hall etc., which generate waste in bulk volumes can be classified as a bulk waste generating source. A group of more than 20 dwelling units located in the same complex used for either residential or commercial purpose will also be classified as a bulk waste generator.

For enumerating bulk waste generating units, each gate at which the waste can be handed over to the waste collector should be considered as one unit. Bulk waste will be collected at the gates of the buildings. It is the responsibility of the building owner on whom the property is registered, to arrange for handing over the waste at the gate of the building to the waste collector. Roadside vending units are to be considered as bulk waste generators and to be enumerated in the respective roads and streets in which they are located. Mobile vending carts are also to be enumerated in the respective streets / roads in which they normally cart for maximum time.

Depending on the size of the commercial activities and the physical spread of these commercial and institutional establishments in the ULB, a ULB can have more than one Commercial bulk waste zone.

3. Mechanized road sweeping

Based on the conditions of the roads and the financial capacity of the MC to bear the costs, specific road stretches can be swept by mechanical sweeping. MC Baripada shall deploy power driven mechanical sweeping machines for specific stretches

Outsourcing work packages:

Instead of taking workers on contract basis for deployment in Solid waste collection activities, MC Baripada is required to shift to a system of outsourcing complete work packages to any

registered legal entity/ society / contractor / agency that are covered by income tax and other statutory regulations. The system of outsourcing complete work packages is meant for getting the following benefits to the MC as measurable operational results such as better delivery of services; compliance to MSW rules & NGT directives; availing better technology, management methods and capital through private, social sector & CSR participation and overall positive impact on the living environment by mitigating pollution and environmental hazards.

Outsourcing of residential Micro Pocket Work Packages:

For outsourcing micro pocket Work Packages, MC is required to adopt the following steps.

I. The available permanent PH workers on the rolls of the MC are to be fully allocated for all micro pocket management activities in the wards that are identified as high density low public movement and low density low public movement areas. They should be allocated for the activities such as micro pocket management – (Gate-to-gate solid waste collection, street sweeping, litter collection, drains cleaning, disinfectant spraying, vector control, removal of weeds and unwanted vegetative growth, berms cutting, removal of animal carcasses from residential areas and the main and arterial roads that are part of the micro pocket.), as loaders for secondary transportation and gang Work
II. The remaining micro pockets and the respective wards should be earmarked for outsourcing. The micro pockets that are earmarked for outsourcing are to be bundled into 2-3 work packages, covering the rest of the MC area other than those micro pockets and wards that are identified for services by the MC permanent staff. As an illustration, each work package for outsourcing may contain 80-100 micro pockets. However, MC can decide on the number of micro pocket work packages that can be outsourced, not exceeding three.

Outsourcing of Commercial, Institutional and Bulk Solid Waste and C&D Collection and Transportation

I. Commercial, institutional and bulk solid waste collection and transportation activity shall be outsourced as a complete work package.
II. MC shall suitably make the RFP, following the model RFP and shall procure the services of a competent bidder.
III. Based on the size and spread of the commercial activities in the MC, the required number of packages can be worked out. Municipal Corporations and larger Special Grade ULBs may have 2-3 Commercial and Bulk Waste Wok Packages, whereas other smaller ULBs may have one work package for commercial, institutional and bulk waste collection and transportation. For deciding upon the work packages, MC shall consider the financial viability on the part of the MC to outsource this activity as a permanent arrangement.
IV. As the approximate quantities of C&D waste that need to be lifted and transported to designated places cannot be determined based on some norms, lifting of this component is to be outsourced to the successful contractors as an additional work on rate contract basis. As and when the C&D wastes are to be lifted, the MC will notify the contractors and make payments separately according to the work executed by them. To this effect, MC shall set up a process to enable citizens to approach MC for service at a quantity based fixed rate. The citizen can make the specified amount through a challan and this

amount will be transferred to the contractor after completing the lifting.

Outsourcing Mechanical Sweeping

Mechanical Sweeping of the select road stretches based on the road conditions (well paved longer roads) can be outsourced as a complete work package.

MC can follow the decision matrix as given in the following table:-

Table 29: Decision Making Matrix for Outsourcing of Work

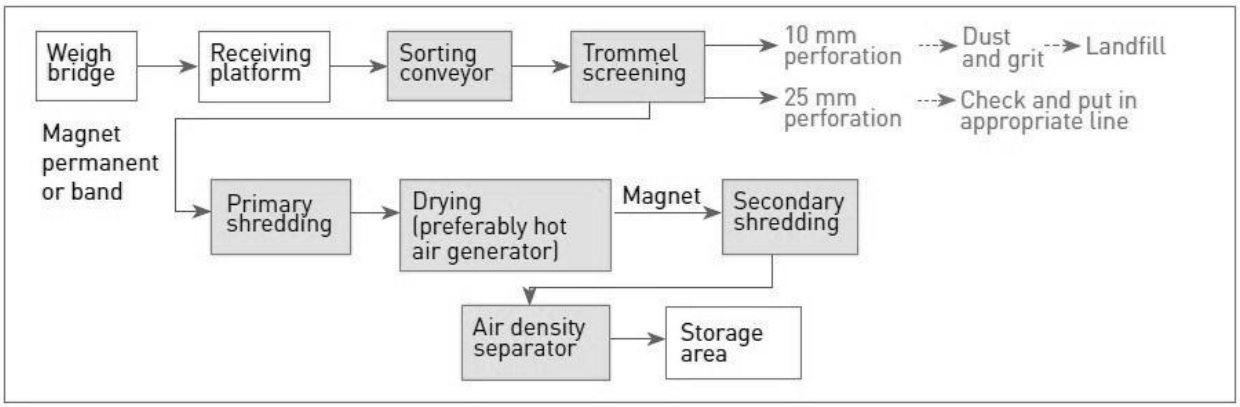
Residential Area and Main Roads Sanitation, Solid Waste Collection and Drains Cleaning	Commercial and Bulk Waste Collection and Transportation	Mechanical Sweeping
1. Adjust all the available permanent workers to as many micro pockets as possible 2. Outsource the remaining micro pockets	Outsource	Outsource
- In case, where outsourcing the works as independent work packages is not possible, create one package for outsourcing after adjusting the existing permanent workers to as many micro pockets as possible. - Where Mechanical Sweeping is not feasible, this package need not be considered as the sweeping and litter collection in the major road areas will be carried out by the respective micro pocket workers		

- MC should issue separate government orders / guidelines for levy of user fee in the form of SWM Cess.
- MC is required to identify suitable locations for depositing the collected waste from the processes as detailed above by the contractors / MC sanitation workers teams.
- Ongoing monitoring of the field activities that are carried out by the MC staff and the outsourced agencies by the senior officials of MC under the management and supervisory guidance of the Commissioner is an important component.
- Municipal Commissioners are required to ensure implementation of the guidelines issued for micro planning, micro pocket management, bulk waste handling, street sweeping etc., without fail.
- Penalties will be levied on the citizens / repeat violators, if they
  - Fail to handover waste, despite the visit of the service provider Fail to handover waste in segregated manner
  - Resort to public littering.
- Municipality should conduct training and capacity building for responsible personnel and agencies for solid waste management. Community IEC should also be conducted on regular basis.

7.3.2 Solid Waste Treatment Options

Material Recovery Facility

Figure 18: Indicative Material Recovery Facility and Pre-sorting Facility dedicated to Dry waste



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Salient features of Material Recovery Facility

- Depending on the scale of operations and the level of mechanisation in the facility, MRFs may be classified as manual or mechanised.
- Usually small- scale units, manual MRFs largely employ manual sorting practices and are typically owned, managed, and operated by the informal sector.
- Mechanised MRFs are large facilities with sophisticated systems and equipment that enable efficient separation of large quantity of material into different fractions.
- Segregated dry material is received in a mixed form consisting of a combination of fibres (paper, card board, mixed paper, magazines, etc.) and commingled containers (plastic, glass, metal, etc.), among other materials.
- The first stage of processing typically uses manual labour or equipment that separate material into various streams (fibre, paper, plastic, containers, etc.).
- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Different process or stages and equipment employed in material recovery facility are shown in table below.

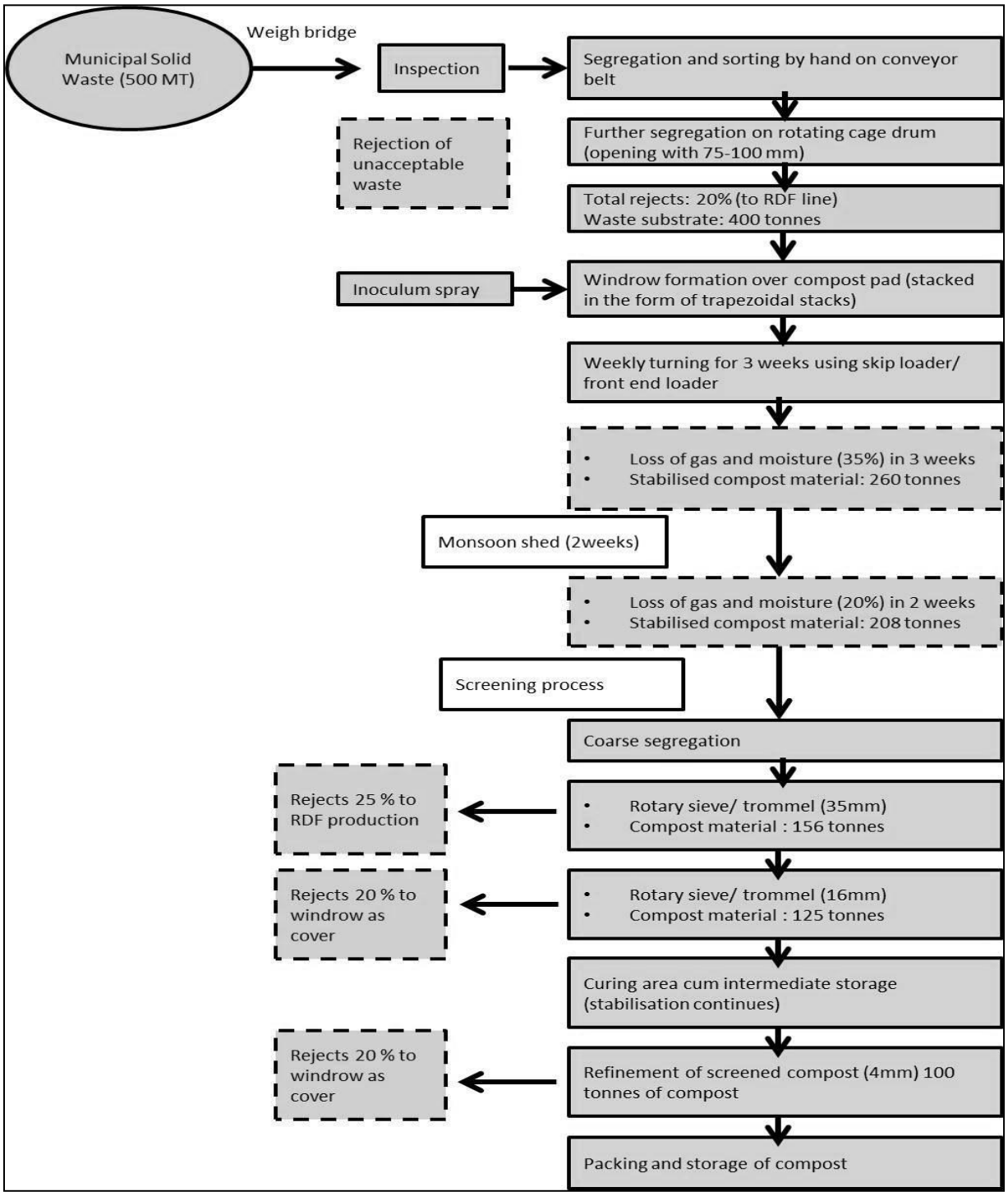
Table 30 Stages of Material Recovery Facility

PROCESS OR STAGES	EQUIPMENT
Pre-sorting material handling equipment	• Belt conveyor • Screw conveyor • Apron conveyor • Bucket elevator • Drag conveyor • Pneumatic conveyor • Vibrating conveyor
Ferrous metal separation	• Magnetic separator and screening
Screening	• Disc Screening • Trommels
Air classification	• Horizontal air classifier • Vibrating inclined air classifier • Inclined air classifier
Non-ferrous metal separation	• Rotating disk separator • Eddy current separator
Size reduction	• Can densifier • Can flattener • Glass crusher • Plastic granulator • Plastic perforator
Pollution control	• Dust collection system • Noise suppression devices • Odour control system • Heating, ventilating, and air conditioning (hvac)
Other fixed equipment	• Fixed storage bin • Live-bottom storage bin • Floor scale for pallet or bin loads • Truck scale • Belt scale

Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Windrow Composting

Figure 19" Process Flowchart and mass balance for anaerobic windrow composting of 500 MT per day of waste of waste



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

Salient Features of Windrow Composting: -

- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Composting in coastal/high rain- fall areas should have a shed to prevent waste from becoming excessively wet and thereby to control leachate generation.
- Land requirement: - For 300 TPD of segregated/pre-sorted MSW: 5 ha of land including buffer zone is required.
- Upto 500MT of waste can be managed by a single facility.
- High requirement of segregation prior to technology
- If only composting is done the about 30% of rejects including inert materials are obtained. If RDF facility is located in same plant then percentage of rejects can be reduced to 15%.
- Capital cost comes up to 15-20Cr for a 500 TPD plant i.e. around 3-4 lakhs per tonne.
- Quality of compost should be compliant with FCO 2013. It has a good market potential.
- Windrow composting is labour intensive. It required technically qualified and experienced and semi-skilled staff.
- Atmospheric pollution is low. Only odour issues.
- In high rainfall areas, the windrow need to be covered either temporarily or permanently to control leachate generation. However, the design of the shed should be such that good natural ventilation is maintained.
- Fire and safety issues should be taken care of.[27]

Vermi Composting

- Vermicomposting is the process of composting the biodegradable fraction of MSW with the help of earthworms, resulting in the production of vermicompost which can be used in agricultural fields as a soil conditioner and nutrient supplier.
- Vermicomposting draws better market price as compared with compost and, in addition, sale of worms can bring in additional revenue.
- Vermicomposting is typically suited for managing smaller waste quantities.
- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW

[27] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Composting in coastal/high rainfall areas should have a shed to prevent waste from becoming excessively wet and thereby to control leachate generation.
- Land Requirement: - For 20 TPD of segregated/pre-sorted: 1.25 ha.
- 1 TPD – 20 TPD quantity of waste can be managed in single facility. Higher capacities can be also planned but then the land requirements become very high.
- Very high requirement of segregation prior to technology
- 30% of the rejects including inert materials are rejected.
- Capital cost comes up to 1Cr per 20 TPD plant i.e. around 5 lakhs per tonne.
- By-product has Good market potential in urban and rural areas.
- Vermi-composting is labour intensive. It required technically qualified and experienced and semi-skilled staff.
- Very low leachate problems.[28]
- Following are some vermin-compost problems, possible causes and solutions.

Table 31 Problems and solutions for vermicomposting

PROBLEMS	POSSIBLE CAUSES	SOLUTIONS
Foul odour	Overfeeding	Remove the excess food, remove meat or dairy products if any
	Not enough air circulation or anaerobic conditions	Fluff up or loosen bedding
	Bed too wet	Add bedding to absorb moisture
Flies	Waste exposed	Bury the waste completely
Ant infestation		Immerse the base or feet of the vermi bed in water
		A barrier of chalk or petroleum jelly may repel the ants
		If bedding seems dry, add water
Mite infestation		Avoid adding foods with high moisture content
Worms are dying or crawling away	Bed too wet	Do not water till it reaches appropriate moisture
	Bed too dry	Sprinkle water till it turns moist
	Excess temperature, not enough air, not enough food	Sprinkle water till it turns moist and temperature drops, add waste appropriately
	Bed packed tightly	Turn bed and make it fluffy

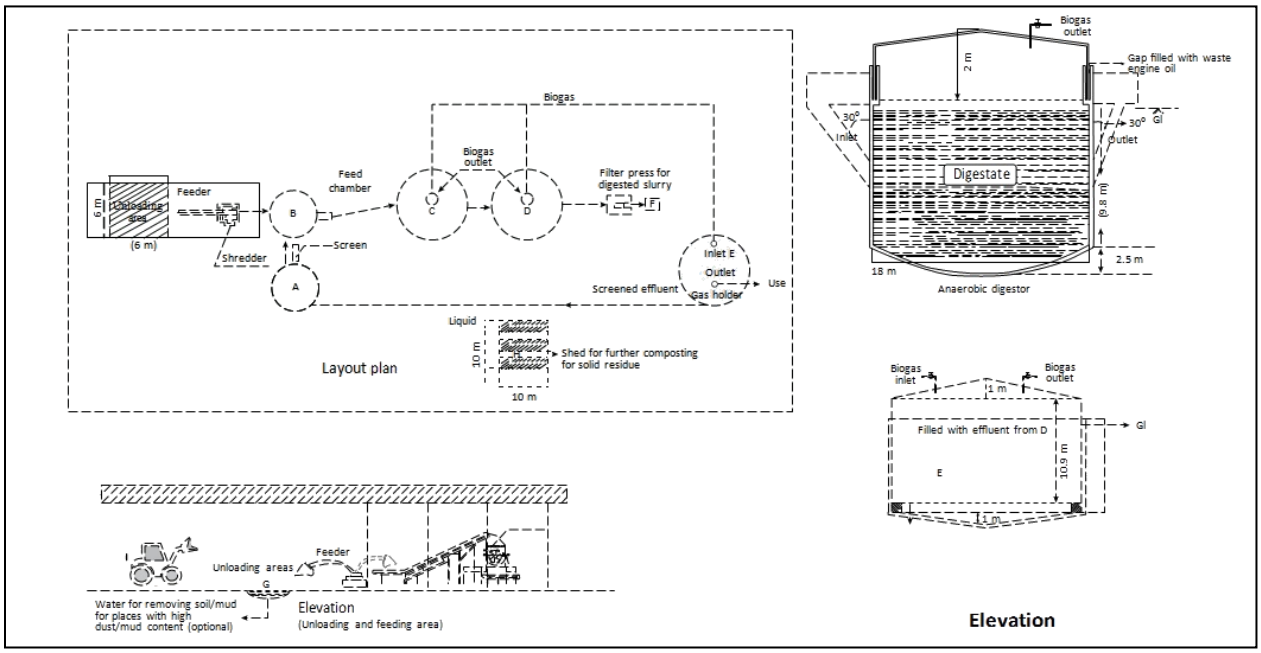
Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

[28] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

Bio- Methanation

- Land Requirements:
  - 500 m for facilities dealing with 100 TPD or more of MSW
  - 400 m for facilities dealing with 75–100 TPD of MSW
  - 300 m for facilities dealing with 50–75 TPD of MSW
  - 200 m for facilities dealing with 10–50 TPD of MSW
  - No buffer zone for facilities dealing up to 5 TPD of MSW
  - No buffer zone for decentralised plants handling less than 1 TPD of MSW (but adequate environmental controls are required)
- Land Requirement: - For 300 TPD of segregated/pre-sorted: 2.5 ha.
- 1 TPD can be managed at small scale 500 TPD can be managed at larger scale.
- Very high requirement of segregation prior to technology
- 30% of the rejects from mixed waste are rejected.
- There is a potential for direct energy recovery
- Capital cost comes up to 75-80Cr for 500 TPD plant i.e. around 15-16 lakhs per tonne.
- Biogas generated can be used for generation of electricity which can be used for illumination of market premises and other bulk wet waste generators which supply raw materials for the plant
- Biomethanation is less labour intensive which require only technically qualified and experienced staff.
- Leakage of biogas and fire and safety issues to be taken care of. [29]
- General plan and elevation for 50 TPD is shown below, however it is only for illustration purpose and will change according to quantity and type of waste.

Figure 20: Biomethanation plant for 50 TPD of waste



Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume II, Government of India.

[29] Source: Swachha Bharat Mission (2016) Municipal Solid Waste Manual, Volume I, Government of India.

7.4 Reuse Options for FSM

Co-composting Technologies

Two main types of composting systems are generally distinguished: 1) open systems such as windrows and static piles and 2) closed 'in-vessel' systems. These in- vessel or 'reactor' systems can be static or movable closed structures where aeration and moisture are controlled by mechanical means. Such systems usually require an external energy supply, either by electricity or through decentralized electricity generators, whereas the latter is often provided by diesel engines. In general, in vessel or reactor systems require higher investment compared with static systems and are also more expensive to operate and maintain. Static composting systems on the other hand, require much lower investments and are hence the preferred option for composting in developing countries. Among them, windrow composting is the most commonly applied system.

The identification of the best-suited option for composting depends on numerous parameters. The main choices to be made are related to a) scale (household, community, commercial), b) input materials, c) business models (public, private or combined), d) demand and market situation, e) Investment and operation cost, f) technology option and equipment, f) standards and legal framework and g) environmental and health concerns as shown in Figure 5. Decision-making has to be done on a case-by-case basis aiming at the highest possible cost- and co-benefits and sustainability level for the operator, community, stakeholder and the environment.

Different technological options are available to establish a specific composting project, as presented in Table below:

Table 32 Composting Technologies - their advantages and disadvantages

Key Features	Advantages	Disadvantages
Static Pile		
Static piles are the simplest form of composting Typically larger than heap size whereas heaps are usually not turned Generally ideal for feedstock with larger particle size and higher porosity	Requires minimal management and equipment Aerobic conditions can be achieved if the porosity in the initial pile is high (>60%) and if there is a high proportion of bulking materials to keep pores open for air exchange	While simple, this method takes longer to produce matured compost; the final product is often quite heterogeneous due to the lack of mechanical treatment and physical breakdown of feedstock during the process. Anaerobic conditions can occur in the core of the heap which can also result in odor emissions
Trench and Pit composting		
Characterized by heaps which are partly or fully contained under the soil surface Structuring the heap with bulky material or turning is usually the	Requires low capital investment Requires less moisture, thus suitable for dry areas	Control of leaching is difficult in trench or pit composting Monitoring the composting process is difficult The process is labor-intense,

choice for best aeration In some cases, composting materials are completely buried in the trench which then serves as a planting bed		especially digging of the pit and emptying it
Aerated static pile/heap		
Aerated static pile (ASP) composting is comprised of forcing (positive) or pulling (negative) air through the pile. In a static aerated pile, a 15-30 cm thick layer of finished compost or wood chips is placed all around the MSW pile to provide insulation. This arrangement minimizes odor generation and also leads to uniform sustained heating of waste leading to destruction of plant pathogens and weed seeds The ASP can be used together with other composting technologies at the curing stage	The land requirements for this method are lower than that of windrow composting The technology allows for capturing and treating air to reduce odor generation Large volumes of feedstock can be treated with the help of aeration systems	The primary disadvantage of using this technology is the lack of mechanical agitation, which slows down physical breakdown of materials Usually suitable for feedstock of similar consistency and homogeneity The compost pile/heap can dry out quickly and therefore requires regular monitoring The aeration system may require capita-intensive installations
Windrow composting		
The material is piled up in heaps or elongated heaps (called windrows) Suitable for outdoor composting in piles that rely on passive, manual or mechanical aeration Some portions of waste piled up in the windrows may not be exposed sufficiently to a temperature of over 55 °C for a period of 7-10 days	Can be low cost Windrow composting produces the highest volume reduction compared to static piling (passively aerated with minimum turning) and forced aeration (static aerated pile) Introducing air mechanically speeds up the composting process and greatly reduces emissions of methane Methane emissions from windrow composting are comparably lower, e.g. passively aerated piles produce higher methane emissions (x100) than windrow turned piles whereas forced aeration piles produced even 1,000 times greater methane emissions	Anaerobic conditions could occur in the core of large piles or windrows, and together with a larger emitting surface, could result in odor generation Such plants often experience resistance from the community where they are set up ƒ Should be sited with consideration of the risk of odor Workers are in close contact with material during composting The minimum windrow/pile size must be 3 m3
In vessel- enclosed composting		
Refers to a group of composting systems, which range from enclosed halls to tunnels and containers, rotary drum or bins	Allows easy collection and discharge (through a chimney) or treatment of air (e.g. bio-filter) to minimize emissions of odors and greenhouse gases	More costly than other units and, in addition, more equipment maintenance is required Skilled labor required for

Often have one exhaust air outlet	Operating temperature is uniform, more efficient in sterilizing the compost compared to open composting techniques ƒ Production of leachate is low (can be recycled if any) Requires less processing time (2-3 weeks) and less labor Less land requirement Effect of weather on the composting process is limited Public acceptance of the facility is higher	operation and maintenance Comparable higher investment cost and energy consumption Additional cost for operation and maintenance There is a need to treat exhaust air
Vermi-composting		
A non-thermophilic, bio oxidative process that uses earthworms and associated microbes to transform organic waste into rich humus, similar to compost Local varieties of both surface and burrowing earthworms can be used In broad-scale vermiculture, the earthworms are introduced to organic waste piled in elongated rows that are covered with protection layers to prevent water logging Appropriate process indicators are survival rate, biomass production and reproduction of earthworms	Both pathogens and weed seeds can be destroyed in the intestines of worms during vermicomposting. Protozoa and fungi are important parts of their diet The earthworms mix, grind, aerate, fragment and digest waste Vermicomposting hastens the decomposition process by 2-5 times Produces much more homogeneous materials compared to thermophilic composting It is particularly suited to urban agriculture because it can be applied in a variety of settings and at different scales	A pre-composting may be required before earthworms are added to the mixture Tolerates temperatures between 0 and 40 °C with pH of 7, while optimal growth is at temperatures from 25-40 °C Optimal moisture content: 40-45%. Higher moisture content may result in the death of earthworms Organic matter is rich in nitrogen Sorting is required after composting to allow removal of earthworms Earthworms may die when conditions are unfavorable; e.g. anaerobic They may be affected by pests/mites

All composting technologies allow production of a safe recycling product but require variable processing time, process control, human and financial resources while having different impacts on the environment and health. The degree of compost stability attained within a certain time is a key indicator which can be used to compare different composting techniques. Decomposition of organic matter through composting can be achieved in the presence or in the absence of oxygen. Therefore, different composting methods involve either aerobic (with oxygen), anaerobic (without oxygen) phases and sometimes even alternate between the two during the decomposition process. Under anaerobic conditions, composting is often achieved at mesophilic temperatures with the disadvantage that the process temperature may be too low to efficiently eliminate pathogens that are especially present if organic input materials from municipal waste management, manures and faecal sludge are utilized for composting. Anaerobic conditions may also generate strong odors which could pose a major nuisance in urban areas. Conversely,

under aerobic conditions, composting is achieved at thermophilic temperatures due to the accelerated growth rate of bacteria that results in a higher biodegradation rate of the waste. As a result, pathogens are more quickly eliminated. A composting facility which is not well managed could generate odor that can expand over a radius of 2 to 3 kilometers (km) around the plant and bother residents.

So one should use/undertake implementation of co-composting technologies based on above discussed points.

Other reuse technologies which can be explored apart from co-composting are Biochar and Black Soldier Flies (BSF)

Biochar

The term charcoal refers to the carbon-rich material obtained from heating wood or plants anaerobically. Biochar is charcoal produced for mixing into soil. Technically, biochar is nothing but a new term for charcoal that is intended for application to soils as a soil amendment and or carbon sequestration

Process

There is a cycle in nature wherein plants use solar energy to covert carbon dioxide into biomass. Biomass is then transformed into biochar thereby producing energy and other co-products. Approximately 50% of the carbon remains in the form of biochar acting as a soil conditioner and delaying release of carbon into atmosphere by 1000 to 2000 years.

Biomass can be transferred to biochar through three processes: slow pyrolysis, fast pyrolysis and gasification. The plant takes faecal sludge along with carbon rich materials like coffee husks. They are subjected in the ratio of 7:3 for a smooth charring process. The faecal sludge has a lot of moisture content in it. It is dried down to a moisture content of 30-35% with the help of using the energy deriving from the carbonizer. In carbonizer a direct pyrolysis happens at temperatures of 300-600°C. Direct pyrolysis here refers to no steering through external heating of the chamber but through the heat generated from the pyrolysis process only.

The material is fed into a reactor after being transferred from a drying belt with the material flow being vertical and the ember remaining on top of the added material.

The hot fumes that originate from the process are redirected from the carbonization chamber and for further processing in a catalyst chamber, where the gases, for example carbon monoxide (CO) is burned.

Simultaneously, cooling of the whole system is maintained by circulating water through the drying component of the plant and thereby, drying the sludge at a temperature of 40-55°C.

The output of the plant, 30 kg per 100 kg of the mixed input material (70% Sludge, 30% carbon rich material), is a fine crumbled charcoal, with a carbon content of 55%.

The carbonizer unit faces problem of sand content. Directly drying faecal content on sand bed is thereby not an option as it was in co-composting. However, a geotextile or filter bag can be sandwiched between sand and the put in the bottom to separate the sand from the drying material if we choose to use drying beds for dewatering.

The plant is equipped with sensors for temperature and can be steered via computer and monitored via Wi-Fi. The plant needs to be under constant surveillance to be able to remove disturbance, such as stones getting stuck in the spiral conveyor.

Outputs

The biochar process results into three outputs:

Biochar (Solid): The charcoal as the main product is currently not sold, but the price is estimated to be in the range of Rs. 9 to 13 per kg. Slow pyrolysis results into high amounts of biochar in comparison to other processes.

Bio-oil (Liquid): Bio-oil is a synthetic fuel being worked upon as a potential substitute for petroleum. It is a kind of tar with high level of oxygen. Fast pyrolysis gives 60% gas and 20% biochar and syngas each. Bio-oil is not a ready to use product. It requires further up gradation into a special engine fuel or syngas and then bio-diesel for making it usable (Zafar, 2015).

Syngas (Gaseous): Also called synthesis gas, syngas is a mixture of fuel gas consisting primarily of carbon monoxide, hydrogen, and very often some carbon dioxide. It is mainly used in electricity generation. Being combustible, it can be used as fuel of internal combustion engines.

Leachate: The leachate obtained from the dewatering process is a valuable output too. If treated properly and applied in adequate doses, it can be an excellent fertilizer. On the contrary discharging it into water bodies would lead to eutrophication.

Costs

The cost of the whole plant is estimated to be around Rs. 30, 48,000 per annum, including two labourers and the energy costs. The energy needed is 4 kW; 1 kW for each of the two exhausters alone, in addition to the consumption in feeding and transporting mechanism (spiral conveyors, belt) and the steering equipment. The cost of a similar machine used in India for pyrolysis of tires is Rs. 55, 00,000.

The salary of composting workers is around Rs. 9,000 to Rs. 10,000. The plant can scale up through adding more carbonization chambers with one chamber being able to process 70kg of solids per hour. The plant size is suitable for towns with a population of 30,000-40,000 people.

Snake and scorpion bites: Charcoal attracts reptiles like snakes and scorpions and can pose a threat to life of farmers. It might result to increased deaths, effect on saving and income due to medical expenditure and reduced productivity.

Benefits

Farmers

- **Higher pH of soil:** Biochar can be used as a buffer for acidic soils, improving the pH and thus increase nutrient uptake for plants. It brings down the minute cost incurred for liming agents.
- **Increased resistance against crop diseases:** Biochar can buffer the soil and increase their resistance against crop diseases.
- **Enhance microbial population:** Biochar has a significant impact on population of healthy microbial organisms in the soil. It also results create a suitable environment for earthworms.
- **Absorption of harmful elements:** Biochar is known to absorb harmful chemicals like phytotoxins and nitrification inhibiters.
- **Increased plant uptake of fertilizer:** Soil requires at least 3% carbon in them to make fertilisers use adequate enough to recover the initial investment. Biochar can act as a substrate for nutrients and raise efficiency of plants to uptake the fertilisers used. This will bring down the overall cost of fertiliser and reduce the damage caused by fertilisers on the soil.
- **Increased nutrient holding capacity:** Compost increases the **cation exchange capacity (CEC)** of soil increasing the nutrient holding capacity of the soil. The increased supply of nutrients to the soil reduces the expense on additional artificial fertilizer to fulfil those requirements.
- **Lower expenditure on Fertilizers:** Farmers are highly dependent on fertilizer for agriculture production. This has led to a surge in fertilizer prices since its introduction in India. Using biochar, the fertilizer requirement will come down due to better absorption from the current supply of nutrients.
- **Improved germination of seedling:** Biochar is known to have positive effects on germination of seedling.
- **Higher water retention capacity:** Biochar altered soil increases the capacity of soil to hold water, thus reducing cost of irrigation and letting crops survives in drought like situation.

The table below describes various effects that biochar has on property of soil as a result of certain property of biochar.

Effect of Biochar on Soil, Plant and Environment

Property	Effect	Biochar property
Soil		
Organic matter	Increased	High C content
Water-holding capacity	Increased	Porous structure
Porosity	Increased	Porous structure
pH	Increased	Alkaline nature
Cation exchange capacity (CEC)	Increased	Specific surface area
Plant		
Crop yield	Increased	Soil organic matter, pH, bulk density, CEC, high porosity
Plant productivity	Increased	Colour, P and K cycling
Environment		
CH_4 emissions	Decreased	Porous structure, pH
N_2O emissions	Decreased	Recalcitrant, porous structure
Carbon sequestration	Increased	Recalcitrant or stable C; black carbon (BC) resists decomposition
Nutrient leaching	Decreased	Porous structure, surface area and negative surface charge

Public

- **Reduced Green House Gases:** The biochar results in retention of as much as 50% of the carbon from escaping into the environment. The carbon gets locked down for 100s to 1000s of years. Lower CO_2 results in lowering of global warming and all the problems caused by it. It reduces the risk of many diseases caused by increased temperature and CO_2 in the air. Every 1% increase in retained Soil Organic Matter (SOM) through biochar, 100 tons of atmospheric CO_2 will be taken out from environment. Other than CO_2, biochar also reduces emission of nitrous oxide (N_20) by 50-80%, Nitrogen Oxide (NO_X) and Methane (CH_4) from soil. Gases like nitrous oxide are 310 more potent as a greenhouse gas then CO_2.
- **Reduced groundwater contamination:** Increased quantities of biochar in soil will lead to higher absorption of agriculture chemicals and other fertilisers and thus reduced groundwater contamination.
- **Reduced eutrophication and bioaccumulation:** Eutrophication is a result of fertilisers being washed off in rain to river bodies. Biochar will help absorb a great part of the

fertilisers applied and thus result in less eutrophication. Biochar is the best method when it comes to absorbing nutrients in all the three methods and thus has the greatest impact.

- **Energy generation:** Biochar production produces bioenergy in two forms: syngas and bio-oils. These can be further processed and upgraded into biodiesel and gasoline substitute thereby reducing pressure on fossil fuels. Syngas can be put into use directly in gas turbines or be processed to produce ammonia, synthetic natural gas and other energy sources. Syngas also has the potential to replace petroleum as a material to create certain products and chemicals from it. Bio-oil is a substitute for heating oil or fuel oil. It also has the potential to be used in a bio-refinery where valuable chemicals and compounds are extracted and the remainder is upgraded to fuel or syngas.

Government

- **Aid in solving energy crises:** The government can take care of the energy crises through biochar while taking care of faecal sludge at the same time. It proves to be a better alternative on this aspect than compost since its energy producing outcomes is greater in quantity.

Limitations

- **Skilled labor required:** Operating a biochar plant requires people with in-depth technical knowledge of the field. The search cost and the salary paid would be higher in comparison to what was paid earlier.
- **Further processing:** Bio-oil cannot be used directly and needs to be processed further to be made usable. This would require further cost and labor charges.
- **Only long term benefits:** Biochar does not reveal short term benefits and thus, can be used only by farmers who are financially able enough to experiment with it and afford to take long term benefits.

Black Soldier Flies (BSF)

Black Soldier Flies in their pupae stage uses organic waste and produce some compost as a result that can be used in small scales in farms or gardens.

Process

An adult BSF has a sole objective of reproduction. It lays its eggs in decomposing organic matter and dies right after. The male would have already died right after mating. The larva stays

in the mix while slowly progressing in its growth stages. After some time they burrow into the mix to complete their development into adults. When the larvae are ready to pupate (around 2 to 4 weeks after eggs are laid), they secrete their digestive system, lose their mouth, and produce an antibiotic coating. Therefore, unlike house flies, they cannot carry disease between wastes and foods we plan to eat. This also makes them safe to feed to our animals.

Each day BSF larvae can digest up to 15 kg of waste per m^2 of feeding surface area (2 lbs/ft^2). The input used in the current facility in Tamil Nadu for experimental purpose is 10 tons of dry sludge along with 3.5-4 tons other organics.

Outputs

- **Feed for hens and fish:** The BSF larvae or pupae that remains at the end has proved to be a good source of balanced lipids, complete protein and calcium and thus can be fed to one's chickens. They can also be fed to fish and livestock. The larvae are approximately 34% – 45% protein, 42% fat, 7% fiber, and 5% calcium. The protein is priced at Rs. 40 per kg and is the main source of income. It will cover a huge amount of expenditure incurred.
- **Compost:** There is a very little amount of compost left after the process. For every 100 kg, 5 kg of compost is made generally.
- **Biodiesel:** One of the products that can be generated on further processing the larvae is biodiesel which has various energy applications. The pupae obtained from it can be further fractionated into their two parts: protein for animal feeds and fats converted into biodiesel.

Costs

- **Capital and Operating and Maintenance expenditure:** The capital expenditure required to establish a BSF plant is Rs. 3, 71, 80,000. The operation and maintenance expenditure along with other supplementary expenses amount to Rs. 1, 05, 36,000.
- **Pathogen infection:** It has been found through various experiments that black soldier flies is inefficient in eliminating pathogens like Enterococcus spp. and A. suum ova. It might run a health risk for farmers and consumers of the final produce. It can be taken care of with additional expenditure incurred in treating the compost with ammonia sanitization.
- **CO_2 emission:** BSF during composting release a very negligible amount of CO_2. It is not a major concern in comparison to the actual CO_2 emission it is saving.

Benefits

Farmers

- **Nutritious feed:** BSF pupae are a very protein rich feed for chicken and fish. They will result into decreased expense on chicken feed and increased productivity in terms of eggs. Alternatively, it can be sold in market or directly to farmers as chicken feed or fish food. It will be obtained in the range of 16-40% of the input.
- **Compost:** The process yields small amount of compost that can be used in small area of farming. Thus, a small scale of nutrient recycling happens when using black solider flies for composting. It is generally obtained as a 5% of the input supplied. However, in the plant in Tamil Nadu, the plant operators were able to obtain up to 30% of the input.

Public

- **Biodiesel:** The larvae can be used to produce biodiesel. Although the process will get a lot more complicated but might result into bringing in profit and making the whole operation sustainable.
- **Reduced houseflies:** BSF larvae acts as a repellent for many pests and problematic flies like houseflies. Houseflies are responsible for serious diseases like typhoid. Typhoid costs were 100 and 29 US $ to public sector and private sector respectively.
- **Wound dresser:** BSF shells left can be used as a wound dresser for no healing wounds.
- **Reduced CH_4 and CO_2 emissions:** BSF have an advantage over other methods like composting when it comes to methane and carbon dioxide production. It prevents anaerobic bacteria from transferring waste into carbon methane and mesophilic and thermophilic bacteria from producing huge amount of CO_2 from waste.

Government

- **Aid in solving energy crises:** The government can take care of the energy crises through biochar while taking care of faecal sludge at the same time.

Limitations

- **Small quantity of compost:** Agriculture is not the main purpose of using black soldier flies because compost produced through BSF is very low and thus, does not serve the purpose of an entity looking for a technology to produce commercial compost.
- **Winter season:** BSF are inactive during the winters and thus, might not provide a round the year solution for all the places. They might be made active by creating a warm environment through consumption of electricity.

7.5 Business Models for FSM

This write up discusses aspects of effective financial models complementing sustainable sanitation solutions such as revenue/business models, sales channels, equity models which can be implemented at various parts of the sanitation value chain and also to strengthen the faecal sludge management.

1. PPP: Public private partnership Model

Also known as P3 model is a long term contractual agreement between the government and private entity to provide public services. Under this model the government shares the burden of cost through partnership with private entities. Such financial models have been successful project such as “Bhakra Nangal Dam”, “Akshaya Patra”, “Mars orbital project”, “Kerala tourism” etc.

Table 33 Available Options under PPP model and their details

Type of Model	What is it?	Potential Strength	Drawback
Lease contracts	Private player is responsible for overall service chain, leases the component from public sector based but capital investment done by government	High incentives for operators	Very risky since Private player is responsible for any loss
Concessions	Private player is responsible for entire capital expenditure, operations and maintenance expenditure and public entity only sets norms and monitors	Highly incentives for operators ,effective and efficient systems can be established	Complex contracts, government needs to have better monitoring process and resources for the same.
Build Operate Transfer Model (BOT)	The private player generates capex to build the facility and owns it for the definite time period to generate the returns then transfers the entity to gov.	Reduced commercial risk for private player since only one type of customer is present	Less impact on operations and output
Management contracts	The investment is provided by the government but working capital is provided by private players.	Without transferring the asset to private player operational gains is leveraged.	No autonomy of authority for private player required to efficient returns.
Service contracts	The government contracts out certain parts of its operations/services to private players majorly done for a time period of 1-3 years.	Building of managerial strength and provide quick impact on operations efficiency. Can be monitored easily	Since operator does not source capex, is not effective of other sources of fund such as government funds etc. not available

Other models under PPP are BOO model, DBO model etc. and in the long run the PPP models tend to be more effective.

2. Hybrid Annuity based PPP model

Hybrid version of the BOT model: 40% of project cost paid by the government and 60% of the project cost paid by private party. Private player bears the operations and maintenance and is paid periodically for the service rendered by government and to meet the costs government issues taxes and tariffs. Service level standards are set and based on the delivery and adherence to the standards the government pays the private players. Major benefits being; reduced initial investment, private player manages the operations, pay only if services are delivered by private party.

Governance and management:

With proper monitoring protocols, regulations and standards supported by effective policies and resolutions, better return on investment is probable in terms of positive social impact. This approach allows creating sustainable business models around each of the components which results in inclusive socio-economic uplift. It is paramount to look at human excreta as a potential resource for the agricultural and energy industry, rather than a problem. With this approach the realization of real sustainable sanitation services is possible.

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