SFD Promotion Initiative

Cuttack
India

Final Report

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SFD Report Cuttack, India, 2015

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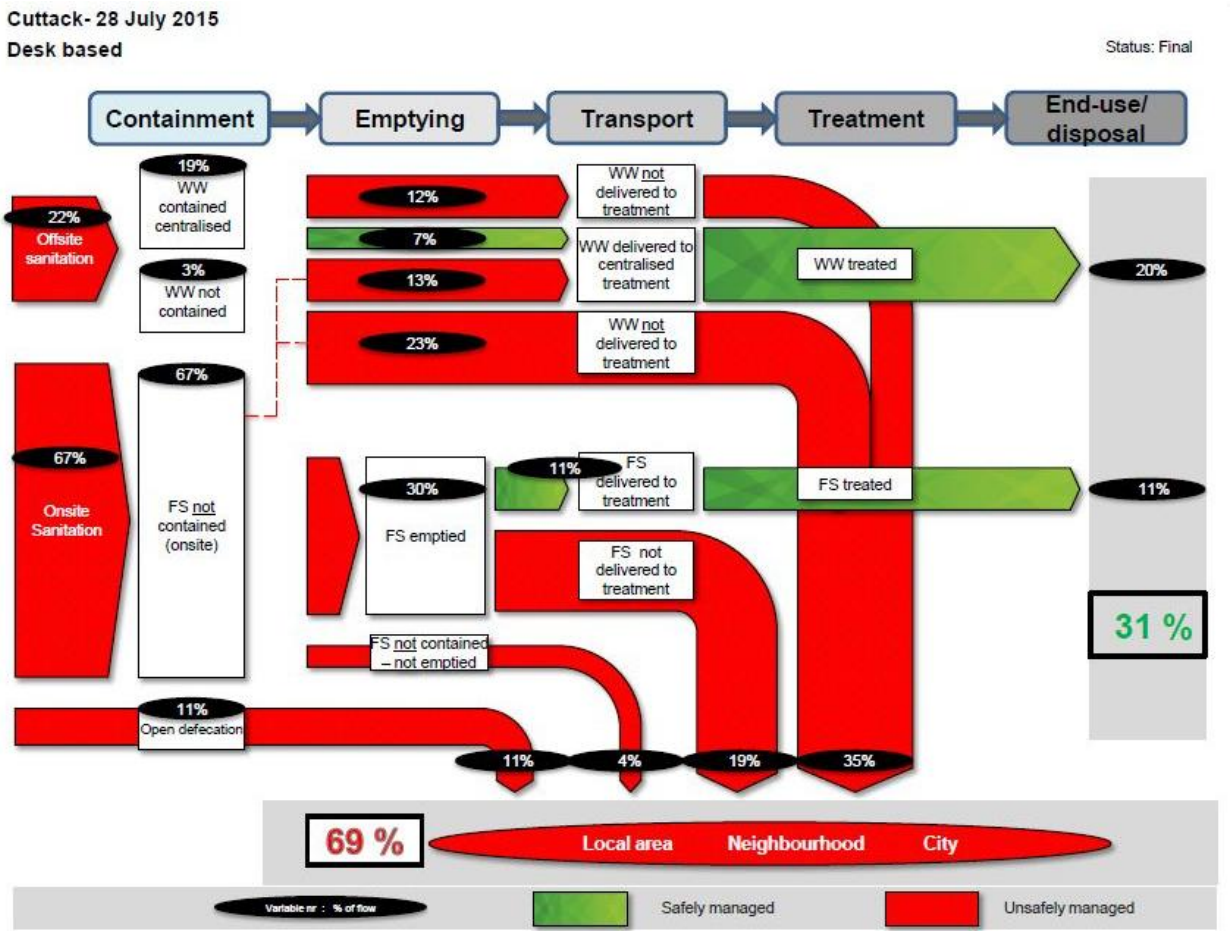
1. The Diagram



2. Diagram information

Desk or field based:

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3. General city information

Cuttack city, lies in east coast plains of India, is the former capital and one of the oldest cities of Odisha, established in 1876 as municipality. It is the district headquarter and is situated at a distance of about 25 km to the north of Bhubaneswar, the present capital of Odisha. The city is surrounded by the rivers Mahanadi, Kathajodi, Birupa and Kuakhai (CMC, 2011).

The population of city, as per the 2011 Census is 606,007 persons. The density of city is 7,769 persons per sq.km which is very high when compared to the state density of 269 persons per sq.km. Total slum population is 223,619 which is 41.78% of the total population (CMC, 2011).

Municipal boundary has been chosen for the current study. It comprises an area of 192.5 sq.km (CMC, 2011).

Cuttack is completely dependent on ground water for water supply. Ground water level is 6 mbgl (CMC, 2011).

4. Service delivery context

In 2008, the Ministry of Urban Development (MoUD) issued the National Urban Sanitation Policy (NUSP). The policy aims to: raise awareness, promote behaviour change; achieve open defecation free cities; develop citywide sanitation plans; and provide 100% safe confinement, transport, treatment and disposal of human excreta and liquid wastes. The NUSP mandates states to develop state urban sanitation strategies and work with cities to develop City Sanitation Plans (CSPs). Furthermore, it explicitly states that cities and states must issue policies and technical solutions that address onsite sanitation, including the safe confinement of faecal sludge (USAID, 2010).

The objectives of NUSP are to be realized through CSPs and state sanitation strategies. As of now there are very few cities which have finalized their CSPs, and those plans are also not implemented. This remains a major drawback in implementation of NUSP.

The advisory note on septage management in urban India, issued by MoUD in 2013, recommends supplementing CSPs with Septage Management Sub-Plan (SMP). Still septage management in India is not prominent due to lack of knowledge, consideration of septage management as an interim solution, lack of sufficient funding and many other socio-political issues.

There are no specific legal provisions relating to septage management, but there are a number of provisions relating to sanitation services and environmental regulations, which majorly stems from, The Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Acts. Municipal acts and regulations usually refer to management of solid and liquid wastes but may not provide detailed rules for septage management (MoUD, 2013). Corporation caters to emptying service, though the disposal is done in open drains only.

5. Service outcomes

Overview on technologies and methods used for different sanitation systems through the sanitation service chain is as follows:

Containment: There is limited sewerage network which conveys waste water to two main open drains flowing through the city. The city is majorly dependent on septic tanks which are generally not adhering to design prescribed by Bureau of Indian Standards (BIS). The effluent from the septic tank flows into open drains. Some households are also connected to pits.

Emptying: Most of the emptying work is done mechanically but there are some instances of manual emptying. Though more than 60% of city's population is dependent on onsite sanitation systems (OSS), the municipal corporation prefers underground sewerage system.

Transport: The total sewage of city is conveyed to two main open drains, through sewerage network and small open drains. Septage is generally transported through vacuum tankers of 3000 litres capacity. There are 3 tankers with the corporation and some private emptiers are also plying their tankers in the city.

Treatment: A 33 MLD Sewage Treatment Plant (STP) is located in Matagajpur. Oxidation ponds are used to treat around 38% of sewage which is tapped from open drains and treated at STP. There is no existing septage treatment facility.

End-use/Disposal: Treated and untreated waste water is disposed in downstream of Khathajodi River. Septage is disposed in open drains.

Figure 1: Open drain in the heart of the city (Source: Shantanu/CSE, 2015)

According to Census, 22% of City is dependent on offsite systems, population connected to sewer line is 19% and user interface discharging in open drain or ground is around 3%.

Rest of the 67% of the city is dependent on OSS, out of which 64% is dependent on septic tanks and 3% on pits. The public latrines are connected to septic tanks and hence are incorporated in OSS. Faecal sludge (FS) from OSS is not contained as the septic tanks are connected to open drains and pits are polluting the ground water.

There is no clear differentiation between percentage of effluent and septage generated from septic tanks, hence it's assumed to be 50% each. Therefore, 33% of FS is effluent and goes into open drains and rest is emptied from tanks whenever full. Some FS is always left in the tanks and is assumed to be 4%.

All the sewers, open drains, and FS emptied ends up in two main drains flowing through the city. The STP is situated at the lowest point of the city which taps about 38% of the waste water flowing in the drains, hence it is assumed that 38% of all the FS emptied, wastewater transported through sewers and open drains is treated, rest of it goes untreated in the river, and hence shown unsafe in SFD. 11% of city which defecates in open is also shown unsafe in SFD.

6. Overview of stakeholders

The 74th Constitutional Amendment Act of 1992 reformed the sector by transferring responsibility for domestic, industrial, and commercial water supply and sewerage (WSS) from state agencies, such as Departments of Public Health Engineering and State Water Boards, to Urban Local Bodies (ULBs). This transfer has resulted in a variety of implementation models, as well as lack of clarity in allocation of roles and responsibilities between state and local agencies, which sometimes results in large gaps in implementation (USAID, 2010).

The following stakeholders are responsible for sanitation service delivery in Cuttack

Key Stakeholders	Institutions / Organizations
Public Institutions	Odisha Water Supply and Sewerage Board (OWSSB), Public Health Engineering Organisation (PHEO), Cuttack Municipal Corporation (CMC), State pollution control board (SPCB)
Private Sector	Private emptier

Table 1: Key stakeholders (Source: Compiled by CSE, 2015)

OWSSB is responsible for planning and executing sewerage schemes. PHEO is responsible for operation and maintenance of sewerage network. CMC is responsible for operation and maintenance of open drains, construction and maintenance of public toilets, septage management. They also regulate private emptiers. Private emptiers are responsible for septage management. There are two licensed emptiers in the city. SPCB is responsible for monitoring and evaluation of STPs.

7. Credibility of data

Two key sources of data are used; Census of India, 2011 and draft of CSP, 2011. The data is crosschecked and updated by Key Informant Interviews (KIIs). Seven KIIs have been conducted with different stake holders.

Data on containment is available in Census. Data on emptying and transport is collected by KIIs. However most of the data is qualitative.

Some of the issues and challenges are listed below:

- Data insufficiency & non availability: No data available on how many septic tanks are connected to open drains
- Accuracy: Discrepancy observed between Census data and actual ground situation
- Data available at different time lines
- Limited data available on reuse (formal / informal)

Assumptions followed for preparing SFDs:

- Data provided by Census, 2011 is correct
- Septic tanks and sewer connections on ground are as per septic tanks & sewer connections defined in Census
- Volume of waste water generated is 80 % of water supplied
- All septic tanks are connected to open drains
- 90% of the people get their tanks emptied when full

8. Process of SFD development

Data is collected through secondary sources, and then the city is visited to conduct KIIs with relevant stakeholders, to fill in the gaps in data and to crosscheck the data collected.

To start with, a relationship between sanitation technologies defined in Census of India and the ones defined in project is established.

The data is fed into the calculation tool to calculate the excreta flow in terms of percentage of the population.

31% of city is managing its excreta safely as there's some treatment at STP, but excreta of rest of the 69% of the city is not managed safely, as it goes untreated into the river through open drains, this also includes 11% of the city which defecates in open.

Limitations of SFD:
It's dependent on secondary data and true picture of the city may differ.

The data available is at different timelines, for example data on containment is from census 2011, and data on emptying and transportation is collected through KIIs conducted in 2015.

Whether excreta is safely managed or not is dependent on whether the system is contained or not, and not on whether waste is safely handled.

9. List of data sources

Below is the list of data sources used for the development of SFD.

- Published reports and books:
  - Census of India 2011, House listing and Housing data, Government of India
- Un–published documents:
  - Draft CSP of Cuttack, Cuttack Municipal Corporation, 2011
- KIIs with representatives from :
  - Government agencies: CMC, PHEO, OPCB,

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Abbreviation

ADB	Asian Development Bank
BIS	Bureau of Indian Standard
CAA	Constitution Amendment Act
CDA	Cuttack Development Authority
CDP	City Development Plan
CGWB	Central Ground Water Board
CMC	Cuttack Municipal Corporation
CPHEEO	Central Public Health & Environmental Engineering Organization
CSP	City Sanitation Plan
CSE	Centre for Science and Environment
DMA	Directorate of Municipal Administration
DPR	Detailed Project Report
DWF	Dry Weather Flow
GIS	Geographic Information System
GoO	Government of Odisha
H&UDD	Housing and Urban Development Department
JICA	Japan International Cooperation Agency
KM	Kilometers
LPCD	Litres Per Capita per Day
MLD	Million Litres per Day
MoUD	Ministry of Urban Development
MSL	Mean Sea Level
NGO	Non-Government Organization
NIUA	National Institute of Urban Affairs
NRW	Non-Revenue Water
O&M	Operation and Maintenance
OWSSB	Odisha Water Supply and Sewerage Board
PHED	Public Health Engineering Department
PHEO	Public Health Engineering Organization
RAY	Rajiv Awas Yojana
SLB	Service Level Benchmarking
SRDP	State Slum Rehabilitation & Development Policy
STP	Sewerage Treatment Plant
SWM	Solid Waste Management
ULB	Urban Local Body
WHO	World Health Organisation
WSS	Water Supply and Sewerage

1 City context

Cuttack, the former capital of Odisha state, is headquarter of the Cuttack district. The city is well known as *silver city* due to its world famous silver filigree jewelry works. It is the major hub for trading and business in and around the city (MoUD, 2013a).

The population of the city, as per the Census 2011, is 606,007 which is 23.14% of the population of Cuttack district and 1.45% of the population of Odisha state. The actual Municipal corporation area is about 78 sq.km which excludes area of the river. The gross population density of the city is 7,769 persons per sq.km (MoUD, 2013a). Slum population is 223,619, it is 36.9% of the total population (Census of India, 2011). Municipal boundary has been chosen for the current study, which comprises of an area of 192.5 sq.km (CMC, 2011). Floating population of city is around 30,000 to 40,000 per day. Cuttack city has 59 wards. The population growth rate of the city is given in the following table.

Table 1: Decadal population growth rate of Cuttack city (MoUD, 2013a)

Census Year	Population	Growth Rate (%)
1971	1, 94, 068	-
1981	2, 94, 966	52%
1991	4, 03, 418	37%
2001	5, 35, 139	32%
2011	6,06, 007	11.69%

Cuttack city is a narrow strip gently sloping from West to East occupying the delta plains of the Mahanadi River in the east and hilly terrain on the west. The topography of the city lies between 20^0 29'North Latitude and 85^0 52' East Longitude. The city is located at 36m above mean sea level and is surrounded by the Mahanadi River and its three distributaries namely Kathajodi, Birupa and Kuakhai (MoUD, 2013a).

Cuttack experiences tropical wet and dry climate. The summer season is from March to June when the climate is hot and humid. The temperature around this season is 35 °C to 40 °C and the monsoon month is from July to October when the city receives the highest rainfall for the whole year. The annual rainfall is around 144 cm. Similarly, winter season is from November to February when the temperature falls to below 10^0 C. Cuttack is completely dependent on ground water for water supply. Ground water level is 6 mbgl (CMC, 2011).

The willingness to pay for sanitation services is low in poor people as compared to middle class people. Despite having toilets, in a few areas, water scarcity or non-availability of water has forced people to go out for open defecation. Poorer families follow open defecation whereas middle-income group prefers toilets with septic tanks. Dumping of solid waste is the root cause for poor functioning of drains (CMC, 2011).

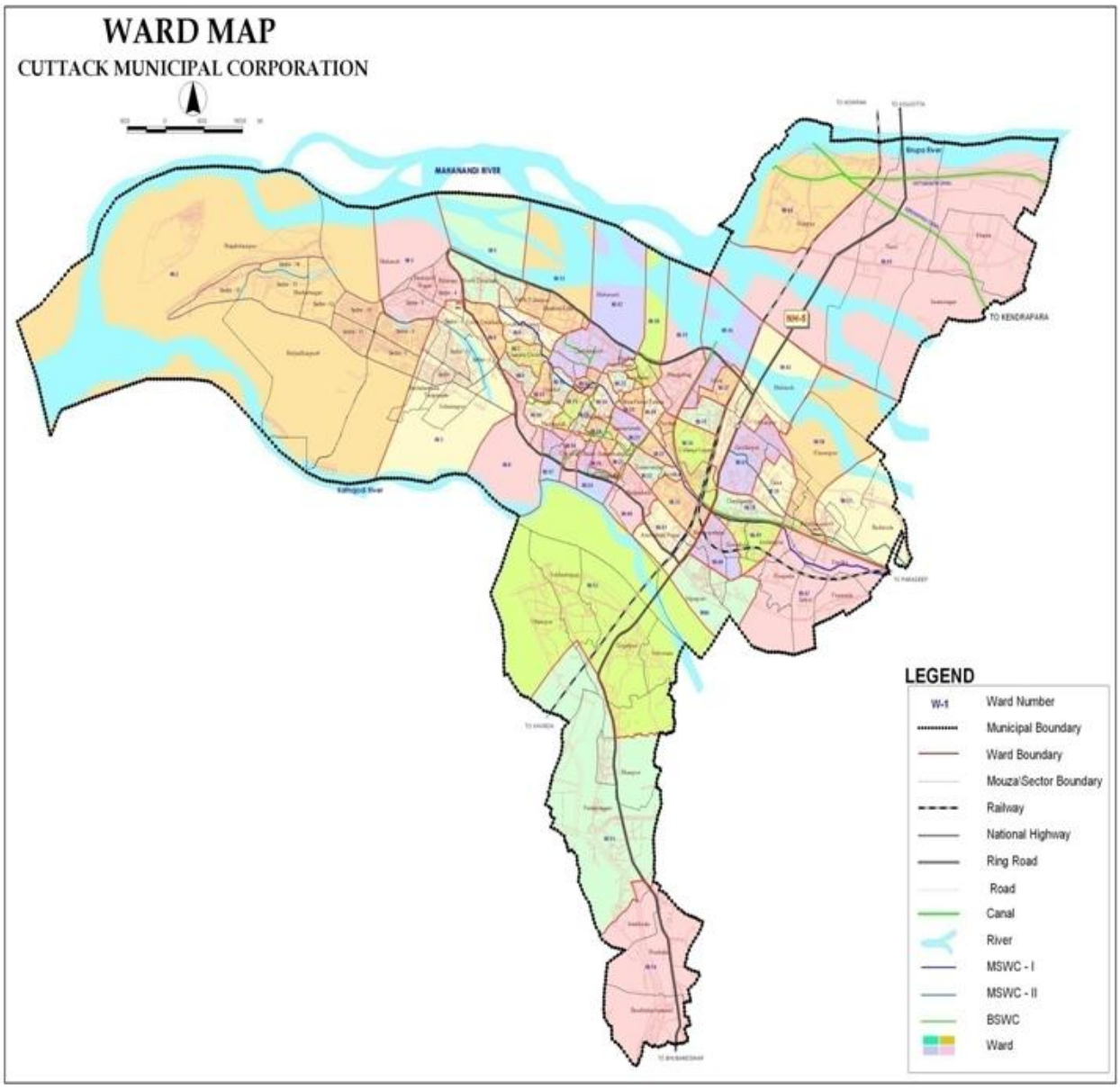

Figure 1: Administrative unit of Cuttack city (CMC, 2015a)

2 Service delivery context description/analysis

2.1 Policies, legislations and regulations

2.1.1 Policies, legislations and regulations at national level

In 2008, the Ministry of Urban Development (MoUD) issued the National Urban Sanitation Policy (NUSP). The policy aims to: raise awareness, promote behavior change; achieve open defecation free cities; develop citywide sanitation plans; and provide 100% safe confinement, transport, treatment and disposal of human excreta and liquid wastes. The NUSP mandates states to develop state urban sanitation strategies and work with cities to develop City Sanitation Plans (CSPs). NUSP specifically highlights the importance of safe and hygienic facilities with proper disposal and treatment of sludge from on-site installations (septic tanks, pit latrines, etc.) and proper operation and maintenance (O&M) of all sanitary facilities. Furthermore, it explicitly states that cities and states must issue policies and technical solutions that address on-site sanitation, including the safe confinement of faecal sludge (FS) (USAID, 2010). The objectives of NUSP are to be realized through CSPs and state sanitation strategies. As of now there are very few cities, which have finalized their CSPs, and those plans are also not implemented. This remains a major drawback in the implementation of NUSP.

The advisory note on septage management in urban India, issued by MoUD in 2013, recommends supplementing CSPs with Septage Management Sub-Plan (SMP) as a part of the CSP being prepared and implemented by cities. Septage here broadly refers to not only FS removed from septic tanks, but also that removed from pit latrines and similar on-site toilets. This advisory provides references to the Central Public Health & Environmental Engineering Organization (CPHEEO) guidelines, Bureau of Indian Standard (BIS) standards, and other resources that users of this advisory may refer for details while preparing their SMP (MoUD, 2013). It clearly discusses on techno- managerial and socio- economic aspects of septage management in India and provides guidelines for Urban Local Bodies (ULB'S) to plan and implement septage management plans.

There are no specific legal provisions relating to septage management, but there are a number of provisions relating to sanitation services and environmental regulations, which majorly stems from, The Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Act, 1974. It also applies to households and cities with regard to disposing wastes into environment. ULBs/ utilities also have to comply with discharge norms for effluent released from sewage treatment plants and to pay water cess under the Water Cess Act, 1977. The ULB is responsible for ensuring the safe handling and disposal of septage generated within its boundaries, for complying with the Water Act for meeting all state permit requirements and regulations (CSE, 2010). Municipal acts and regulations usually refer to the management of solid and liquid wastes, but do not provide detailed rules for septage management (MoUD, 2013).

The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act is enacted in 2013. This act prohibits employment of manual scavengers, insanitary latrines. It has laid strong emphasis on rehabilitation of manual scavengers. This act has become instrumental in eradicating manual scavenging in India.

2.1.2 Policies, legislations and regulations at state level and ULB level

According to Constitution of India, water and sanitation is a state subject. Statutory powers are conferred to the state for making laws on water and sanitation. There is no specific state sanitation policy for Odisha, but the state follows the approach advocated in the NUSP. There are no specific laws and regulations on septage management at state level. But municipal laws have some provisions for it. Some of them are listed below:

a. Odisha Urban Sanitation Strategy, 2011: The objectives of the strategy, passed by Government of Odisha (GoO), includes; comprehensive information about the full cycle of sanitation, ensuring the accessibility to sanitation and also to build capacities within ULBs and other line agencies for participatory citywide sanitation (GoO, 2011).

Strategy emphasizes on promoting proper disposal and treatment of sludge from on-site installations (septic tanks, pit latrines, etc.); It also indicates that ULBs should ensure that all the human wastes are collected safely, confined and disposed of after treatment so as not to cause any hazard to public health or the environment (GoO, 2011).

b. State Slum Rehabilitation & Development Policy (SRDP): Prepared and approved by the GoO for holistic development of urban slums in the state as part of sanitation movement. The overarching vision of the SRDP is to build a Slum Free Odisha by the year 2020 and bring about a significant reduction in the urban poverty level (CMC, 2011).

c. Orissa Municipal Act, 1950: The act governs the structure and management of the notified area councils and municipalities. Provisions for sanitation have been listed below.

All house-drains, whether within or without the premises to which they belong, and all private latrines and cesspools within the Municipal area shall be under the control of the Municipality but shall be altered, repaired, cleaned and kept in proper order at the expense of the owner of the premises to which the same belong, or for the use of which they were constructed, and in conformity with by-laws and regulations framed by the Municipality in this behalf (GoO, 1950).

d. Odisha Municipal Corporation Act, 2003: It empowers the corporations to make by-laws and regulations for construction of cesspools and septic tanks. Both the acts don't emphasize on regulation and licensing of private emptiers (GoO, 2003).

2.1.3 Institutional roles

The MoUD is the nodal Ministry for policy formulation and guidance for the urban water supply and sewerage sector. The Ministry's responsibilities include broad policy formulation,

institutional and legal frameworks, setting standards and norms, monitoring, promotion of new strategies, coordination and support to State Programmes through institutional expertise and finance. The Ministry is also responsible for managing international sources of finance. The Central Public Health and Environmental Engineering Organisation (CPHEEO), created in 1953, is the technical wing of the MoUD, which advises the Ministry in all technical matters and collaborates with the state agencies about water supply and sanitation activities. CPHEEO plays a critical role in externally funded programmes and special programmes. CPHEEO also plays a central role in setting design standards and norms for urban water supply and sanitation (Planning commission, 2002).

The 74th Constitutional Amendment Act of 1992 reformed the sector by transferring responsibility for domestic, industrial, and commercial water supply and sewerage (WSS) from state agencies, such as Departments of Public Health Engineering and State Water Boards, to Urban Local Bodies (ULBs). This transfer has resulted in a variety of implementation models, as well as lack of clarity in allocation of roles and responsibilities between state and local agencies, which sometimes leave large gaps in implementation (USAID, 2010).

This chapter discusses the institutional framework for urban sanitation services and septage management in Odisha state. It also focuses on the institutional arrangements for provision, operation and maintenance of sanitation services in Cuttack City.

CMC is responsible for SWM, sanitation, tax recovery, slum development work, maintenance of parks and plantations, issuance of license, traffic and junction improvement, capital work and maintenance of roads, nalas, etc, maintenance of hospitals, schools, CMC office buildings, market complexes, etc owned by CMC.

The engineering section carries out capital work for roads, junction improvement, open drains (including O&M), maintenance of parks and plantations, community and public toilets, street lights, provision of water through stand posts, capital works for SWM services provided by the health section, etc.

Two major parastatal agencies carry out all the capital works of the respective sectors owing to lack of manpower and technical capabilities of the ULB to take charge of the functions. The agencies are:

- PHD-I under the Public Health and Engineering Organization (PHEO)
- OWSSB

The PHD and OWSSB are under the administrative control of Housing and Urban Development (H & UD) Department of the Govt. of Odisha. Assets for large projects created by PHD and OSWWB (sewerage and drainage) are handed over to CMC for O&M. This function is further outsourced through open tendering process by CMC due to lack of technical skill and manpower.

The table below lists the role of CMC, PHD, OWSSB in urban service delivery. Multiple agencies are responsible for delivering various facilities leading to lack of coordination accountability and transparency.

Table 2: Roles and responsibilities (MoUD, 2013a)

Institution	Roles and responsibilities
PHD-I	The PHD is responsible for planning, designing, construction, operation and maintenance of water supply system and management of wastewater schemes including their transportation and distribution. Apart from this, the PHD under the PHEO is also responsible for construction and maintenance of external and internal water supply, sewerage and sanitary installation for state government buildings (both residential and non residential) in the city.
OWSSB	The OWSSB is responsible for construction and maintenance of major storm water drains (10 nos.) within CMC limits. The Board is also responsible for construction and provision of sewerage network within the city.
OSPCB	Regulatory measures for septage disposal operations, licensing for environmental check etc.
Cuttack Municipal Corporation	Under the Orissa Municipal Act, 1957, Cuttack Municipal Corporation (CMC) was constituted. Orissa Municipal Act and CMC Public Health & Sanitation Regulations have provided provisions to impose penalties on non-compliance of municipal rules and regulations including urban sanitation matters. In Cuttack, sanitation is managed by the CMC. However the main works are related to municipal solid waste management, which was handed over to Ramky Enviro Engineers Limited.
Cuttack Development Authority	Preparation and implementation of area development plans and projects for ensuring scientific land use pattern. Working as coordinating agency between various government departments and other agencies involved in development activities. Land acquisition and development for various purposes at suitable locations based on an assessment of future needs, control of land subdivision and reconstruction of plots wherever necessary. Determining the phasing development.

2.1.4 Service provision

Institutional arrangements for water supply and sanitation in Indian cities vary greatly. Typically, a state-level agency is in charge of planning and investment, while the local government (Urban Local Bodies) is in charge of operation and maintenance (NIUA, 2005). Some of the larger cities have created municipal water and sanitation utilities that are legally and financially separated from the local government. However, these utilities remain weak in terms of financial capacity. In spite of decentralization, ULBs remain dependent on capital subsidies from state governments. Tariffs are also set by state governments, which often even subsidize operating costs (Planning commission, 2002a).

In the absence of a separate utility, there is no separation of accounts for different activities within a municipality. Some states and cities have non-typical institutional arrangements. For example, in Rajasthan the sector is more centralized and the state government is also in charge of operation and maintenance while in Mumbai the sector is more decentralized and local government is also in charge of planning and investment (NIUA, 2005).

In Cuttack, OWSSB is responsible for planning, designing and construction of sewerage network. PHD-I is responsible for the operation and maintenance of sewerage network. Public health and sanitation are delivered by PHD-I through the engineering (sewerage), health and sanitation department. CMC and private emptiers both are responsible for providing emptying services. CMC doesn't regulate private emptiers by licensing.

2.1.5 Service standards

1. Service Level Benchmarks (SLB), 2008: Issued by the Ministry of Urban Development in 2008, which seeks to (i) identify a minimum set of standard performance parameters for the water and sanitation sector that are commonly understood and used by all stakeholders across the country; (ii) define a common minimum framework for monitoring and reporting on these indicators and (iii) set out guidelines on how to operationalize this framework in a phased manner.SLB refers to improving service through better provision and delivery. It evaluates the performance of urban services provided by different ULBs of the country.

2. General Standards for Discharge of Environmental Pollutants Part-A: Effluents-The Environment (Protection) Rules, 1986 (Schedule VI): Issued by, Central Pollution Control Board (CPCB), a statutory organization constituted in September 1974 under the Water (Prevention and Control of Pollution) Act, 1974.

3. Manual on Sewerage & Sewage Treatment, Second Edition, 2013: This manual has been developed by Central Public Health and Environmental Engineering Organization (CPHEEO).It provides detailed design and guidelines for various technologies of wastewater management.

4. Code of Practice for Installation of Septic Tanks, 1985: Issued by, Bureau of Indian Standards. It is a national standards setting body of India. The code specifies standards and design consideration for installation of septic tanks.

3 Service outcomes

Service outcome analysis is based on secondary sources. Two key sources of data are used; Census of India, 2011 and draft CSP, 2011. The data is crosschecked and updated by Key Informant Interviews (KIIs). Data on containment is available in the Census. Data on emptying and transport is collected by KIIs. However, most of the data is qualitative.

3.1 Overview

This section presents the range of sanitation technologies/infrastructure, methods and services designed to support the management of FS and/or Waste Water (WW) through sanitation service chain in Cuttack. The details on quantitative estimations are presented in table below and following sections:

Table 3: Sanitation Technologies and contribution of excreta in terms of percentage of population

S. No.	Sanitation technologies and systems as defined by:		SFD Reference Variable	Percentage of population
	Census of India	SFD Promotion Initiative		
1	Piped sewer system	User interface discharges directly to centralized separate sewer	T1A1C2	18.6%
2	Septic tank	Septic tank connected to open drain or storm sewer	T1A2C6	59.8%
3	Other systems	User interface discharges directly to open ground	T1A1C8	1.2%
4	Pit latrine with slab	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, significant risk	T2A5C10	2.3%
5	Pit latrine without slab	Unlined pit no outlet or overflow, significant risk	T2A6C10	0.3%
6	Night soil disposed into open drain	User interface discharges directly to open drain or storm drain	T1A1C6	0.7%
7	Service latrine	User interface discharges directly to ‘don’t know where’	T1A1C9	1.2%
8	Public latrine	Septic tank connected to open drain or storm sewer	T1A2C6	4.4%
9	Open defecation	Open Defecation	T1B11C7 TO C9	11.5%

3.1.1 Sanitation facilities

This section presents existing sanitation facilities apart from household toilets.

Public and community toilets:

There are 64 Community toilets (pay and use) in slums, out of which 11 are non-functional. There are 18 public toilet blocks in city maintained by Souchalaya and SAI International Sanitation Organization on pay and use basis (as per the information shared by CMC). Each toilet is having 15 seats on an average, half for gents and half for ladies. Users are charged Rs. 5/- per-use from both men and women. Tourists and few local residents use the toilet facility. The physical condition of public toilets is not good due to poor maintenance. The toilets are connected directly to septic tanks and effluent from the septic tanks is directed into open drains (CMC, 2011).

Institutional sanitation:
There are 273 educational institutions which include 118 Primary Schools, 64 Middle Education Schools, 64 High Schools, 17 Colleges, One Medical College, 2 Engineering Colleges, 2 Law Colleges, 2 Training Colleges and 3 Industrial Training Institutes (MoUD, 2013a). Data on sanitation of these institutions is not available and hence not considered in making the SFDs.

Commercial and Industrial Areas:
There are 9 Hospitals, 23 Dispensaries, 6 Medical Units and 9 Nursing Homes (MoUD, 2013a). Cuttack Municipal Corporation has a record of 14 hotels, 55 restaurants. Data on number of industries and industries within city administration area is not available. Data on sanitation of these areas is not available and hence not considered in making the SFDs.

Due to lack of data on excreta generated from institutions, industrial areas, restaurants and hotels, these establishments are out of consideration for the production of SFD. Whereas excreta from households and public toilets that includes residential as well as commercial areas is under consideration for this study.

The secondary survey has indicated that the majority of them prefer individual toilets with pour-flush system and people who are below poverty line either prefer using community toilet or practice open defecation. With respect to technology choice, low cost sewerage system was preferred by the poor as well as middle income group families due to constraints in paying higher connection charges, required for a conventional underground sewer system (CMC, 2011).

Septage from septic tanks and pit latrines is collected by the Municipal Corporation using mechanical vacuum tankers and discharged in the current landfill site used for dumping solid waste of the city. Septic tanks are emptied once in a year and according to the situation based on the request from individual households (CMC, 2011).

3.1.2 Containment

There is a limited sewerage network, which conveys wastewater to two main open drains flowing through the city. The city is majorly dependent on septic tanks. The effluent from the septic tank flows into open drains. Some households are also connected to the pits. Waste water from households is discharged into open drains along the road network. It was observed during the visit to the city that, size, location, and design of on-site systems is majorly dependent on the space available, the practice followed in the particular area from a long time and prerogative of local masons. There is no such protocol followed, as mentioned in the IS code 2470-2 (1985) prescribed by the Bureau of Indian Standards. Congested areas in the heart of the city and smaller plot areas also pose space constraints in the construction of latrines and discourage households to construct latrines (CMC, 2011).

3.1.3 Emptying

Septage from septic tanks and pit latrines is emptied by the Cuttack Municipal Corporation using vacuum tankers and disposed off in the current landfill site used for dumping solid waste of the city. Septic tanks are emptied based on the request from households (CMC, 2011). A resident has to register to sanitation wing of CMC in advance to avail the service. A sustainable mechanism to provide emptying service is yet to be worked out. Charges levied for service provision are INR 750 (11.29 USD) (CMC, 2015). There are instances of private emptiers are also plying their tankers in the city, but no data available for the same.

Emptying work is done mechanically, but there are some instances of manual emptying. For state owned vacuum tankers: generally, there are 2-3 persons; one driver, one operator and the rest are helpers. There is no provision/usage of gloves, boots or masks or any other safety gears. Even though more than 60% of the city's population is dependent on onsite sanitation systems (OSS), the municipal corporation prefers an underground sewerage system (CMC, 2011).

3.1.4 Transportation

In the Cuttack city, two major drains namely drain no.1 & 2 carry both storm water and wastewater of the city. Besides, there are a number of small drains which are intercepted and diverted to the existing two major drains. Dry Weather Flow(DWF) of drain no. 2 is pumped to drain no.1 near the Matagajpur STP from where the combined DWF of Drain No.1 & 2 is trapped through suitable trapping arrangement and pumped to the STP (PHD-I, 2015). Septage is generally transported through vacuum tankers. There are 3 vacuum tankers owned by the Municipal Corporation. The capacity of each tank is 3000 litres. Service provider carry septage in vacuum tankers and travel 15 -20 km outskirt of the city. There are instances that septage is indiscriminately disposed on the barren land, on the way towards the landfill site (CMC, 2015). Septage discharged on the way to a landfill site during transportation causes unhygienic, unsafe and hazardous condition to the local environment.

3.1.5 Treatment and disposal

A 33 MLD Sewage Treatment Plant (STP) is located in Matagajpur consisting of the stabilization pond system. It treats around 38% of sewage which is intercepted and trapped through suitable trapping arrangement from main drain No. 1 and treated at STP. There is no separate existing septage treatment facility. Septage is discharged into landfill/ barren land or in open drains. Septage is often discharged to a place called Sati Chaura for disposal in outskirts of the city. Treated and untreated waste water is disposed downstream of Kathajodi River (CMC, 2011).

3.2 SFD matrix

The final SFD for Cuttack is presented in appendix 7.1.

3.2.1 SFD matrix explanation

According to Census, 22% of the City is dependent on off-site systems, population connected to sewer line is 19% and user interface discharging in open drain or the ground is around 3%. Around 67% of the city is dependent on Onsite Sanitation Systems, out of which 64% are dependent on septic tanks and 3% on pits. The public latrines are connected to septic tanks and hence are incorporated in OSS. FS from OSS is not contained as the septic tanks are connected to open drains and pits are polluting the ground water.

There is no clear differentiation between the percentage of effluent and septage generated from septic tanks, hence it's assumed to be 50% each. Therefore, 33% of FS is effluent which goes into open drains and the rest is emptied from tanks whenever full. Some FS is always left in the tanks and is assumed to be 4%. All the sewers, open drains, and FS emptied ends up in two main drains flowing through the city. The STP is situated at the lowest point in the city which taps about 38% of the wastewater flowing into the drains, hence it is assumed that 38% of all the FS emptied, wastewater transported through sewers and open drains is treated, the rest of it goes untreated in the river, and hence shown unsafe in SFD. 11% of the city which defecates in the open is also shown unsafe in SFD. Definition (Table 4) and estimation of different variables (used to make SFD) are explained below.

Assuming Census figures are correct; W2 was estimated to be around 19%. It is assumed that 38% of W2 would reach STP hence W4a is estimated to be 7% and W11a as 12%. W15 is rounded off as 3%, as it includes WW discharged into open drains i.e. 0.7%, WW discharged on open ground (defined as other systems in the Census) i.e. 1.2% and WW from service latrines i.e. 1.2%. 33% of FS, that is effluent from septic tanks, is discharged into open drains. WW tapped from open drain and delivered to the treatment plant is estimated to be 13%, therefore W4c=13%. The rest of the WW which is not contained and not delivered to treatment plant comes out to be 23%, hence W11c=23%. Total WW not delivered to a treatment plant, i.e.W11 comes out to be 35% (W11=W11a+W11c). Since all the WW delivered to treatment plant is treated, W5a becomes 20%.

F10 is estimated to be around 67%, which constitutes of 64 % population dependent on septic tanks, 2.3 % dependent on lined pits with semi-permeable walls and open bottom and 0.3% dependent on unlined pits. Since there is no clear demarcation in the quantity of solid FS generated and effluent/infiltration generated from on-site systems, it is assumed to be 50%

each. It is also assumed that 90% of the population (dependent on on-site systems) gets their system emptied when full.

Table 4: Description of variables used in SFD

Variable	Description
W2	WW contained centralized (offsite)
W15	WW not contained (offsite)
W11	WW not delivered to treatment
W11a	WW not delivered to centralized treatment plant
W11c	WW not contained not delivered to treatment plant
W4a	WW delivered to centralized treatment plant
W4c	WW not contained delivered to treatment plant
W5a	WW treated at centralized treatment plant
F10	FS not contained (onsite)
F3	FS emptied
F3b	FS not contained- emptied
F15	FS not contained- not emptied
F11	FS not delivered to treatment
F4	FS delivered to treatment plant
F5	FS treated
OD9	Open Defecation

Population dependent on OSS is 67% and FS of 30% population gets emptied, therefore F3b=30%. It is estimated that 11% FS is delivered and co-treated at the WW treatment plant, hence F4 and F5 comes out to be 11%. The rest of the emptied FS is discharged untreated in environment, therefore F11 comes out to be 19%. Since there's some sludge always left in the tanks and pits, F15 is estimated to be 4%. 11% of population practice open defecation hence OD9 is computed to be 11%.

It can be concluded that excreta of 31% population is managed safely in the Cuttack city and 69% of excreta is discharged in environment untreated. The following table summarizes the

percentages of the population using each sanitation technology and method along the service chain.

Table 5: Percentage of the population using each system technology and method

System type	Containment	Emptying	Transport	Treatment	End-use/ disposal
Offsite	T1A1C2 (Reference L1): 19% of the population is connected to centralised sewer, hence W2 is 19%. T1A1C6 (Reference L4): 0.7 % of the population is discharging their excreta directly to open drain. T1A1C8 & T1A1C9 (Reference L5): 1.2 % of the population is discharging their excreta directly to open ground and 1.2% discharging- don't know where. Total WW not contained (offsite), i.e.W15, adds up to 3%.	Not Applicable.	WW of 7%of the population served by centralised sewers, reaches treatment facilities, hence W4a is 7%. It is estimated that 12% would be discharged to open drain, hence W11a=12% WW not contained, delivered to centralised treatment plant, i.e. W4c is estimated to be13%. WW not contained not delivered to centralised treatment plants, i.e. W11c, is 23% which includes effluent from OSS. Total WW not delivered to treatment plant, i.e. W11, is 35%.	WW of 7% of population gets treated. But W5a is 20% as it includes treatment of WW which is not contained. WW of 13%of population, which is not contained, gets treated and adds upto W5a	Treated WW is disposed in river and also used for irrigation sometimes. WW disposed after treatment is 13% WW disposed untreated in local area comes out to be 35%
Onsite	67% of population is dependent on onsite sanitation systems, since none of the systems are contained, F10, FS not contained is 67% T1A2C6 (Reference L8): 64% of population is dependent on septic tanks connected to open drain T2A5C10 (Reference S4):2.3% of population is dependent on lined pit with semi permeable walls and open bottom T2A6C10 (Reference S4):0.3% of population is dependent on unlined pit	Since most of the population is getting their systems emptied, it is assumed 90% of population has their onsite technology emptied. Since there is no clear differentiation between % of septage and effluent, it is assumed to be 50% each. FS not contained- emptied, i.e. F3b comes out to be 30% and FS not contained-not emptied becomes 4%.	FS transported to treatment plant is estimated to be 11% therefore F4=11% FS not delivered to treatment plant, i.e.F11, comes out to be 19%.	FS is indirectly co-treated at WW treatment plant hence, therefore FS treated, i.e. F5, is 11%.	All the FS along with WW with or without treatment ends up in river.
Open Defecation	11% of population practice open defecation and hence OD9 is computed to be 11%.				

3.2.2 Risk of groundwater contamination

Water for the entire city is extracted from the ground, as the surface water source, Mahanadi, is polluted. Water supplied to city is 100 MLD. Extraction of water from each production well is approximately 1MLD. There are many private bore wells and stand posts spread across the city. There is no water treatment plant; water is chlorinated and then supplied (MoUD, 2013a).

The soil beneath the city is composed of unconsolidated alluvium in alternating sequence of sand, silt, and clay, the depth of which continues up to 120 m and is placed above Gondwanaland sedimentary rock of archaean crystallines. The depth of water table changes with monsoon, it goes down to 4-6 mbgl during pre monsoon and rises to 0 to 3 mbgl during monsoon and post monsoon period. The first confined aquifer lies at a depth of 30 mbgl with thickness varying from 15 to 40 meters separated from the second confined aquifer by clay bed of 15 to 20 meters thickness (CGWB, 2007).

The ground water is safe for consumption, falling within safe limits prescribed by WHO, when tested from sources distant from unprotected septic tanks. Ground water sources located near the drains are relatively more polluted. It was found from the (physico-chemical and microbial) study that potential source of ground water contamination is domestic sewage. There is a need to create awareness among the people about the effect of using polluted water (G. Sunpriya Achary et al, 2011).

4 Stakeholder engagement

4.1 Key informant interviews

The relevant departments were contacted through e-mail, letter, call and fax prior to visit to the city. The purpose of the SFD study and depth of data required was conveyed through an introductory letter to respective departments. Overall, Seven KIIs were conducted with different stakeholders of government functionaries (see appendix 7.2). The GoO operates through its PHEO/H&UD department. The department is supported by ADB and JICA.

Limited documents were available on web hence the visit to the city also helped in collecting data, including unpublished reports. The KIIs and data collected helped in understanding the existing situation and upcoming development plans in the sanitation sector. Due to limitation of desk-based study, all the key stakeholders engaged in sanitation services could not be interviewed in person.

5 Acknowledgements

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7 Appendix

7.1 SFD matrix

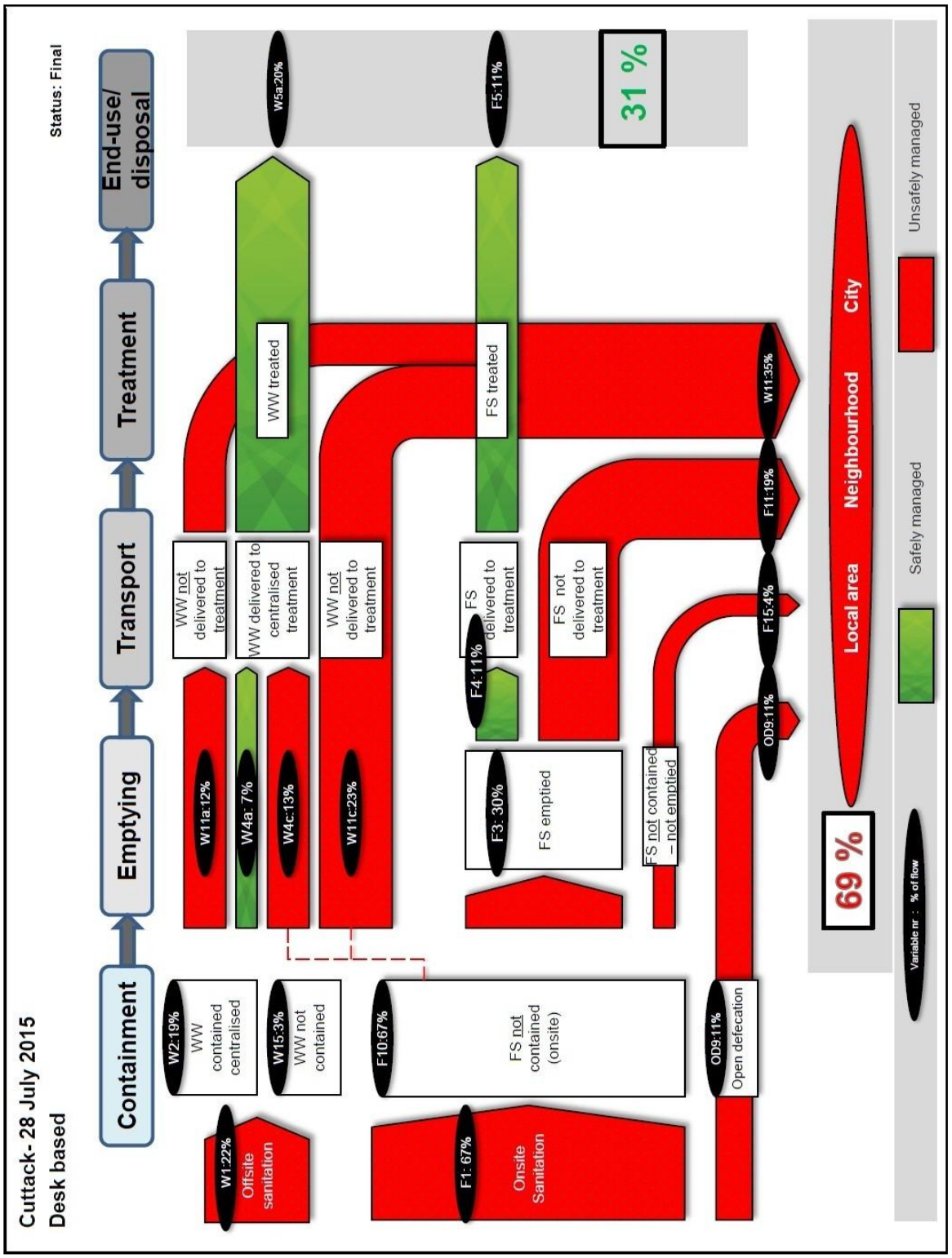

Figure 2: SFD matrix

7.2 Stakeholder identification

Table 6: Stakeholder identification

No.	Stakeholder group	In Cuttack context
1	City council / Municipal authority / Utility	Cuttack Municipal Corporation
2	Ministry in charge of urban sanitation and sewerage	Housing and Urban Development Department, GoO
3	Ministry in charge of urban solid waste	Housing and Urban Development Department, GoO
4	Ministries in charge of urban planning finance and economic development.	Housing and Urban Development Department, GoO
	Ministries in charge of environmental protection	Forest and Environment Department, GoO
	Ministries in charge of health	State Health Department, GoO
5	Service provider for construction of onsite sanitation technologies	N/A
6	Service provider for emptying and transport of FS	Cuttack Municipal Corporation
7	Service provider for operation and maintenance of treatment infrastructure	OWSSB/PHD-I
8	Market participants practising end-use of FS end products	N/A
9	Service provider for disposal of FS (sanitary landfill management)	Cuttack Municipal Corporation
10	External agencies associated with FSM services: e.g. NGOs, academic institutions, donors	Private emptiers

7.3 Tracking of engagement

Table 7: Tracking of stakeholder engagement

Name of organisation	Name of contact person	Position	Date of engagement	Purpose of engagement
Cuttack Municipal Corporation	Mr Gyana Das	Commissioner	11/2/2015	Introducing SFD, securing support for project
Public Health and Engineering Organisation	Mr Kshitish Chandra Sahu	Chief Engineer	9/2/2015	Introducing SFD, securing support for project
Cuttack Municipal Corporation	Dr. P.K Pradhan	City Health Officer	11/2/2015	KII
Cuttack Municipal Corporation	D.R Tripathy	Assistant Executive Engineer	11/2/2015	KII
Cuttack Municipal Corporation	Mr Ajay Mohanty	Sanitary wing	11/2/2015	KII
Odhisa Pollution Control Board	Er S.K Panda	-	12/2/2015	KII
Odhisa Pollution Control Board	Mr R.B Samhal	-	9/2/2015	KII
Cuttack Municipal Corporation	Mr Pramod	Landfill Supervisor	11/2/2015	KII
PHD-I	Mr Rashmi Ranjan Sahoo	Asst. Executive Engineer	12/2/2015	KII

7.4 Selected pictures taken during visit

Figure 3: Open drain carrying sewage

Figure 4: CMC's vacuum tanker

Figure 5: Waste stabilization pond

Figure 6: Indiscriminate disposal of sewage into Kathajodi River