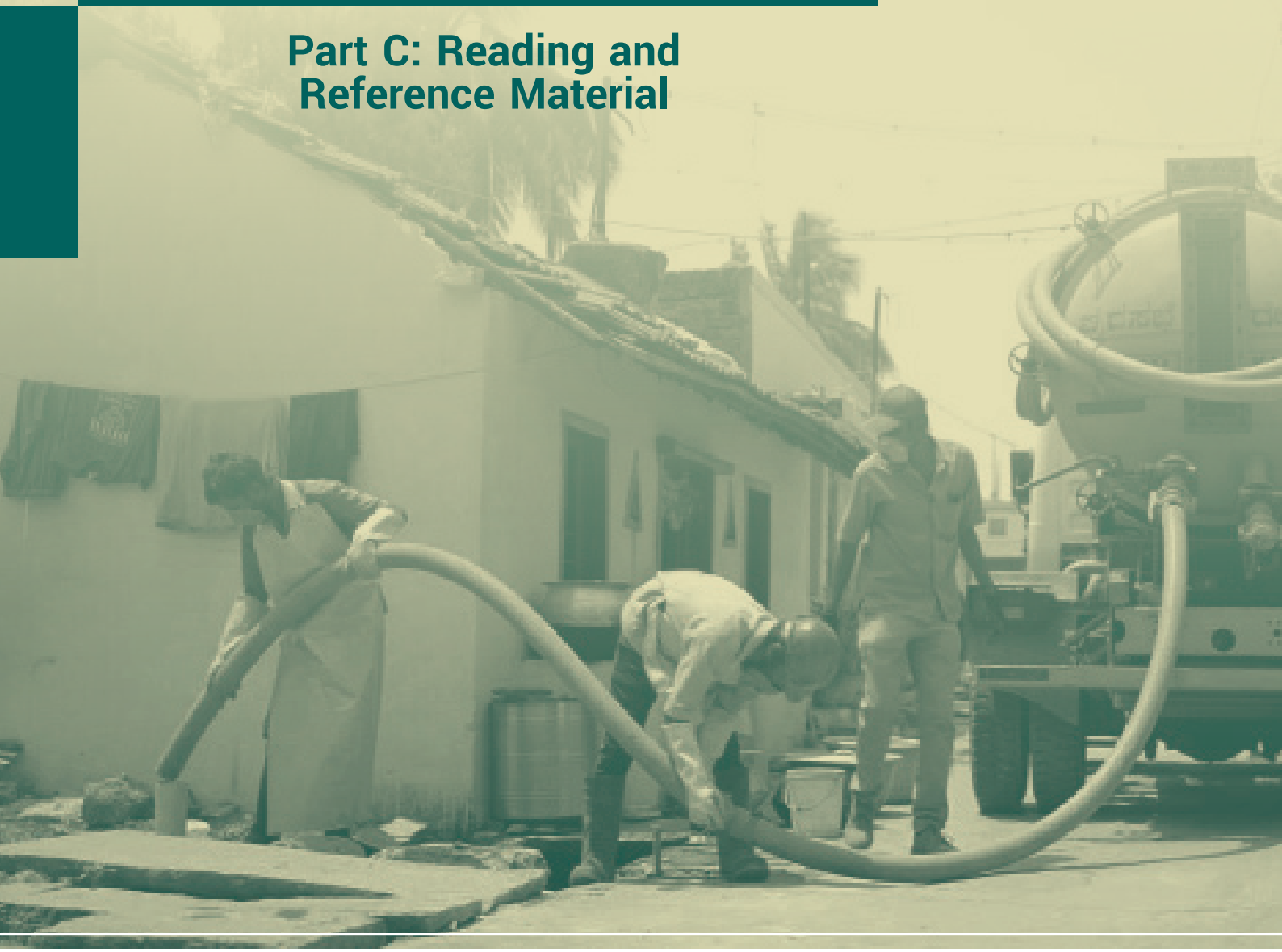
FAECAL SLUDGE AND SEPTAGE MANAGEMENT

An Orientation Module

Part C: Reading and Reference Material

SCBP

Sanitation Capacity Building Platform



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National Institute of Urban Affairs

FAECAL SLUDGE AND SEPTAGE MANAGEMENT

An Orientation Module

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TITLE
FAECAL SLUDGE AND SEPTAGE MANAGEMENT — AN ORIENTATION MODULE
(PART C: READING AND REFERENCE MATERIAL)

PUBLISHER
NATIONAL INSTITUTE OF URBAN AFFAIRS, DELHI

RESEARCH PROJECT
SANITATION CAPACITY BUILDING PLATFORM

GRAPHIC DESIGN
Deep Pahwa, Kavita Rawat

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Year Of Publishing: 2017

CONTENT
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The full module should be referenced as follows:
NIUA (2018) “Faecal Sludge and Septage Management: An Orientation Module”.
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READING MATERIAL - SESSION 1
URBAN SANITATION AND FUNDAMENTALS OF FSSM

Number of UAs/Towns and Out Growths (OGs)

Census of India 2011

Provisional Population Totals
Urban Agglomerations and Cities

Data Highlights

This data release covers the total population, population (0 to 6 years) and number of literates for each UA/City with a population of 1 Lakh and above as per the provisional population totals of Census 2011.

Definitions:

Towns:

For the Census of India 2011, the definition of urban area is as follows;

1. All places with a municipality, corporation, cantonment board or notified town area committee, etc.
2. All other places which satisfied the following criteria:

   i) A minimum population of 5,000;
   ii) At least 75 per cent of the male main working population engaged in non-agricultural pursuits; and
   iii) A density of population of at least 400 persons per sq. km.

The first category of urban units is known as Statutory Towns. These towns are notified under law by the concerned State/UT Government and have local bodies like municipal corporations, municipalities, municipal committees, etc., irrespective of their demographic characteristics as reckoned on 31st December 2009. Examples: Vadodara (M Corp.), Shimla (M Corp.) etc.

The second category of Towns (as in item 2 above) is known as Census Town. These were identified on the basis of Census 2001 data.

Urban Agglomeration (UA): An urban agglomeration is a continuous urban spread constituting a town and its adjoining outgrowths (OGs), or two or more physically contiguous towns together with or without outgrowths of such towns. An Urban Agglomeration must consist of at least a statutory town and its total population (i.e. all the constituents put together) should not be less than 20,000 as per the 2001 Census. In varying local

conditions, there were similar other combinations which have been treated as urban agglomerations satisfying the basic condition of contiguity. Examples: Greater Mumbai UA, Delhi UA, etc.

Out Growths (OG): An Out Growth (OG) is a viable unit such as a village or a hamlet or an enumeration block made up of such village or hamlet and clearly identifiable in terms of its boundaries and location. Some of the examples are railway colony, university campus, port area, military camps, etc., which have come up near a statutory town outside its statutory limits but within the revenue limits of a village or villages contiguous to the town. While determining the outgrowth of a town, it has been ensured that it possesses the urban features in terms of infrastructure and amenities such as pucca roads, electricity, taps, drainage system for disposal of waste water etc. educational institutions, post offices, medical facilities, banks etc. and physically contiguous with the core town of the UA. Examples: Central Railway Colony (OG), Triveni Nagar (N.E.C.S.W.) (OG), etc. Each such town together with its outgrowth(s) is treated as an integrated urban area and is designated as an 'urban agglomeration'.

In the 2011 Census, 475 places with 981 OGs have been identified as Urban Agglomerations as against 384 UAs with 962 OGs in 2001 Census.

Number of UAs/Towns and Out Growths (OGs):

	Type of Towns/UAs/OGs	Number of towns	
		2011 Census	2001 Census
1	Statutory Towns	4,041	3,799
2	Census Towns	3,894	1,362
3	Urban Agglomerations	475	384
4	Out Growths	981	962

At the Census 2011 there are 7,935 towns in the country. The number of towns has increased by 2,774 since last Census. Many of these towns are part of UAs and the rest are independent towns. The total number of Urban Agglomerations/Towns, which constitutes the urban frame, is 6166 in the country.

Whole document can be downloaded from http://censusindia.gov.in/2011-prov-results/paper2/data_files/India2/1.%20Data%20Highlight.pdf

ODF Definition and ODF declaration protocol

Declaring your City/Town ODF: A ready reckoner

स्वच्छ भारत
एक कदम स्वच्छता की ओर

Definitions and Necessary conditions

Definition of Open Defecation Free city / ward

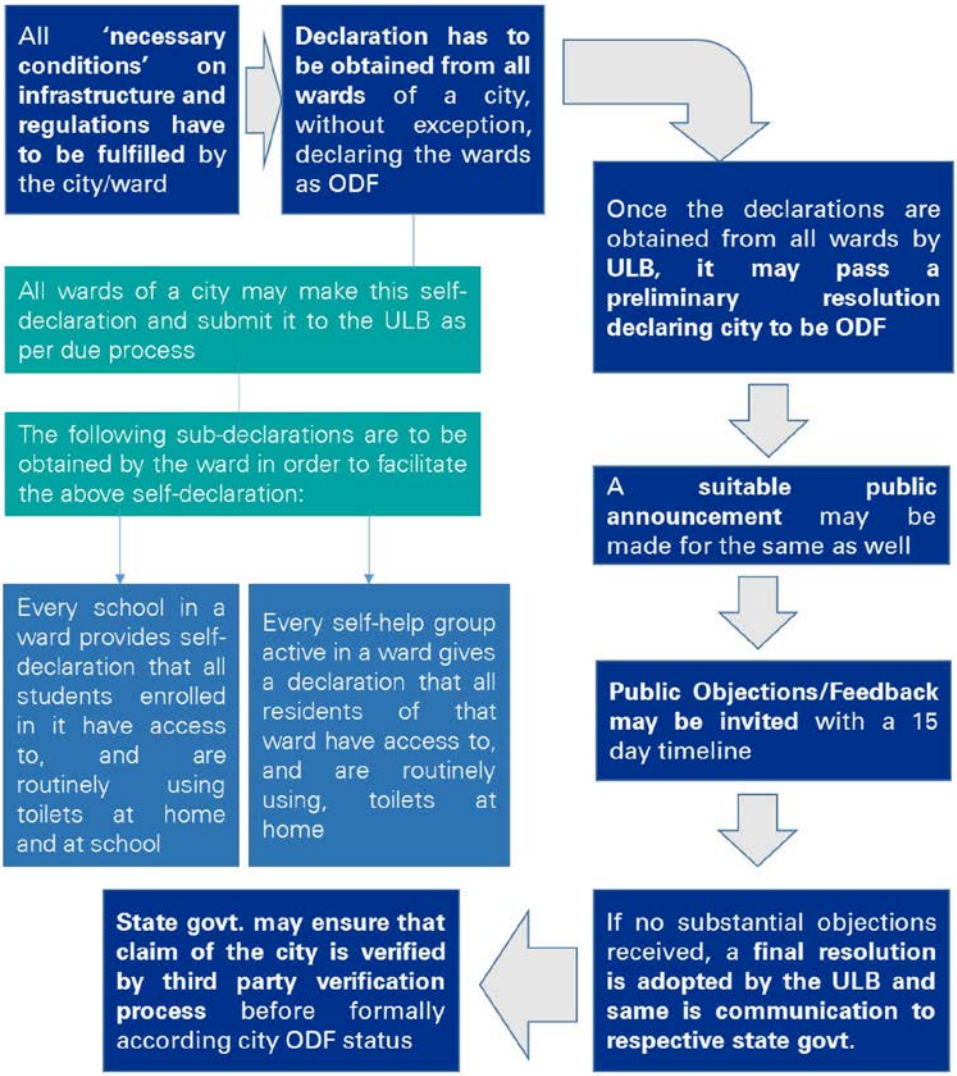
A city / ward can be notified/declared as ODF city/ ODF ward if, at any point of the day, not a single person is found defecating in the open.

Necessary infrastructure and regulatory conditions to be achieved before declaring a city/ ward as Open Defecation Free:

1) All households that have space to construct toilet, have constructed one.
2) All occupants of those households that do not have space to construct toilet have **access to a community toilet within a distance of 500 meters.**
3) All commercial areas have **public toilets within a distance of 1 kilometer.**
4) City has a mechanism in place through which fines are imposed fine on people found defecating in the open

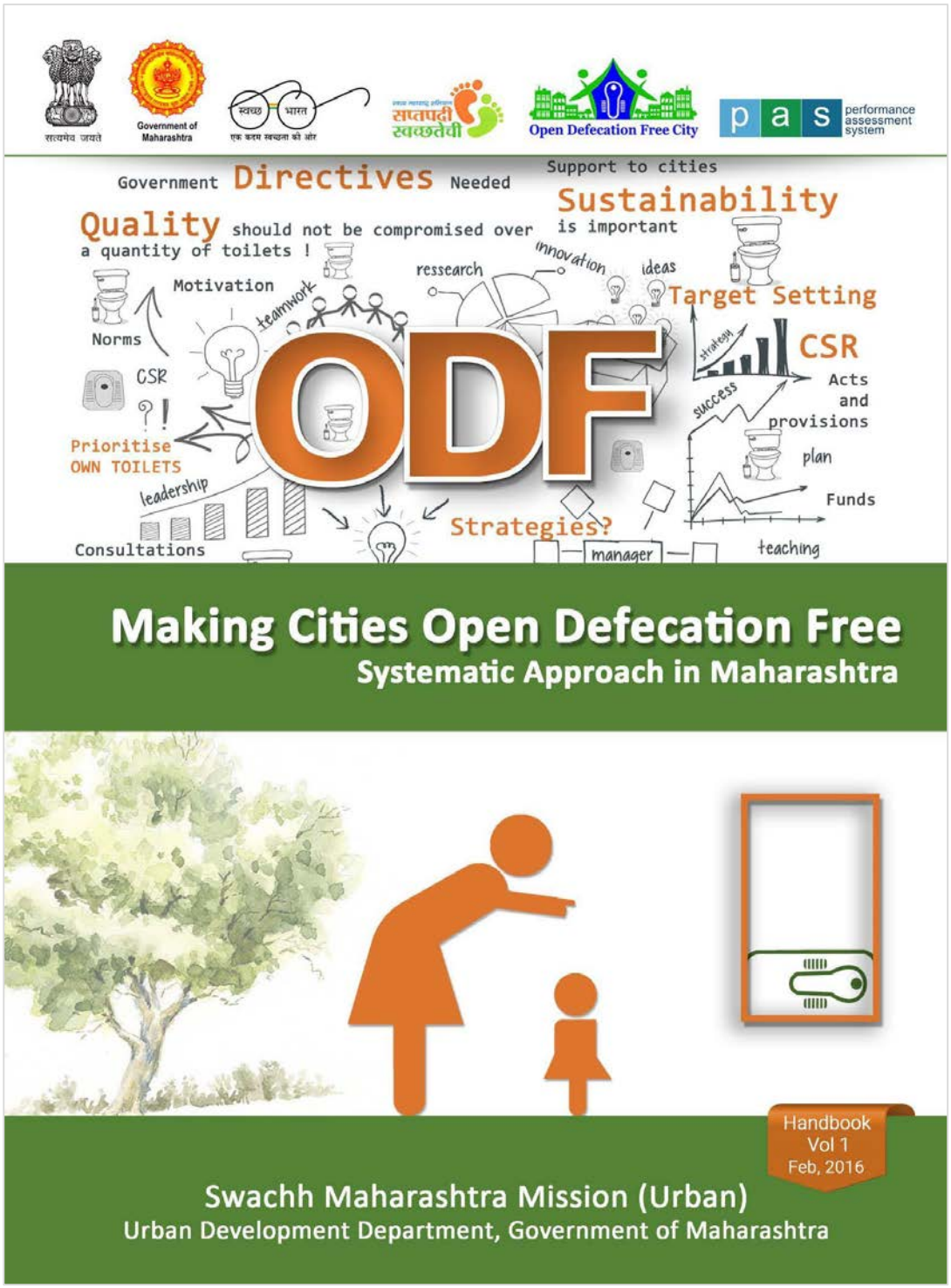
ODF Declaration Protocols

The following protocol is to be adopted for declaring a city / ward as Open Defecation Free (ODF):



Retrieved from ready reckoner for ULBs to declare a city/ward open defecation free. This document is available on http://sac.ap.gov.in/sac/UserInterface/Downlaods/IECMaterials/ODF%20Declaration%20booklet.pdf

Maharashtra ODF framework



What are "ODF Cities" in Maharashtra ?

A framework developed by Government of Maharashtra for defining "ODF Cities" in Maharashtra

As a long term vision, GoM aims to move towards improved sanitation by encouraging access to own toilets with safe management of faecal waste.

With many new toilets being built under SMMU, cities have to face increased challenges in disposing the faecal waste. For creating awareness about the need of own toilets and safe and regular management of faecal waste SMMU has identified the whole process of 'granting' ODF status to cities. In order to encourage ULBs for taking into consideration entire service chain of sanitation, GoM has developed concept of "ODF+ Cities" and "ODF++ Cities"

Framework for "ODF, ODF + and ODF ++ Cities"

	Elimination of OD practices	Access to toilets	Conveyance and treatment of faecal waste
ODF City	• Not a single person found defecating in the open • No traces of faeces are visible in the city at any time of the day.	• All the properties in the city have access to either own toilet or functional community/ public toilet • Floating population in the city has an access to sufficient and functional public toilets	• All toilets are connected to a disposal system
ODF+ City	• Not a single person found defecating in the open • No traces of faeces are visible in the city at any time of the day.	• At least **80%** of residential properties in the city have access to own toilets • Remaining properties and floating population in the city have access to functional community/ public toilets	• All toilets are connected to a disposal system • Regular and safe **collection, conveyance and treatment of all the feacal matter**
ODF++ City	• Not a single person found defecating in the open • No traces of faeces are visible in the city at any time of the day.	• At least **95%** of residential properties in the city have access to own toilets • Remaining properties and floating population in the city have access to functional community/public toilets	• All toilets are connected to safe disposal system • Regular **safe collection, conveyance and treatment of all feacal matter and waste water** including septic tank effluent and grey water

2

Maharashtra ODF guidelines can be downloaded from
http://pas.org.in/Portal/document/UrbanSanitation/uploads/ODF%20framework%20of%20Govt%20of%20Maharashtra.pdf

CONTROL OF URBAN POLLUTION
SERIES : CUPS/68/2007

Evaluation Of Operation And Maintenance Of Sewage Treatment Plants In India-2007

CENTRAL POLLUTION CONTROL BOARD
Ministry of Environment & Forests
Parivesh Bhawan, East Arjun Nagar,
Delhi-110 032
Website : http://www.cpcb.nic.in e-mail : cpcb@nic.in

system due to lack/absence of preliminary treatment by individuals tanners. Sampling/testing of the effluent at CETP is being done by the West Bengal Pollution Control Board and the treated effluent is meeting the design standards for all the parameters e. g. TSS, BOD, Total Chromium etc.

Grade: Satisfactory

CHAPTER 4

Conclusions and Recommendations

1. Mostly influent to the STP was found to contain lot of solid wastes including plastics, pouches etc. which may cause wear and tear of pumps & machinery and reduced efficiency of treatment, specially in case of UASB process where the feeding pipes and overflow weirs/V-notches in division boxes/effluent gutters, are chocked/obstructed, thus also resulting in reduced STP capacity. It is, generally, observed that mechanical screens installed in STPs/PSS are out of order, mainly because of the reason that these are not regularly sun and also clue to poor maintenance. Comprehensive scheme for providing solid waste management in all the towns including public awareness, institutional strengthening etc. need to be implemented. As an immediate solution to the problem, specially in UASB process, fine/mesh screens can be put in place of ordinary bar screens. Larger size of feeding pipes with more frequent cleaning can also solve this problem.

2 Staff/officers/engineers engaged for O&M at some STPs are not fully familiar and aware of the subject of sewage treatment. They are not trained in the O&M of the STPs. Proper training programme needs to planned & implemented for all the engineering level staff/officers who are deputed for O&M of STPs. This should be followed by training for operators as well as chemists who perform sampling/testing work.

3 At most of the STPs, either O&M manual is not prepared or it is not available/used, or it is not comprehensive enough to include various steps /procedures to be followed in day to day O&M of the plants as per design so as to have desired quality of treated effluent. O&M manual should spell out the procedure of reporting and recording of all the data/parameters including quality of waste water in various units of the plants.

4 Polishing ponds (in case of UASB process) and Waste Stabilization Ponds (WSPs) are mostly found accumulated with sludge resulting in reduced capacity/detention time in the tank. This also effects the quality of treated effluent due to sludge flowing out with it. Sludge levels should be checked regularly and the ponds should be cleaned off deposited sludge accordingly.

5 In case of polishing ponds or WSPs, it is found that single unit of these ponds have been provided in some STPs. In such cases, it is very difficult to clean off the accumulated sludge /silt without closing the STP. So it is important that at least two units of such ponds are provided at each STP. Also, in case of big ponds/channels wide and long partition/baffle wall need to be provided for easy access for inspection/repairs.

6 Sludge in UASB reactors are not withdrawn regularly based on its level and concentration in the reactors which results in sludge flowing with the effluent in polishing ponds and thus poor quality of treated effluent. Regular checking of sludge level and its concentration in the reactors is essential for proper sludge withdrawal.

7 Due to improper removal of filtrate from sludge drying beds, subsequent removal/withdrawal of sludge from sludge drawing beds/reactors is not possible in a desired manner, as the capacity of sludge drying beds is reduced. Hence, filtrate from the beds and sludge from the reactors/sludge drying beds need to be taken out regularly in a proper way.

8 It is important to prepare daily status report so as to record occurrence of problems in respect of running, functioning, repair, maintenance etc. of all the equipments, units, facilities etc. installed in each STP, so that the problems, if any, can be solved as and when applicable. This will also serve as feed back for future planning & execution as well as tool for monitoring the performance of STPs at a higher level.

9 Some of the STPs don't have sufficient baffle walls and also, sufficient length of overflow weirs at their final outlets in case of UASB polishing ponds and WSPs, resulting in poor effluent quality. Baffle walls should be constructed for whole length the pond width so that scum/sludge does not flow out with the effluent. Similarly, longer overflow weirs will ensure less approaching velocity of flow and subsequently, efficient solid liquid separation.

10 In view of frequent rusting/damage of iron/MS parts/accessories installed in STPs/PSs due to sulphur action, such items e.g. railings, screens, platforms etc., as far as possible, should be manufactured in stainless steel, as seen in case of STPs being constructed/renovated in TamilNadu, Maharashtra etc. Moreover, small electric installations such as motors, flow meters, starters, etc put up for operation of aerators, screens, grit removal mechanism, gates etc. should be covered with temporary sheds (PVC) to protect against rain water, dust etc.

11 It is observed that in most of the towns specially, in UP, Bihar and even Delhi, where there is acute shortage of power supply, standby arrangement during power cut/failure does not generally exists to meet the power requirement for running the plant.

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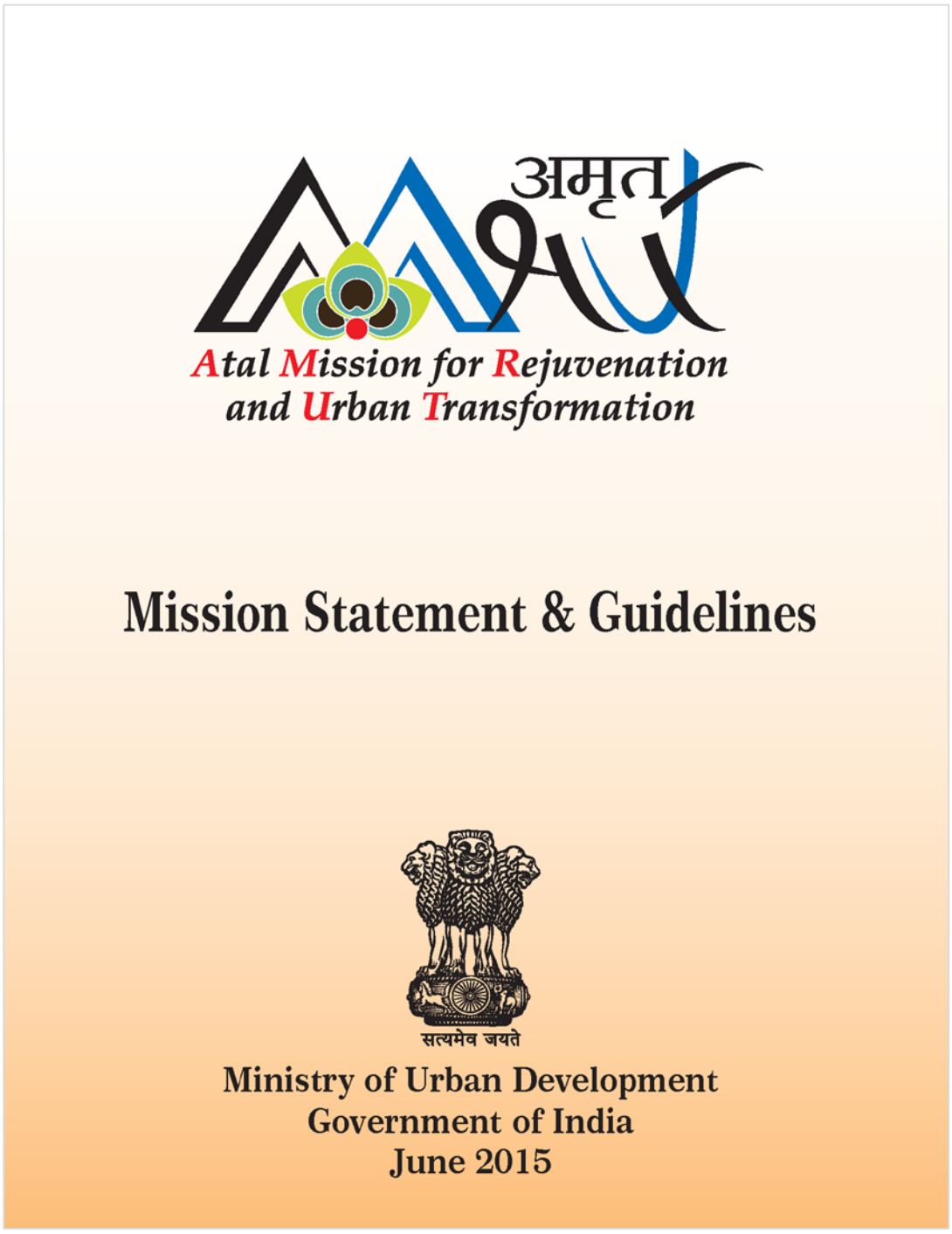
CPCB report on "Evaluation of O&M of STPs" is available on
http://www.cpcb.nic.in/upload/NewItems/NewItem_99_NewItem_99_5.pdf

Atal Mission for Rejuvenation and Urban Transformation (AMRUT) guidelines:



3.1.9 **Indicative (not exhaustive) list of inadmissible components**

i. Purchase of land for projects or project related works,
ii. Staff salaries of both the State Governments/ULBs,
iii. Power,
iv. Telecom,
v. Health,
vi. Education, and
vii. Wage employment programme and staff component.

4. Fund Allocation

4.1 The total outlay for AMRUT is Rs. 50,000 crore for five years from FY 2015-16 to FY 2019-20 and the Mission will be operated as a Centrally Sponsored Scheme. The AMRUT may be continued thereafter in the light of an evaluation done by the MoUD and incorporating learnings in the Mission. The Mission funds will consist of the following four parts:

i. Project fund - 80% of the annual budgetary allocation.
ii. Incentive for Reforms - 10% of the annual budgetary allocation.
iii. State funds for Administrative & Office Expenses (A&OE) - 8% of the annual budgetary allocation
iv. MoUD funds for Administrative & Office Expenses (A&OE) - 2% of the annual budgetary allocation

However, for FY 2015-16 the project fund would be 90% of the annual budgetary allocation as incentive for Reforms will be given only from FY 2016-17 onwards. The Mission funds would be allocated to States/UTs based on the following principles.

4.2 **Project Fund**

The project fund will be divided among States/UTs at the beginning of each year. An equitable formula will be used to distribute the annual budgetary allocation in which equal (50:50) weightage is given to the urban population of each State/UT (Census 2011) and the number of statutory towns in the State/UT. As the number of statutory towns are notified by States/UTs and will change during the Mission period, the formula will take into account changes in this number every year. The amount of project fund allocated will be informed to the States/UTs at the appropriate time. The Central Assistance (CA) for the projects will be in three instalments of 20:40:40 of the approved cost (Refer para 9).

4.3 **Incentive for Reform**

One purpose of the Mission is to improve governance through a set of Reforms. During the Mission period, 11 Reforms will be implemented. The list is given in Annexure 1. The following principles will govern the grant of incentives to States.

i. Past exprience shows that projects get delayed if release of project funds is linked to non-completion of Reforms. Therefore, the AMRUT shifts from penalization to

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AMRUT guidelines can be downloaded from this link:
http://amrut.gov.in/writereaddata/amrut%20guidelines%20.pdf

Thirteenth Finance Commission

2010–2015

Volume I: Report

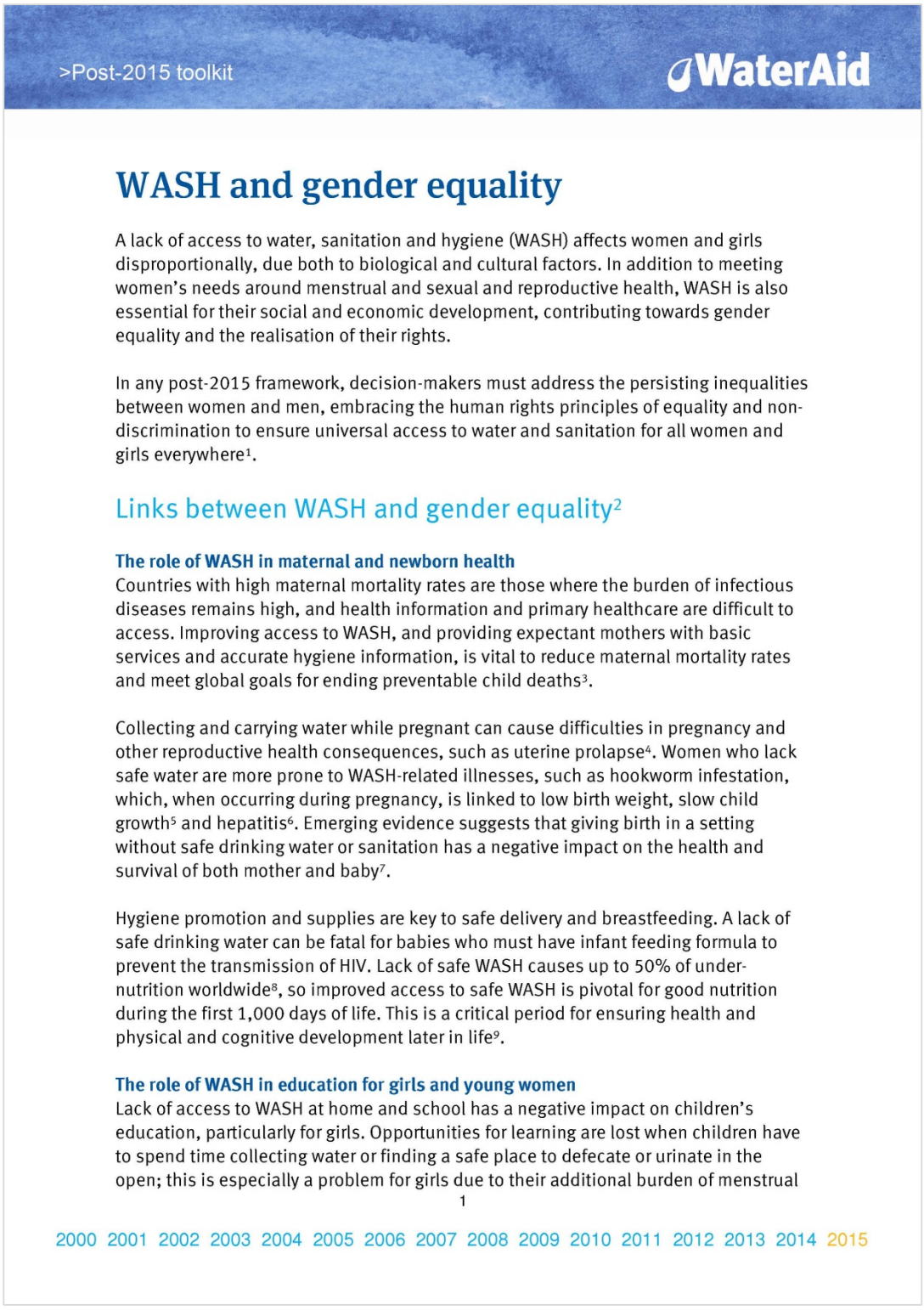
December 2009

Sl. No.	State	Levels of Rural Local Bodies (including ADCs)	FC-XII	FC-XIII	Levels of Urban Local Bodies	FC-XII	FC-XIII
1	2	3		4	5		6
22	Rajasthan	1. Gram Pachayats	9189	9184	1. Municipal Corporations	3	3
		2. Panchayat Samities	237	237	2. Municipal Councils	11	11
		3. Zilla Parishads	32	32	3. Municipal Boards	169	169
		Total	**9458**	**9453**	**Total**	**183**	**183**
23	Sikkim	1. Gram Pachayats	166	163	Municipal Corporation	0	1
		2. Zilla Panchayats	4	4	Municipal Councils	0	2
					Nagar Panchayats	0	9
		Total	**170**	**167**	**Total**	**0**	**12**
24	Tamil Nadu	1. Village Panchayats	12618	12618	1. Municipal Corporations	6	8
		2. Panchayats Unions	385	385	2. Municipalities	102	150
		3. District Panchayats	28	29	3. Town Panchayats	611	561
		Total	**13031**	**13032**	**Total**	**719**	**719**
25	Tripura	1. Gram Panchayats	540	513	1. Municipal Councils	1	1
		2. Panchayat Samities	23	23	2. Nagar Panchayats	12	12
		3. Zilla Panchayats	4	4			
		4. Autonomus District Councils		1			
		Total	**567**	**541**	**Total**	**13**	**13**
26	Uttar Pradesh	1. Gram Panchayats	52029	52000	1. Nagar Nigam	11	12
		2. Kshetra Panchayats	809	820	2. Nagar Palika Parishads	195	194
		3. Zilla Panchayats	70	70	3. Nagar Panchayats	417	422
		Total	**52908**	**52890**	**Total**	**623**	**628**
27	Uttarakhand	1. Gram Panchayats	7055	7227	1. Nagar Nigam*	1	1
		2. Intermediate Panchayats	673	95	2. Nagar Palika Parishads*	31	31
		3. District Panchayats		13	3. Nagar Panchayats*	31	31
		Total	**7728**	**7335**	**Total**	**63**	**63**
28	West Bengal	1. Gram Panchayats	3358	3354	1. Municipal Corporations*	6	6
		2. Panchayat Samities	341	341	2. Municipalities*	114	118
		3. Zilla Parishads	18	18	3. Notified Area Authority*	3	3
		Total	**3717**	**3713**	**Total**	**123**	**127**
		1. Gram/Village Panchayats (including Village Councils & Boards)	**236350**	**239432**	**Total No. of Municipal Corporations**	**109**	**139**
		2. Panchayat Samities	**6795**	**6087**	**Total No. of Municipalities**	**1432**	**1595**
		3. Zilla Panchayats	**531**	**543**	**Total No. of Nagar Panchayats**	**2182**	**2108**
		4. Autonomus District Councils	**9**	**14**			
	Total	**Grand Total (ALL RLBs)**	**243685**	**246076**	**Grand Total (ALL ULBs)**	**3723**	**3842**
		Grand Total (ALL LBS)	**247408**	**249918**			

Source: FC-XIII:Data Submitted by State Governments to Thirteenth Finance Commission
FC-XII: Report of the Twelfth Finance Commission

CPCB report is divided in two volumes. Both volumes are available on http://fincomindia.nic.in/ShowContentOne.aspx?id=28&Section=1

Link between gender and sanitation



>Post-2015 toolkit

WaterAid

WASH and gender equality

A lack of access to water, sanitation and hygiene (WASH) affects women and girls disproportionally, due both to biological and cultural factors. In addition to meeting women's needs around menstrual and sexual and reproductive health, WASH is also essential for their social and economic development, contributing towards gender equality and the realisation of their rights.

In any post-2015 framework, decision-makers must address the persisting inequalities between women and men, embracing the human rights principles of equality and non-discrimination to ensure universal access to water and sanitation for all women and girls everywhere[1].

Links between WASH and gender equality[2]

The role of WASH in maternal and newborn health

Countries with high maternal mortality rates are those where the burden of infectious diseases remains high, and health information and primary healthcare are difficult to access. Improving access to WASH, and providing expectant mothers with basic services and accurate hygiene information, is vital to reduce maternal mortality rates and meet global goals for ending preventable child deaths[3].

Collecting and carrying water while pregnant can cause difficulties in pregnancy and other reproductive health consequences, such as uterine prolapse[4]. Women who lack safe water are more prone to WASH-related illnesses, such as hookworm infestation, which, when occurring during pregnancy, is linked to low birth weight, slow child growth[5] and hepatitis[6]. Emerging evidence suggests that giving birth in a setting without safe drinking water or sanitation has a negative impact on the health and survival of both mother and baby[7].

Hygiene promotion and supplies are key to safe delivery and breastfeeding. A lack of safe drinking water can be fatal for babies who must have infant feeding formula to prevent the transmission of HIV. Lack of safe WASH causes up to 50% of under-nutrition worldwide[8], so improved access to safe WASH is pivotal for good nutrition during the first 1,000 days of life. This is a critical period for ensuring health and physical and cognitive development later in life[9].

The role of WASH in education for girls and young women

Lack of access to WASH at home and school has a negative impact on children's education, particularly for girls. Opportunities for learning are lost when children have to spend time collecting water or finding a safe place to defecate or urinate in the open; this is especially a problem for girls due to their additional burden of menstrual

1

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

hygiene management (MHM). A lack of access to drinking water and toilets during the school day affects the learning environment for both students and teachers.

Adolescent girls in particular are disinclined to use school toilets that are dirty or lack privacy, especially when they are menstruating, and this affects their attendance.

Because menstruation is a taboo subject in many cultures and has negative connotations attached to traditional beliefs, effective education programmes need to be supported by fully accessible, child-friendly and gender-segregated WASH facilities. Without them, the resulting stigma, learned at a young age, exacerbates the challenges of managing menstrual hygiene in societies where there are no safe, private toilets with a water supply[10].

Raising awareness about MHM among school-age girls and boys can reduce fear and discrimination. This is achieved by replacing the silence and shame of menstruation with pride and confidence; equipping women and girls with the knowledge and means to manage their menstruation hygienically and with dignity, and providing means for the safe disposal of menstrual waste[11].

The role of WASH in preventing violent behaviour towards women

Women are often vulnerable to harassment or violence when they have to travel long distances to fetch water, use shared toilets, or practise open defecation. Women and girls often wait until nightfall to defecate, which increases the risk of assault. Many choose to 'hold it' or limit their consumption of food and drink to delay the need to relieve themselves, which can increase the chance of urinary tract infections. The shame and indignity of defecating in the open also affects women's self esteem, as does a lack of water for washing clothes and personal hygiene[12].

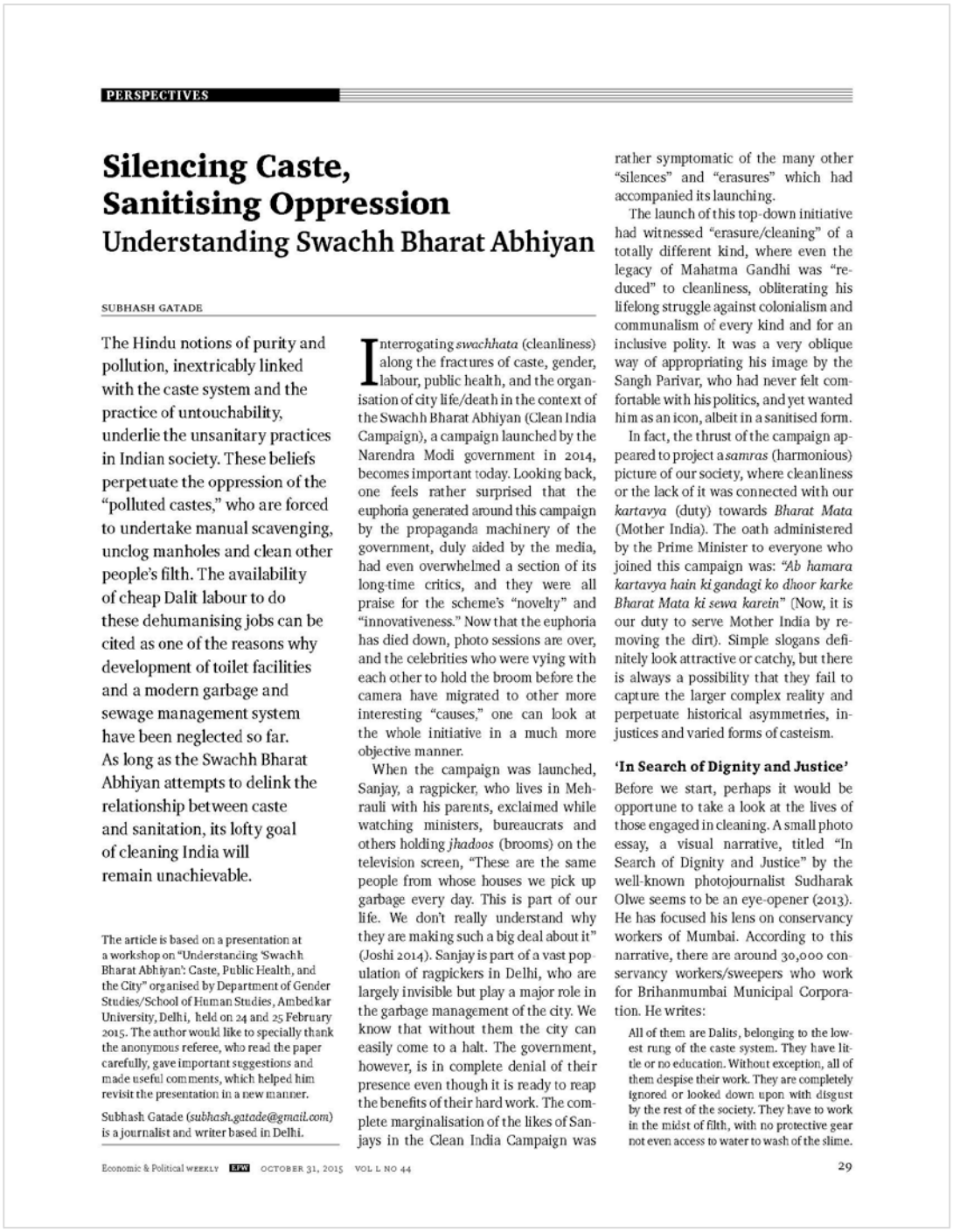
The role of WASH in empowering women economically

Women and girls perform most of the unpaid labour associated with WASH in households and communities. This reduces the time they have available for education, economic activities and leisure. A lack of economic independence compromises their empowerment and perpetuates gender inequality.

With improved access to WASH, women have more time to undertake income generating activities. WASH programmes also provide women with the water needed to carry out economic activities and can create opportunities for paid work. Easier access to water can, for example, enable a woman to water a kitchen garden, improving her family's food security and providing an opportunity to earn money by selling the surplus. Women's involvement in decision-making about water resources and in WASH programmes is critical to their empowerment, but it is important that they are not overburdened with additional unpaid work on top of their existing responsibilities.

A report by WaterAid on "WASH and Gender Equality" was published which is available on https://sustainabledevelopment.un.org/getWSDoc.php?id=2428

Link between caste and sanitation



PERSPECTIVES

Silencing Caste, Sanitising Oppression

Understanding Swachh Bharat Abhiyan

SUBHASH GATADE

The Hindu notions of purity and pollution, inextricably linked with the caste system and the practice of untouchability, underlie the unsanitary practices in Indian society. These beliefs perpetuate the oppression of the "polluted castes," who are forced to undertake manual scavenging, unclog manholes and clean other people's filth. The availability of cheap Dalit labour to do these dehumanising jobs can be cited as one of the reasons why development of toilet facilities and a modern garbage and sewage management system have been neglected so far. As long as the Swachh Bharat Abhiyan attempts to delink the relationship between caste and sanitation, its lofty goal of cleaning India will remain unachievable.

The article is based on a presentation at a workshop on "Understanding 'Swachh Bharat Abhiyan': Caste, Public Health, and the City" organised by Department of Gender Studies/School of Human Studies, Ambedkar University, Delhi, held on 24 and 25 February 2015. The author would like to specially thank the anonymous referee, who read the paper carefully, gave important suggestions and made useful comments, which helped him revisit the presentation in a new manner.

Subhash Gatade (*subhash.gatade@gmail.com*) is a journalist and writer based in Delhi.

Interrogating *swachhata* (cleanliness) along the fractures of caste, gender, labour, public health, and the organisation of city life/death in the context of the Swachh Bharat Abhiyan (Clean India Campaign), a campaign launched by the Narendra Modi government in 2014, becomes important today. Looking back, one feels rather surprised that the euphoria generated around this campaign by the propaganda machinery of the government, duly aided by the media, had even overwhelmed a section of its long-time critics, and they were all praise for the scheme's "novelty" and "innovativeness." Now that the euphoria has died down, photo sessions are over, and the celebrities who were vying with each other to hold the broom before the camera have migrated to other more interesting "causes," one can look at the whole initiative in a much more objective manner.

When the campaign was launched, Sanjay, a ragpicker, who lives in Mehrauli with his parents, exclaimed while watching ministers, bureaucrats and others holding *jhadoos* (brooms) on the television screen, "These are the same people from whose houses we pick up garbage every day. This is part of our life. We don't really understand why they are making such a big deal about it" (Joshi 2014). Sanjay is part of a vast population of ragpickers in Delhi, who are largely invisible but play a major role in the garbage management of the city. We know that without them the city can easily come to a halt. The government, however, is in complete denial of their presence even though it is ready to reap the benefits of their hard work. The complete marginalisation of the likes of Sanjays in the Clean India Campaign was rather symptomatic of the many other "silences" and "erasures" which had accompanied its launching.

The launch of this top-down initiative had witnessed "erasure/cleaning" of a totally different kind, where even the legacy of Mahatma Gandhi was "reduced" to cleanliness, obliterating his lifelong struggle against colonialism and communalism of every kind and for an inclusive polity. It was a very oblique way of appropriating his image by the Sangh Parivar, who had never felt comfortable with his politics, and yet wanted him as an icon, albeit in a sanitised form.

In fact, the thrust of the campaign appeared to project a *samras* (harmonious) picture of our society, where cleanliness or the lack of it was connected with our *kartavya* (duty) towards *Bharat Mata* (Mother India). The oath administered by the Prime Minister to everyone who joined this campaign was: *"Ab hamara kartavya hain ki gandagi ko dhoor karke Bharat Mata ki sewa karein"* (Now, it is our duty to serve Mother India by removing the dirt). Simple slogans definitely look attractive or catchy, but there is always a possibility that they fail to capture the larger complex reality and perpetuate historical asymmetries, injustices and varied forms of casteism.

'In Search of Dignity and Justice'

Before we start, perhaps it would be opportune to take a look at the lives of those engaged in cleaning. A small photo essay, a visual narrative, titled "In Search of Dignity and Justice" by the well-known photojournalist Sudharak Olwe seems to be an eye-opener (2013). He has focused his lens on conservancy workers of Mumbai. According to this narrative, there are around 30,000 conservancy workers/sweepers who work for Brihanmumbai Municipal Corporation. He writes:

> All of them are Dalits, belonging to the lowest rung of the caste system. They have little or no education. Without exception, all of them despise their work. They are completely ignored or looked down upon with disgust by the rest of the society. They have to work in the midst of filth, with no protective gear not even access to water to wash of the slime.

This document explains link between caste and urban sanitation. It is available on http://www.indiawaterportal.org/sites/indiawaterportal.org/files/silencing_caste_sanitising_oppression_understanding_swachh_bharat_abhiyan_epw_2015.pdf


Formative Research to Develop Appropriate Participatory Approaches towards Water, Sanitation, and Hygiene in Rural Areas
MARI
India WASH Forum | May 2016

Malnutrition, hard physical labour, repeated bouts of malaria, stomach and respiratory infections, early marriages and child births - are the most significant contributors to a weak immunity and susceptibility to infections and disease. Poor sanitation is a contributory factor.

celebrate with special offerings to the god or local deity which again involves considerable expenditure. Such faith and beliefs as well as lack of understanding on the oral fecal route of contamination are the major deterrents to behavioral change towards improved sanitation and hygiene.

In Jharkhand and Gujarat villages, major illness was usually malaria and respiratory diseases and not serious stomach infections like Jaundice, Cholera, and Diarrhea. *People do not attribute lack of sanitation to be the primary cause for major illness. Lack of proper nutrition, hard physical labour or general weakness of the human system over the years from early marriage and child birth, weakness from repeated bouts of malaria and viral fevers, etc., are seen as some of the most important factors for poor health condition than sanitation and hygiene borne factors.* Health sector experts identify delayed breast feeding and related personal hygiene as important factors of high infant mortality in India.

Previous exposure to toilets:

In some villages in Jharkhand, we came across masons who build septic tank toilets in urban areas but do not have a toilet at home. Affordability was cited as a reason, they were not willing or unable to spare Rs.12,000 for building a toilet with a septic tank though they knew ways of cost cutting.

In Telangana villages, some of the respondents shared impressions gathered over a period of time that reinforce barriers to using toilets. The resistance to use toilets arises from varied perceptions: *toilets stink particularly when the shit and urine gets mixed up; floors are always wet; claustrophobic feelings; privacy is inadequate as people outside can hear the sounds; cannot move away from the shit (which is shared as an advantage with open defecation practice); urine and watery motion will be absorbed by soil in open defecation while in toilet the spillover may spoil clothes; not good to use the same toilets used by menstruating women; and sitting in the toilet causes lot of sweating.*

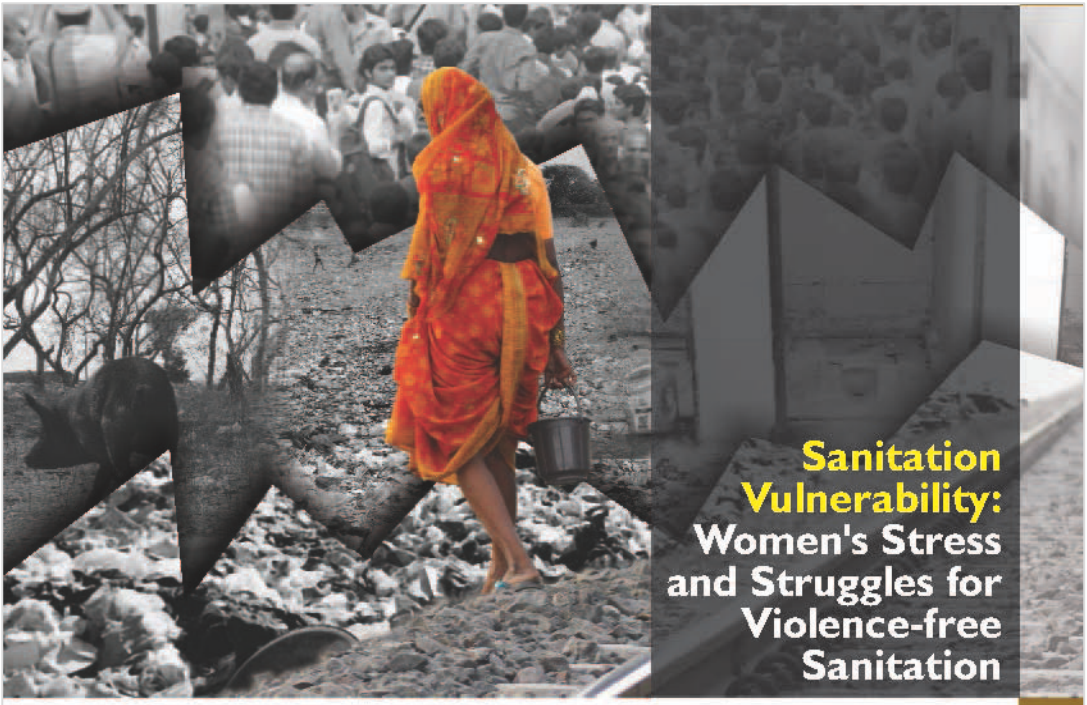
Smaller size pit latrines (3x3 feet dimension) are not considered user friendly by most people.

The educated urban people, particularly, the students have mixed feelings about the toilet construction at home and their feeling is dependent on the maintenance of toilets they are using in the hostels and colleges. They do not seem to be carrying a strong belief that toilet is a good convenience or has strong health impacts, and need to be promoted for their parents in their villages. Since the youth have practiced open defecation in their formative age, they do not feel embarrassed or discomforted in going for open defecation during their visits to their home in the villages. It is like switching back to old habits. However, in our formal conversation, they did not share any reluctance to encourage toilets construction at their home but many of them cited lack of financial resources as the barrier. Many of them also lacked proper understanding of the oral fecal route of contamination risks.

In Jharkhand villages, OBC community women had better exposure to using toilets than tribal women and hence were more willing to build and use toilets. Hence, they were more inclined to build and use toilets at home as compared to the tribal communities. Some families have restored the non functional toilets provided to them under TSC, only because of some family members who have become old or are suffering from disability and arthritis. These are old single offset pit toilets that are unlikely to last long and hence are used occasionally only.

Probably, the exposure to toilets in the outer world away from their villages has a positive impact on the willingness to build and use toilets. However, if other factors—availability of water and space to build toilets—are a challenge besides behavior change, then probably sanitation programmes of the government need to address these physical barriers first.

The document shows participatory approaches towards water, sanitation and hygiene in rural areas. The same is available on: http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Behaviour-Change-Formative-Research-2016.pdf



Sanitation Vulnerability: Women's Stress and Struggles for Violence-free Sanitation

Introduction

That billions of people are without adequate household sanitation is well known. One third of the world's 2.5 billion people without improved sanitation live in India (WHO/Unicef Joint Monitoring Program for Water Supply and Sanitation (JMPWSS) 2012). In India, the absence of sanitation in urban and rural areas is much discussed in the popular press (Boo 2012), the grey literature (http://www.wsscc.org/countries/asia/india/wash coalition overview; Stangland Trasi 2011; Pattanayak et al. 2009), and scholars from a variety of fields (McFarlane 2008; Jenkins and Scott 2007; Clasen et al. 2012). One feature of this conversation is the sheer number of people without improved sanitation, and the difficulty of achieving sanitation coverage in urban areas, where building sewerage is a massive task and where many without sanitation are landless or living in informal settlements.

For women lack of sanitation is not only a question of lack of privacy and dignity, but also one of physical insecurity and vulnerability. Women must respond to the psycho social stresses created by the hazards, risks and shame associated with the need to enter into dangerous spaces for the purpose of open defecation (OD).

The study

Based on research undertaken between October 2013 May 2014 in Pune (Maharashtra) and Jaipur (Rajasthan) this summary offers ethnographic evidence of poor urban women's experiences of harassment (e.g., eve teasing) and violence (e.g., assault) related to open defecation, as well as the multitude of coping mechanisms that they have adopted to minimize risk and psycho social stress. Our primary question was, "If gendered violence is symptomatic of power inequalities in society, then how do those inequalities manifest themselves in women's psycho social stress and translate into women's decisions about where to relieve themselves?"

We interviewed 112 women from the two cities of Pune and Jaipur to understand the psycho social stresses that women across diverse groups face as a result of lack of sanitation. Individual interviews, focus groups discussions and GIS mapping of OD sites and public toilets (PTs) were the different methods we used for the study.

Key findings

Our research has vividly brought out the multitude of psycho social stresses that women face due to unsafe, inadequate or the complete lack of sanitation facilities in addition to the various everyday struggles of their lives. It shows how experiences of psycho social stress vary across caste, class, age, kind of sanitation facility and location of the bastis (slums). Importantly the study shows how existing forms of socio economic inequalities reproduce a lack of safe spaces for sanitation just as much as they structure the coping mechanisms or the 'solutions' to the problem.

In conclusion

Poor slum dwelling women have developed habits that fit their caste, stage in the life course, marital status, etc. Nonetheless, every day is a different day, and the fears and discomfort that women confront are not necessarily the same in content, intensity, or even present on any given day, depending on the circumstances that they leave at home, their physical condition that day, and the presence/absence of certain groups/individuals at/near the defecation site.

Our discussion of the multiple inequalities that constrain women's choices surrounding sites of defecation begs the question, "What might the provision of adequate sanitation do to curtail gendered violence?" We take as a starting point that an alteration of gendered social relations is required. We find that individual women experience the risks of inadequate sanitation differently, but at broader scales, we reach the conclusions that provision of adequate sanitation is not sufficient to alter gendered social relations. Adequate sanitation without attention to gendered relations of power puts the burden of safety on women, and does not address the caste and gender based patterns of violence against women.

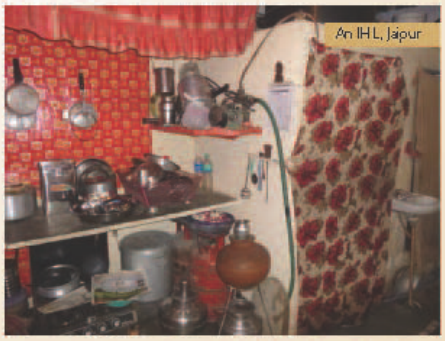
"Yes we need toilets, clean toilets, but we also need a place to stay, some employment to support us."

What emerges from the analysis of women's words is an understanding of both their individual struggles and the broad political relationships that hold India's gendered urban sanitation crisis in place. In particular, there are tensions between the needs of the urban poor and state led, neoliberal development agendas. Being part of the city's not so desirable population itself puts the poor in a vulnerable position. As Gidwani and Reddy (2011) write, the poor form the 'waste' of the city something that is outside of political modernity. So while there is a continual engagement with this 'waste' whether in terms of labour or spaces, it is mainly to maximize the potential of converting that labour or space into profit. Different arrangements emerge in this process, whereby common spaces are converted into private ones and labour is engaged in as much as it supports profit making. In such a paradigm of urban development the poor have to be gated out to the extent possible. The urban underclass is thus already in an unfavourable location and is thus not seen as worthy of any amenities.

We have no argument against a need for urban sanitation in India. The point has been made clearly by scholars and activists working in this sector. However through our evidence we argue for a need to move beyond abstractions such as 'right to sanitation' and 'sanitation deprivation' to ground the absence or inadequacy of sanitation in the everyday struggles and psycho social stress of women impacted by this reality (Sultana 2012).

Recommendations

- Rethinking the urban development paradigm has to come to the forefront of the agenda. Sanitation plans will have to be integrated into the larger development plans of cities and states, where development is based on principles of equity, sustainable use of resources and democratic participation.
- For the urban poor the immediate concerns are those of space and survival. Issues of lack of tenure, living space and drainage have been voiced as the key constraints in constructing toilets. While the National Urban Sanitation Policy (NUSP) strongly suggests that the urban local bodies (ULBs) will have to settle these issues and provide for minimum access to sanitation facilities (NUSP 2008), a strong national budgetary commitment for the same is in order.
- From slum dwelling women's point of view, however providing a toilet whether public or individual is not sufficient, its maintenance was a key issue. Public toilet maintenance has to be the ultimate responsibility of the ULBs. Moreover the study clearly showed that these toilets have to respond to needs of diverse women (for example old, pregnant, with children, disabled, belonging to different religious and caste communities) by being better lit, in safer locations and with regular provisioning of water.
- A need for a community mental health centre was evident given the various psycho social stresses that women faced.
- Finally a community monitoring process is required whereby women and other stakeholders across diverse caste, class, and religious groups can monitor schemes and their outcomes that are implemented for their sake.


An IHL, Jaipur


A PT, Pune

A research on urban sanitation linked with gender, class and caste is done by Society for Promoting Participative Ecosystem Management (SOPPECOM). Research paper is available on https://www.soppecom.org/pdf/sanitation-vulnerability.pdf

रजिस्ट्री सं० डी० एल०—(एन)04/0007/2003—13 REGISTERED NO. DL—(N)04/0007/2003—13

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II — खण्ड 1
PART II — Section 1
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं० 35] नई दिल्ली, बृहस्पतिवार, सितम्बर 19, 2013/ भाद्र 28, 1935 (शक)
No. 35] NEW DELHI, THURSDAY, SEPTEMBER 19, 2013/BHADRA 28, 1935 (SAKA)

इस भाग में भिन्न पृष्ठ संख्या दी जाती है जिससे कि यह अलग संकलन के रूप में रखा जा सके।
Separate paging is given to this Part in order that it may be filed as a separate compilation.

MINISTRY OF LAW AND JUSTICE

(Legislative Department)

New Delhi, the 19*th September*, 2013/*Bhadra* 28, 1935 (*Saka*)

The following Act of Parliament received the assent of the President on the 18th September, 2013, and is hereby published for general information:—

THE PROHIBITION OF EMPLOYMENT AS MANUAL SCAVENGERS AND THEIR REHABILITATION ACT, 2013

No. 25 OF 2013

[18*th September*, 2013.]

An Act to provide for the prohibition of employment as manual scavengers, rehabilitation of manual scavengers and their families, and for matters connected therewith or incidental thereto.

WHEREAS promoting among the citizens fraternity assuring the dignity of the individual is enshrined as one of the goals in the Preamble to the Constitution;

AND WHEREAS the right to live with dignity is also implicit in the Fundamental Rights guaranteed in Part III of the Constitution;

AND WHEREAS article 46 of the Constitution, *inter alia*, provides that the State shall protect the weaker sections, and, particularly, the Scheduled Castes and the Scheduled Tribes from social injustice and all forms of exploitation;

AND WHEREAS the dehumanising practice of manual scavenging, arising from the continuing existence of insanitary latrines and a highly iniquitous caste system, still persists in various parts of the country, and the existing laws have not proved adequate in eliminating the twin evils of insanitary latrines and manual scavenging;

(*b*) all the occupiers, jointly and severally, in all other cases:

Provided that the State Government may give assistance for conversion of insanitary latrines into sanitary latrines to occupiers from such categories of persons and on such scale, as it may, by notification, specify:

Provided further that non-receipt of State assistance shall not be a valid ground to maintain or use an insanitary latrine, beyond the said period of nine months.

(*3*) If any occupier fails to demolish an insanitary latrine or convert it into a sanitary latrine within the period specified in sub-section (*2*), the local authority having jurisdiction over the area in which such insanitary latrine is situated, shall, after giving notice of not less than twenty one days to the occupier, either convert such latrine into a sanitary latrine, or demolish such insanitary latrine, and shall be entitled to recover the cost of such conversion or, as the case may be, of demolition, from such occupier in such manner as may be prescribed.

Contract, agreement, etc., to be void.

6. (*1*) Any contract, agreement or other instrument entered into or executed before the date of commencement of this Act, engaging or employing a person for the purpose of manual scavenging shall, on the date of commencement of this Act, be terminated and such contract, agreement or other instrument shall be void and inoperative and no compensation shall be payable therefor.

(*2*) Notwithstanding anything contained in sub-section (*1*), no person employed or engaged as a manual scavenger on a full-time basis shall be retrenched by his employer, but shall be retained, subject to his willingness, in employment on at least the same emoluments, and shall be assigned work other than manual scavenging.

Prohibition of persons from engagement or employment for hazardous cleaning of sewers and septic tanks.

7. No person, local authority or any agency shall, from such date as the State Government may notify, which shall not be later than one year from the date of commencement of this Act, engage or employ, either directly or indirectly, any person for hazardous cleaning of a sewer or a septic tank.

Penalty for contravention of section 5 or section 6.

8. Whoever contravenes the provisions of section 5 or section 6 shall for the first contravention be punishable with imprisonment for a term which may extend to one year or with fine which may extend to fifty thousand rupees or with both, and for any subsequent contravention with imprisonment which may extend to two years or with fine which may extend to one lakh rupees, or with both.

Penalty for contravention of section 7.

9. Whoever contravenes the provisions of section 7 shall for the first contravention be punishable with imprisonment for a term which may extend to two years or with fine which may extend to two lakh rupees or with both, and for any subsequent contravention with imprisonment which may extend to five years or with fine which may extend to five lakh rupees, or with both.

Limitation of prosecution.

10. No court shall take cognizance of any offence punishable under this Act except upon a complaint thereof is made by a person in this behalf within three months from the date of the occurrence of the alleged commission of the offence.

CHAPTER IV

IDENTIFICATION OF MANUAL SCAVENGERS IN URBAN AND RURAL AREAS AND THEIR REHABILITATION

Survey of manual scavengers in urban areas by Municipalities.

11. (*1*) If any Municipality has reason to believe that some persons are engaged or employed in manual scavenging within its jurisdiction, the Chief Executive Officer of such Municipality shall cause a survey to be undertaken to identify such persons.

(*2*) The content and methodology of the survey referred to in sub-section (*1*) shall be such as may be prescribed, and it shall be completed within a period of two months from its commencement in the case of Municipal Corporations, and within a period of one month in the case of other Municipalities.

This Act is available on: http://indiacode.nic.in/acts-in-pdf/252013.pdf

Sanitation and the Sustainable Development Goals 2015:

Annex

Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development

Sustainable Development Goal indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics, in accordance with the Fundamental Principles of Official Statistics.[1]

Goals and targets (from the 2030 Agenda for Sustainable Development)	*Indicators*
Goal 1. End poverty in all its forms everywhere	
1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day	1.1.1 Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)
1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	1.2.1 Proportion of population living below the national poverty line, by sex and age
	1.2.2 Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions
1.3 Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable	1.3.1 Proportion of population covered by social protection floors/systems, by sex, distinguishing children, unemployed persons, older persons, persons with disabilities, pregnant women, newborns, work-injury victims and the poor and the vulnerable
1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1.4.1 Proportion of population living in households with access to basic services
	1.4.2 Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure
1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	1.5.1 Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population
	1.5.2 Direct economic loss attributed to disasters in relation to global gross domestic product (GDP)
	1.5.3 Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030
	1.5.4 Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies

[1] Resolution 68/261.

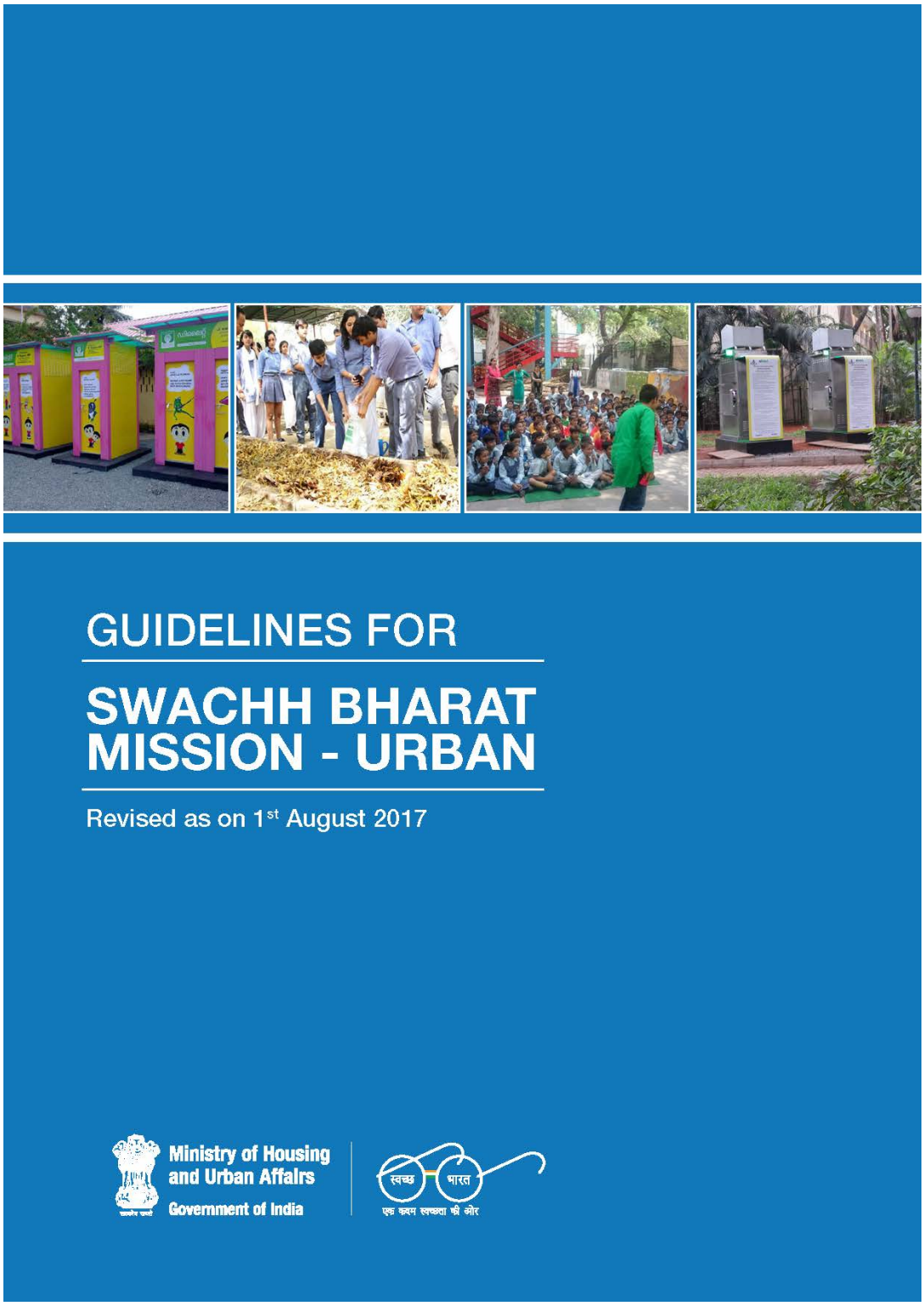
Work of the Statistical Commission pertaining to the 2030 Agenda for Sustainable Development **A/RES/71/313**

Goals and targets (from the 2030 Agenda for Sustainable Development)	*Indicators*
control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws	and (*b*) share of women among owners or rights-bearers of agricultural land, by type of tenure
	5.a.2 Proportion of countries where the legal framework (including customary law) guarantees women's equal rights to land ownership and/or control
5.b Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women	5.b.1 Proportion of individuals who own a mobile telephone, by sex
5.c Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels	5.c.1 Proportion of countries with systems to track and make public allocations for gender equality and women's empowerment
Goal 6. Ensure availability and sustainable management of water and sanitation for all	
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	6.1.1 Proportion of population using safely managed drinking water services
6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.1 Proportion of wastewater safely treated
	6.3.2 Proportion of bodies of water with good ambient water quality
6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	6.4.1 Change in water-use efficiency over time
	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	6.5.1 Degree of integrated water resources management implementation (0–100)
	6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time
6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies	6.a.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan
6.b Support and strengthen the participation of local communities in improving water and sanitation management	6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management

7/21

The global indicator framework was developed by the Inter-Agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGs). Targets and indicators of the goal are mentioned in this document, which is available on: https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework_A.RES.71.313%20Annex.pdf

Introduction to Swachh Bharat Mission (SBM):



2. Swachh Bharat Mission (Urban) – Overview

2.1 Mission Objectives

2.1.1 Elimination of open defecation
2.1.2 Eradication of Manual Scavenging
2.1.3 Modern and Scientific Municipal Solid Waste Management
2.1.4 To effect behavioral change regarding healthy sanitation practices
2.1.5 Generate awareness about sanitation and its linkage with public health
2.1.6 Capacity Augmentation for ULBs to create an enabling environment for private sector participation in Capex (capital expenditure) and Opex (operation and maintenance)

2.2 Duration of the Mission

The Mission will be in force till 2nd October 2019

2.3 Mission Components

2.3.1 Household toilets, including conversion of insanitary latrines into pour-flush latrines
2.3.2 Community toilets,
2.3.3 Public toilets and urinals
2.3.4 Solid waste management
2.3.5 IEC & Public Awareness
2.3.6 Capacity building and Administrative & Office Expenses (A&OE)

By Public Toilets, it is implied that these are to be provided for the floating population / general public in places such as markets, train stations, tourist places, near office complexes, or other public areas where there are considerable number of people passing by.

By Community toilets, it is implied that a shared facility provided by and for a group of residents or an entire settlement. Community toilet blocks are used primarily in low-income and/or informal settlements / slums, where space and/or land are constraints in providing a household toilet. These are for a more or less fixed user group.

2.4 Mission Coverage: Cities and target population

All Statutory towns will be covered under the Mission. Definition of statutory towns is at Annexure I.

2.5 Mission Strategy

2.5.1 Comprehensive Sanitation Planning, which includes
(a) City level sanitation plans
(b) State Sanitation Concept as per Annexure IV
(c) State Sanitation Strategy

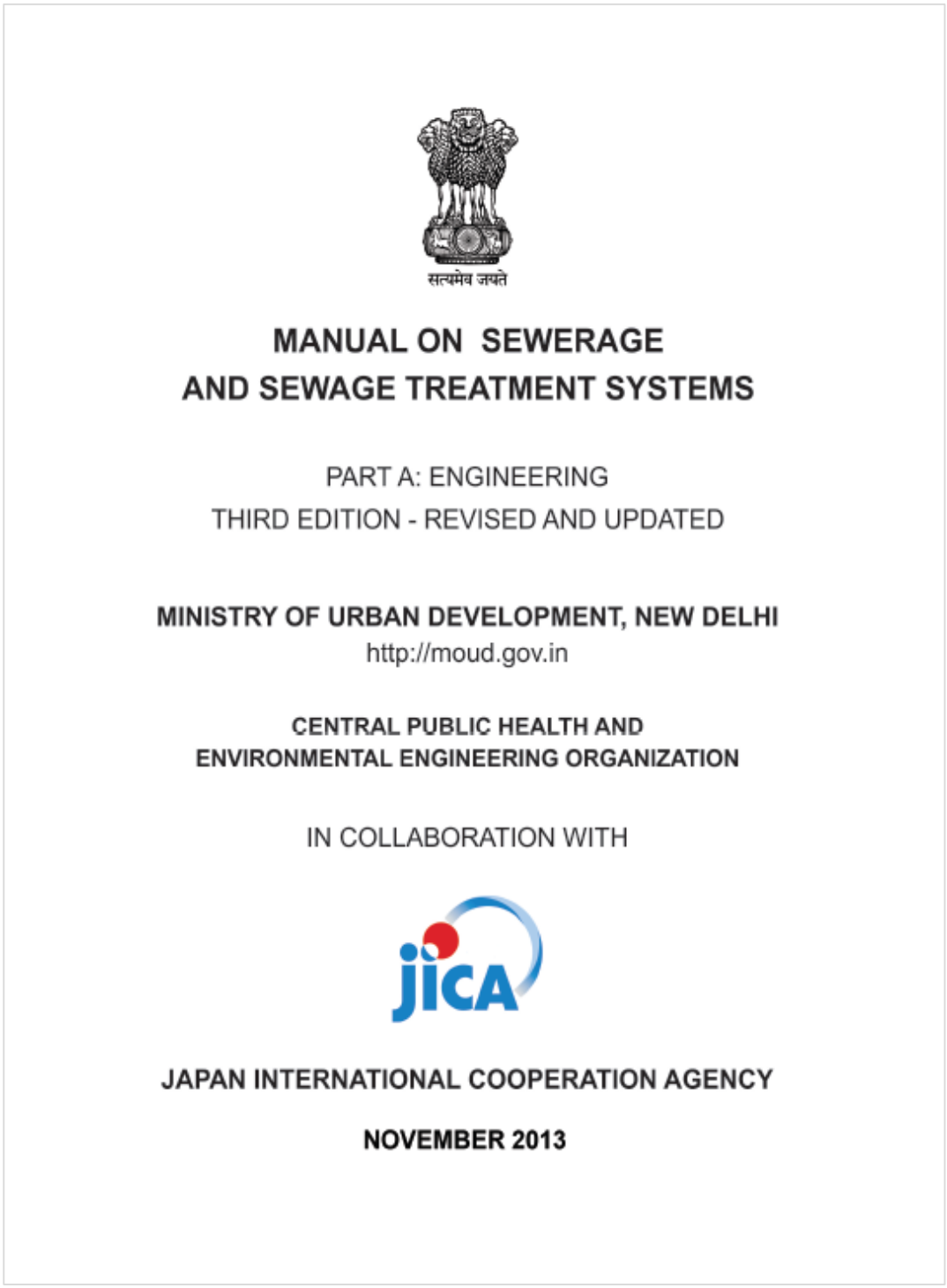
2.5.2 Behavioral Change Strategy and IEC
2.5.3 Enabling Environment for Private Sector Participation
2.5.4 Capacity Building
2.5.5 Special Focus Groups:

The State Governments shall pursue the following:

i. All manual scavengers in urban areas are identified, insanitary toilets linked to their employment are upgraded to sanitary toilets, and the manual scavengers are adequately rehabilitated.
ii. In their efforts to streamline and formalize SWM systems it shall be the endeavor of ULBs that the informal sector workers in

SBM revised guidelines is available on this link:
http://www.swachhbharaturban.in:8080/sbm/content/writereaddata/SBM_Guideline.pdf

Definition of grey and black water is taken from Manual on Sewerage and Sewage Treatment Systems, Part A Engineering, CPHEEO, 2013



सत्यमेव जयते

MANUAL ON SEWERAGE
AND SEWAGE TREATMENT SYSTEMS

PART A: ENGINEERING
THIRD EDITION - REVISED AND UPDATED

MINISTRY OF URBAN DEVELOPMENT, NEW DELHI
http://moud.gov.in

CENTRAL PUBLIC HEALTH AND
ENVIRONMENTAL ENGINEERING ORGANIZATION

IN COLLABORATION WITH

JICA

JAPAN INTERNATIONAL COOPERATION AGENCY

NOVEMBER 2013

CHAPTER 5: DESIGN AND CONSTRUCTION OF SEWAGE TREATMENT FACILITIES

5.1 GENERAL

Sewage is 99 % water carrying domestic wastes originating in kitchen, bathing, laundry, urine and night soil. A portion of these goes into solution. The remaining goes into colloidal or suspended stages. It also contains salts used in cooking, sweat, bathing, laundry and urine. It also contains waterborne pathogenic organisms from the night soil of already infected persons. The concentrations are mentioned in Table 5.1

Table 5.1 Contribution of human wastes in grams per capita per day

	Parameters				Range
1	Biochemical oxygen demand, BOD				45-54
2	Chemical oxygen demand, COD				1.6-1.9 times BOD
3	Total organic carbon, TOC				0.6-1.0 times BOD
4	Total solids, TS				170-220
5	Suspended solids, SS				70-145
6	Grit (inorganic,0.2 mm and above)				5-15
7	Grease				10-30
8	Alkalinity as calcium carbonate ($CaCO_3$)				20-30
9	Chlorides				4-8
10	Total nitrogen N				6-12
11	Organic nitrogen				~0.4 total N
12	Free ammonia				~0.6 total N
13	Nitrate				~0.0-0.5 total N
14	Total phosphorus				~0.6-4.5
15	Organic phosphorus				~0.3 total P
16	Inorganic(ortho- and poly-phosphates)				~0.7 total P
17	Potassium(as potassium oxide K_2O)				2.0-6.0
	Microorganisms in 100 ml of sewage				
18	Total bacteria	10^9-10^{10}	22	Protozoan cysts	Up to 10^3
19	Coliforms	10^9-10^{10}	23	Helminthic eggs	Up to 10^3
20	Faecal streptococci	10^5-10^6	24	Virus (plaque forming units)	10^2-10^4
21	Salmonella Typhosa	10^1-10^4			

Source: Arceivala, 2000

Note:

1. The wastewater from toilets is usually referred to as black water and the rest of the wastewater from all other activities is referred to as grey water.
2. As already cited in chapter 1, about 12.6 % of population are still not having toilets and practice open defecation. Their grey water somehow gets into sewers by way of open drains discharging into sewers.
3. Thus, the BOD of raw sewage has to be foreseen realistically because this dictates the cost of the STP almost pro-rata.

continued in next page

CPHEEO Manual on Sewerage and Sewage Treatment Systems, Part A Engineering. It can be downloaded from http://cpheeo.nic.in/Sewerage.aspx

Health risks due to unsafe disposal of waste water

In 2015, 5.2 billion people used safely managed drinking-water services – that is, they used improved water sources located on premises, available when needed, and free from contamination. The remaining 2.1 billion people without safely managed services in 2015 included:

- 1.3 billion people with *basic* services, meaning an improved water source located within a round trip of 30 minutes
- 263 million people with *limited* services, or an improved water source requiring more than 30 minutes to collect water
- 423 million people taking water from unprotected wells and springs
- 159 million people collecting untreated surface water from lakes, ponds, rivers and streams.

Sharp geographic, sociocultural and economic inequalities persist, not only between rural and urban areas but also in towns and cities where people living in low-income, informal, or illegal settlements usually have less access to improved sources of drinking-water than other residents.

Water and health

Contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid, and polio. Absent, inadequate, or inappropriately managed water and sanitation services expose individuals to preventable health risks. This is particularly the case in health care facilities where both patients and staff are placed at additional risk of infection and disease when water, sanitation, and hygiene services are lacking. Globally, 15% of patients develop an infection during a hospital stay, with the proportion much greater in low-income countries.

Inadequate management of urban, industrial, and agricultural wastewater means the drinking-water of hundreds of millions of people is dangerously contaminated or chemically polluted.

Some 842 000 people are estimated to die each year from diarrhoea as a result of unsafe drinking-water, sanitation, and hand hygiene. Yet diarrhoea is largely preventable, and the deaths of 361 000 children aged under 5 years could be avoided each year if these risk factors were addressed. Where water is not readily available, people may decide handwashing is not a priority, thereby adding to the likelihood of diarrhoea and other diseases.

Diarrhoea is the most widely known disease linked to contaminated food and water but there are other hazards. Almost 240 million people are affected by schistosomiasis – an acute and chronic disease caused by parasitic worms contracted through exposure to infested water.

In many parts of the world, insects that live or breed in water carry and transmit diseases such as dengue fever. Some of these insects, known as vectors, breed in clean, rather than dirty water, and household drinking water containers can serve as breeding grounds. The simple intervention of covering water storage containers can reduce vector breeding and may also reduce faecal contamination of water at the household level.

Source: http://www.who.int/mediacentre/factsheets/fs391/en/

Roles and Responsibilities of various stakeholders for FSSM

Table 6: Roles and responsibilities of institutions in the development of FSSM plans

Institution	Lead role towards septage management	Supportive role
Ministry of Urban Development	Technical and planning support to states and ULBs	Formulation of state- and city-level FSSM strategies and implementation plans
Ministry of Drinking Water and Sanitation	Technical and planning support to peri-urban and rural areas	Formulation and implementation of plans for rural India
Ministry of Environment, Forest and Climate Change	Enforce compliance of the relevant environmental laws and rules during the collection, transport, treatment, and disposal of faecal sludge and septage	Support and build capacity of state pollution control boards towards enforcement of relevant laws and rules
Ministry of Social Justice and Empowerment	National-level awareness campaign through monitoring and evaluation	Help states and ULBs eliminate manual scavenging and rehabilitate manual scavengers
Ministry of Women and Child Development	----	Gender mainstreaming in information, education and communication (IEC) material for FSSM across the country
State governments	Develop state level FSSM strategy and implementation plan	• Technical, financial and administrative support to ULBs • Encourage coordination and cooperation among ULBs • Regulate and help ULBs set up systems to ensure financial sustainability in provision of FSSM services • Implement municipal by-laws.
Urban local bodies	Design, develop, plan and implement ULB level FSSM strategy	Create enabling environment for NGOs and private initiatives to achieve safe and sustainable FSSM
Households	Maintenance of septic tanks through scheduled desludging regular maintenance and monitoring of septic tanks	Engage with decision-makers at state and ULB level to ensure that they receive good quality FSSM services

Source: Compiled by CSE, 2017

3.3 Suggested institutional framework

In India, there are few institutions at the city- and state-level which take care of septage management. This section enumerates the suggestions under the National Urban FSSM Policy, which highlights that each state and city needs to formulate its own FSSM strategy and integrate the same in their respective state and city sanitation plans in overall conformity with the national policy (see Table 6: *Roles and responsibilities of institutions in the development of FSSM plans*; a more detailed table on the roles and responsibilities has been provided in the *Appendix 3*).

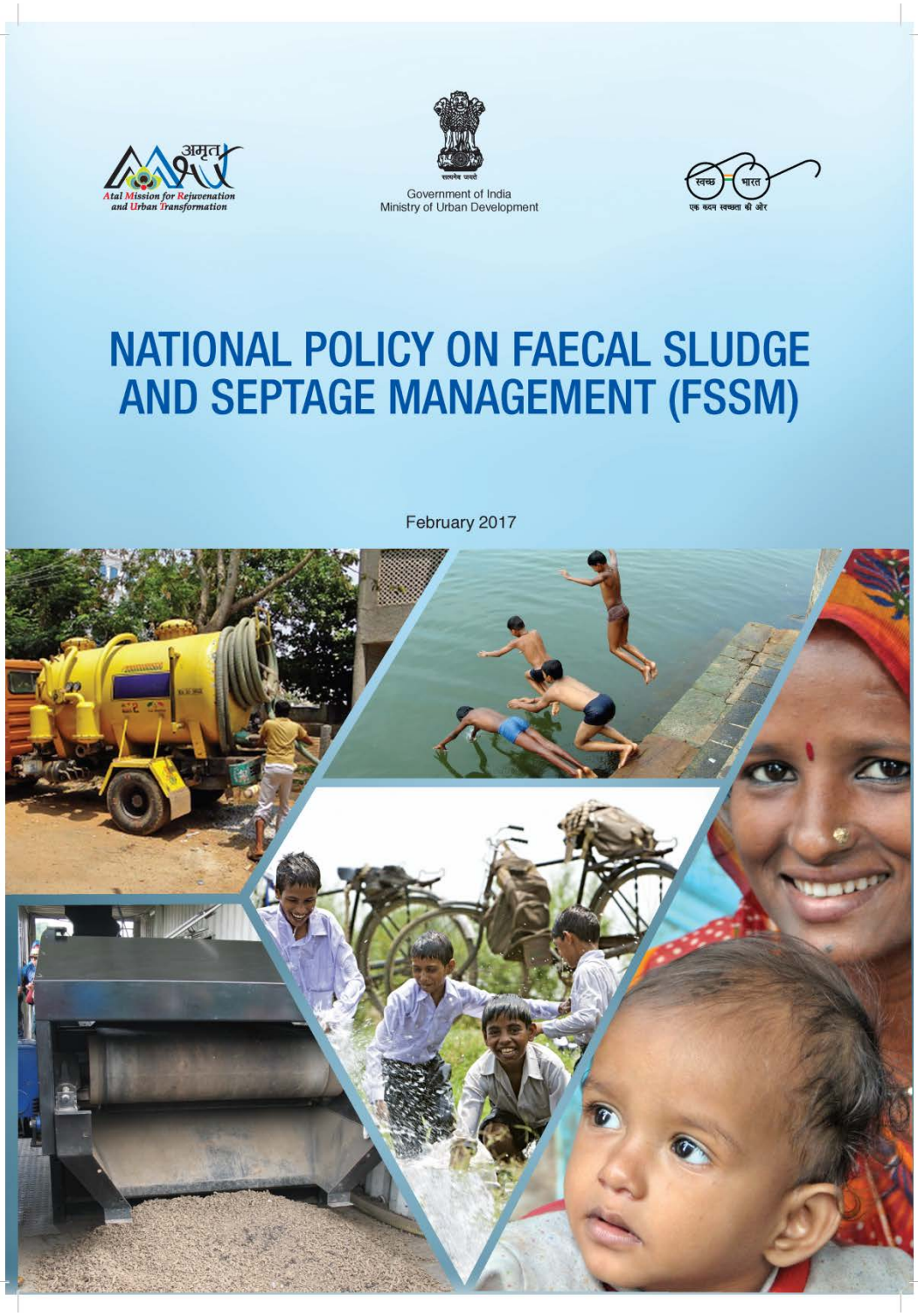
3.4 Current economics and business model

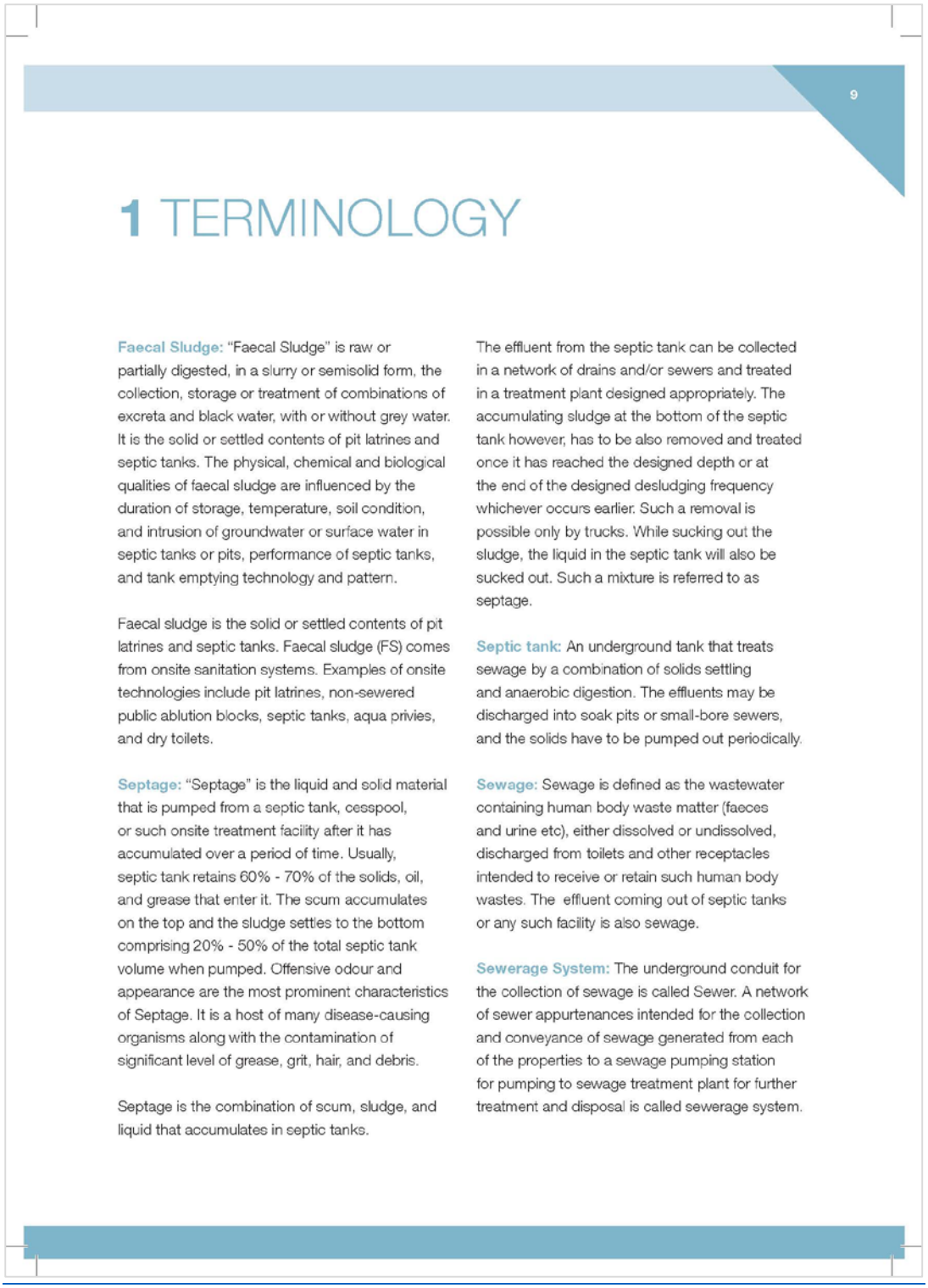
3.4.1 Current economics behind septage management

In the present scenario, septage management is primarily in the hands of private operators. The operators charge for emptying services provided to different stakeholders. Emptying points can be individual households, residential colonies, commercial establishments, institutions, toilet complexes, offices etc. Generally, the operators are called for emptying only when the containment is full. The fee for emptying varies widely. Due to absence of dedicated disposal sites, private emptiers practice illegal dumping of septage into water bodies, utterly disregarding the threat posed to health and environment. They run their business without paying any fees to government authorities which means that despite high charges collected from the customers, no revenue is generated by government authorities from the emptying business. Farmers in whose fields the collected septage or faecal sludge is disposed of also pay the private operators.

This is taken from Septage Management, A practitioner's guide, CSE which is available on:
http://www.swachhbharaturban.in:8080/sbm/content/writereaddata/Septage%20Management%20A%20Practitioner%E2%80%99s%20Guide%20with%20SBM%20logo.pdf

National Policy on Faecal Sludge and Septage Management:





9

1 TERMINOLOGY

Faecal Sludge: "Faecal Sludge" is raw or partially digested, in a slurry or semisolid form, the collection, storage or treatment of combinations of excreta and black water, with or without grey water. It is the solid or settled contents of pit latrines and septic tanks. The physical, chemical and biological qualities of faecal sludge are influenced by the duration of storage, temperature, soil condition, and intrusion of groundwater or surface water in septic tanks or pits, performance of septic tanks, and tank emptying technology and pattern.

Faecal sludge is the solid or settled contents of pit latrines and septic tanks. Faecal sludge (FS) comes from onsite sanitation systems. Examples of onsite technologies include pit latrines, non-sewered public ablution blocks, septic tanks, aqua privies, and dry toilets.

Septage: "Septage" is the liquid and solid material that is pumped from a septic tank, cesspool, or such onsite treatment facility after it has accumulated over a period of time. Usually, septic tank retains 60% - 70% of the solids, oil, and grease that enter it. The scum accumulates on the top and the sludge settles to the bottom comprising 20% - 50% of the total septic tank volume when pumped. Offensive odour and appearance are the most prominent characteristics of Septage. It is a host of many disease-causing organisms along with the contamination of significant level of grease, grit, hair, and debris.

Septage is the combination of scum, sludge, and liquid that accumulates in septic tanks.

The effluent from the septic tank can be collected in a network of drains and/or sewers and treated in a treatment plant designed appropriately. The accumulating sludge at the bottom of the septic tank however, has to be also removed and treated once it has reached the designed depth or at the end of the designed desludging frequency whichever occurs earlier. Such a removal is possible only by trucks. While sucking out the sludge, the liquid in the septic tank will also be sucked out. Such a mixture is referred to as septage.

Septic tank: An underground tank that treats sewage by a combination of solids settling and anaerobic digestion. The effluents may be discharged into soak pits or small-bore sewers, and the solids have to be pumped out periodically.

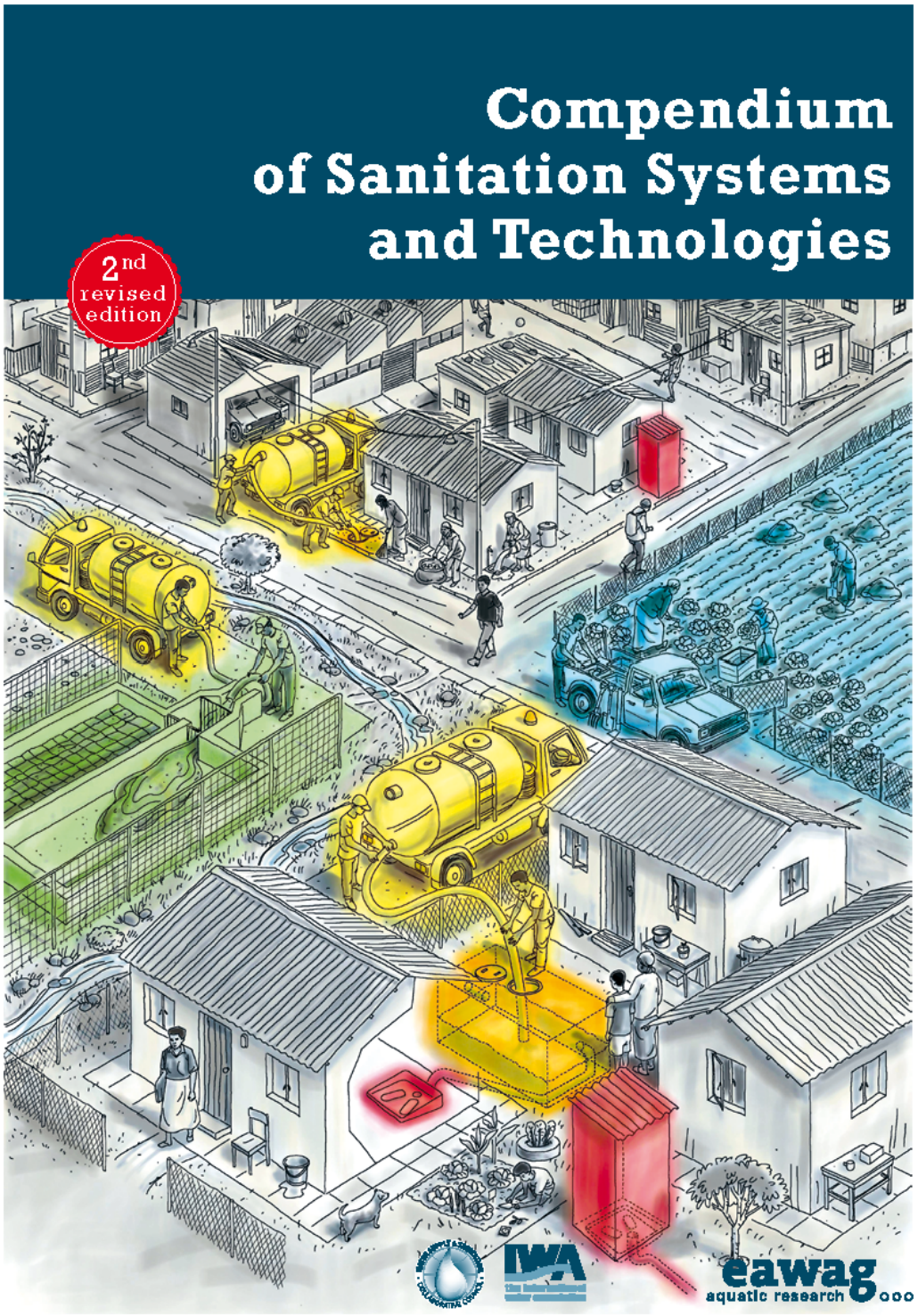
Sewage: Sewage is defined as the wastewater containing human body waste matter (faeces and urine etc), either dissolved or undissolved, discharged from toilets and other receptacles intended to receive or retain such human body wastes. The effluent coming out of septic tanks or any such facility is also sewage.

Sewerage System: The underground conduit for the collection of sewage is called Sewer. A network of sewer appurtenances intended for the collection and conveyance of sewage generated from each of the properties to a sewage pumping station for pumping to sewage treatment plant for further treatment and disposal is called sewerage system.

This policy document is available on this link:
http://www.swachhbharaturban.in:8080/sbm/content/writereaddata/FSSM%20Policy%20Report_23%20Feb_Artwork.pdf

READING MATERIAL - SESSION 2
PLANNING FOR FSSM AT TOWN LEVEL – CONTAINMENT AND CONVEYANCE

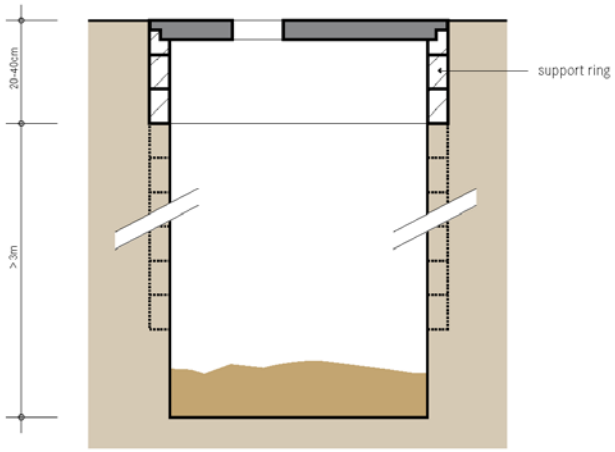
Containment system for storing waste water



Containment system – Single pit

S.2 **Single Pit** | Applicable to: **System 1**

Application Level:	Management Level:	Inputs: Excreta, Blackwater, Faeces (+ Anal Cleansing Water) (+ Dry Cleansing Materials)
★★ Household	★★ Household	Outputs: Sludge
★ Neighbourhood	★★ Shared	
City	Public	



The single pit is one of the most widely used sanitation technologies. Excreta, along with anal cleansing materials (water or solids) are deposited into a pit. Lining the pit prevents it from collapsing and provides support to the superstructure.

As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction.

Design Considerations On average, solids accumulate at a rate of 40 to 60 L per person/year and up to 90 L per person/year if dry cleansing materials such as leaves or paper are used. The volume of the pit should be designed to contain at least 1,000 L. Typically, the pit is at least 3 m deep and 1 m in diameter. If the pit diameter exceeds 1.5 m, there is an increased risk of collapse. Depending on how deep they are dug, some pits may last 20 or more years without emptying. To prevent groundwater contamination, the bottom of the pit should be at least 2 m above groundwater level (rule of thumb). If the pit is to be reused, it should be lined. Pit lining materials can include brick, rot-resistant timber, concrete, stones, or mortar plastered onto the soil. If the soil is stable (i.e., no presence of sand or gravel deposits or loose organic materials), the whole pit need not be lined. The bottom of the pit should remain unlined to allow for the infiltration of liquids out of the pit.

As liquid leaches from the pit and migrates through the unsaturated soil matrix, pathogenic germs are sorbed to the soil surface. In this way, pathogens can be removed prior to contact with groundwater. The degree of removal varies with soil type, distance travelled, moisture and other environmental factors and, thus, it is difficult to estimate the distance necessary between a pit and a water source. A minimum horizontal distance of 30 m is normally recommended to limit exposure to microbial contamination.

When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a viable alternative: the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks. A raised pit can also be constructed in an area where flooding is frequent in order to keep water from flowing into the pit during heavy rain. Another variation is the unlined shallow pit that may be appropriate for areas

where digging is difficult. When the shallow pit is full, it can be covered with leaves and soil, and a small tree can be planted (see Arborloo, D.1).
A Ventilated Improved Pit (VIP, S.3) is slightly more expensive than a single pit, but greatly reduces the nuisance of flies and odours, while increasing comfort.
If a urine-diverting User Interface is used, only faeces are collected in the pit and leaching can be minimized.

Appropriateness Treatment processes in a single pit (aerobic, anaerobic, dehydration, composting or otherwise) are limited and, therefore, pathogen reduction and organic degradation is not significant. However, since the excreta are contained, pathogen transmission to the user is limited.
Single pits are appropriate for rural and peri-urban areas; in densely populated areas they are often difficult to empty and/or have insufficient space for infiltration. Single pits are especially appropriate when water is scarce and where there is a low groundwater table. They are not suited for rocky or compacted soils (that are difficult to dig), or for areas that flood frequently.

Health Aspects/Acceptance A single pit is an improvement to open defecation; however, it still poses health risks:
- Leachate can contaminate groundwater;
- Stagnant water in pits may promote insect breeding;
- Pits are susceptible to failure and/or overflowing during floods.

Single pits should be constructed at an appropriate distance from homes to minimize fly and odour nuisances and to ensure convenience and safety.

Operation & Maintenance There is no daily maintenance associated with a single pit apart from keeping the facility clean. However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available.

Pros & Cons
+ Can be built and repaired with locally available materials
+ Low (but variable) capital costs depending on materials and pit depth
+ Small land area required
- Flies and odours are normally noticeable
- Low reduction in BOD and pathogens with possible contamination of groundwater
- Costs to empty may be significant compared to capital costs
- Sludge requires secondary treatment and/or appropriate discharge

References & Further Reading

_ ARGOSS (2001). *Guidelines for Assessing the Risk to Groundwater from on-Site Sanitation.* British Geological Survey Commissioned Report, CR/01/142, Keyworth, UK. Available at: www.bgs.ac.uk

_ Brandberg, B. (1997). *Latrine Building. A Handbook for Implementation of the Sanplat System.* Intermediate Technology Publications, London, UK.
(A good summary of common construction problems and how to avoid mistakes)

_ Franceys, R., Pickford, J. and Reed, R. (1992). *A Guide to the Development of on-Site Sanitation.* WHO, Geneva, CH.
Available at: www.susana.org/library
(For information on accumulation rates, infiltration rates, general construction and example design calculations)

_ Graham, J. P. and Polizzotto, M. L. (2013). *Pit Latrines and Their Impacts on Groundwater Quality: A Systematic Review.* Environmental Health Perspectives, National Institute of Environmental Health Sciences, Research Triangle Park, US.
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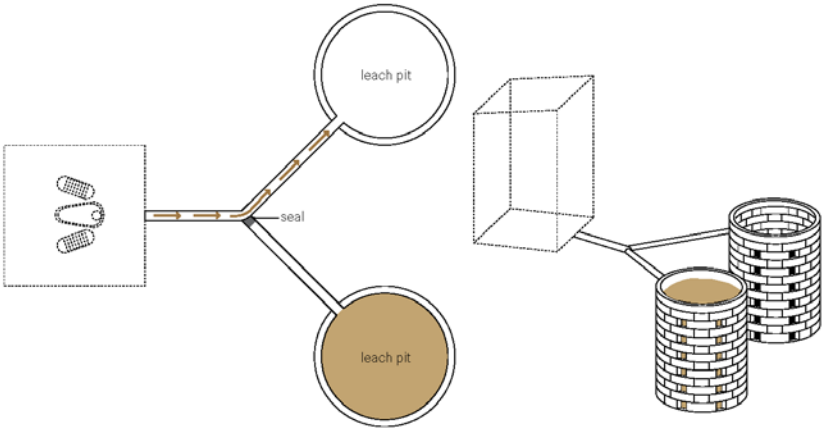
_ Robens Institute (1996). *Fact Sheets on Environmental Sanitation. Fact Sheet 3.4: Simple Pit Latrines.* University of Surrey, UK and WHO, Geneva, CH.
Available at: www.who.int

Containment system – Twin pit

S.6 Twin Pits for Pour Flush

Applicable to: **System 3**

Application Level:	Management Level:	Inputs: Blackwater (Greywater)
★★ Household	★★ Household	
★ Neighbourhood	★★ Shared	Outputs: Pit Humus
City	★ Public	



This technology consists of two alternating pits connected to a Pour Flush Toilet (U.4). The blackwater (and in some cases greywater) is collected in the pits and allowed to slowly infiltrate into the surrounding soil. Over time, the solids are sufficiently dewatered and can be manually removed with a shovel.

The twin pits for pour flush technology can be designed in various ways; the toilet can be located directly over the pits or at a distance from them. The superstructure can be permanently constructed over both pits or it can move from side to side depending on which one is in use. No matter how the system is designed, only one pit is used at a time. While one pit is filling, the other full pit is resting.

As liquid leaches from the pit and migrates through the unsaturated soil matrix, pathogenic germs are sorbed onto the soil surface. In this way, pathogens can be removed prior to contact with groundwater. The degree of removal varies with soil type, distance travelled, moisture and other environmental factors.

The difference between this technology and the Double VIP (S.4) or Fossa Alterna (S.5) is that it allows for water and it is not necessary to add soil or organic material to the pits. As this is a water-based (wet) technology, the full pits require a longer retention time (two years is recommended) to degrade the material before it can be excavated safely.

Design Considerations The pits should be of an adequate size to accommodate a volume of waste generated over one or two years. This allows the contents of the full pit enough time to transform into a partially sanitized, soil-like material that can be manually excavated.

It is recommended that the twin pits be constructed 1 m apart from each other to minimize cross-contamination between the maturing pit and the one in use. It is also recommended that the pits be constructed over 1 m from any structural foundation as leachate can negatively impact structural supports. Water within the pit can impact its stability. Therefore, the full depth of the pit walls should be lined to prevent collapse and the top 30 cm should be fully mortared to prevent direct infiltration and to support the superstructure.

There is a risk of groundwater pollution when pits are located in areas with a high or variable water table, and/or fissures or cracks in the bedrock. As soil and groundwater properties are often unknown, it is difficult

to estimate the distance necessary between a pit and a water source. It is normally recommended to have a minimum horizontal distance of 30 m between them to limit exposing the water source to microbial contamination.

To ensure that only one of the two pits is used at any time, the idle pipe of the junction connecting to the out-of-use pit should be closed (e.g. with cement or bricks). Alternatively, the Pour Flush Toilet could also be directly connected to the pit in use by a single straight pipe fixed in place with light mortar and covered with earth. The risk of failure and misuse is minimized by ensuring that the junction and pipes are not easily accessible.

Appropriateness Twin pits for pour flush are a permanent technology appropriate for areas where it is not possible to continuously build new pit latrines. As long as water is available, this technology is appropriate for almost every type of housing density. However, too many wet pits in a small area is not recommended as the soil matrix may not be of sufficient capacity to absorb all the liquid and the ground could become water-logged (oversaturated). In order for the pits to drain properly, the soil must have a good absorptive capacity; clay, tightly packed or rocky soils are not appropriate. This technology is not suitable for areas with a high groundwater table or where there is frequent flooding.

Greywater can be co-managed along with the blackwater in the twin pits, especially if the greywater quantities are relatively small, and no other management system is in place to control it. However, large quantities of flushwater and/or greywater may result in excessive leaching from the pit and possibly groundwater contamination.

The dewatered, solid material is manually emptied from the pits (it is dug, not pumped out), therefore, space is not required for vacuum trucks to access them.

Health Aspects/Acceptance It is a commonly accepted sanitation option; however, some health concerns exist:

- Leachate can contaminate groundwater;
- Stagnant water in pits may promote insect breeding;
- Pits are susceptible to failure and/or overflowing during floods.

Operation & Maintenance

The pits must be regularly emptied (after the recommended two year resting time), and care must be taken to ensure that they do not flood during rainy seasons. Emptying is done manually using long handled shovels and proper personal protection.

Pros & Cons

+ Because double pits are used alternately, their life is virtually unlimited
+ Excavation of humus is easier than faecal sludge
+ Significant reduction in pathogens
+ Potential for use of stored faecal material as soil conditioner
+ Flies and odours are significantly reduced (compared to pits without a water seal)
+ Can be built and repaired with locally available materials
+ Low (but variable) capital costs depending on materials; no or low operating costs if self-emptied
+ Small land area required
- Manual removal of humus is required
- Clogging is frequent when bulky cleansing materials are used
- Higher risk of groundwater contamination due to more leachate than with waterless systems

References & Further Reading

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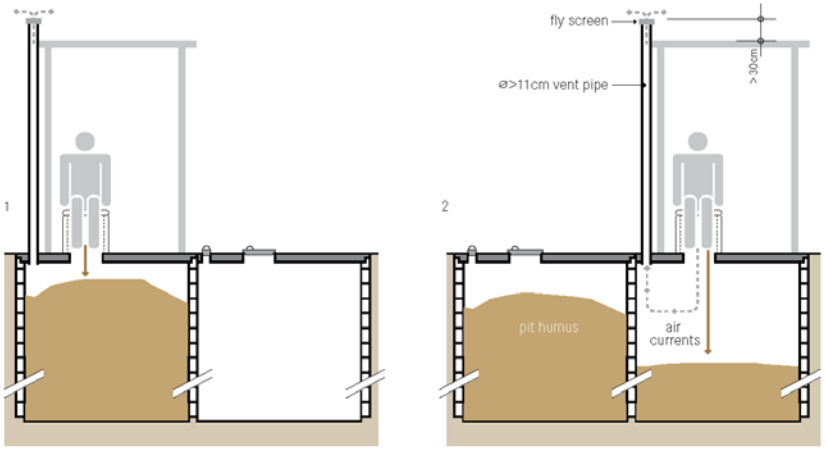
Containment system – Double ventilated improved pit

S.4 Double Ventilated Improved Pit (VIP)

Applicable to: **System 2**

Application Level:	Management Level:	Inputs: Excreta, Faeces (+ Anal Cleansing Water) (+ Dry Cleansing Materials)
★★ Household	★★ Household	Outputs: Pit Humus
★ Neighbourhood	★★ Shared	
City	★ Public	



The double VIP has almost the same design as the Single VIP (S.3) with the added advantage of a second pit that allows it to be used continuously and permits safer and easier emptying.

By using two pits, one pit can be used, while the content of the second rests, drains, reduces in volume, and degrades. When the second pit is almost full (the excreta is 50 cm from the top of the pit), it is covered, and the content of the first pit is removed. Due to the extended resting time (at least 1 or 2 years after several years of filling), the material within the pit is partially sanitized and humus-like.

Design Considerations The superstructure may either extend over both holes or it may be designed to move from one pit to the other. In either case, the pit that is not being filled should be fully covered and sealed to prevent water, garbage and animals, or people from falling into the pit. The ventilation of the two pits can be accomplished using one ventilation pipe moved back and forth between the pits, or each pit can be equipped with its own dedicated pipe. The two pits in the double VIP are continually used and should be well lined and supported to ensure longevity.

Appropriateness The double VIP is more appropriate than the Single VIP for denser, peri-urban areas. After the resting time, the soil-like material is manually emptied (it is dug out, not pumped out), so vacuum truck access to the pits is not necessary.
The double VIP technology will only work properly if the two pits are used sequentially and not concurrently. Therefore, an adequate cover for the out of service pit is required. Double VIPs are especially appropriate when water is scarce and where there is a low groundwater table. They should be located in an area with a good breeze to allow for proper ventilation. They are not suited for rocky or compacted soils (that are difficult to dig) or for areas that flood frequently.

Health Aspects/Acceptance The double VIP can be a very clean, comfortable and well accepted sanitation option, in some cases even more so than a water-based technology. However, some health concerns exist:

- Leachate can contaminate groundwater;
- Pits are susceptible to failure and/or overflowing during floods;
- Health risks from flies are not completely removed by ventilation.

Operation & Maintenance To keep the double VIP free of flies and odours, regular cleaning and maintenance is required. Dead flies, spider webs, dust and other debris should be removed from the ventilation screen to ensure a good flow of air. The out of service pit should be well sealed to reduce water infiltration and a proper alternating schedule must be maintained.

Pros & Cons

+ Longer life than Single VIP (indefinite if maintained properly)
+ Excavation of humus is easier than faecal sludge
+ Significant reduction in pathogens
+ Potential for use of stored faecal material as soil conditioner
+ Flies and odours are significantly reduced (compared to non-ventilated pits)
+ Can be built and repaired with locally available materials
- Manual removal of humus is required
- Possible contamination of groundwater
- Higher capital costs than Single VIP; but reduced operating costs if self-emptied

References & Further Reading

_ ARGOSS (2001). *Guidelines for Assessing the Risk to Groundwater from on-Site Sanitation.* British Geological Survey Commissioned Report, CR/01/142, Keyworth, UK. Available at: www.bgs.ac.uk

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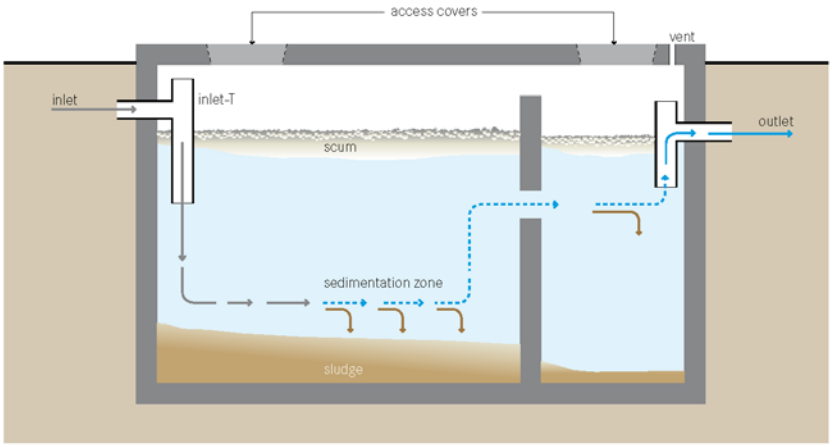
_ Mara, D. D. (1996). *Low-Cost Urban Sanitation.* Wiley, Chichester, UK. (General description of VIPs with a focus on the ventilation system)

_ Morgan, P. R. (2009). *Ecological Toilets. Start Simple and Upgrade from Arborloo to VIP.* Stockholm Environment Institute, Stockholm, SE. Available at: www.ecosanres.org

S.9 Septic Tank

Applicable to: **Systems 6, 7**

Application Level:	Management Level:	Inputs: Blackwater, Brownwater, Greywater
★★ Household	★★ Household	Outputs: Effluent, Sludge
★★ Neighbourhood	★★ Shared	
City	★★ Public	



A septic tank is a watertight chamber made of concrete, fibreglass, PVC or plastic, through which blackwater and greywater flows for primary treatment. Settling and anaerobic processes reduce solids and organics, but the treatment is only moderate.

Liquid flows through the tank and heavy particles sink to the bottom, while scum (mostly oil and grease) floats to the top. Over time, the solids that settle to the bottom are degraded anaerobically. However, the rate of accumulation is faster than the rate of decomposition, and the accumulated sludge and scum must be periodically removed. The effluent of the septic tank must be dispersed by using a Soak Pit (D.7) or Leach Field (D.8), or transported to another treatment technology via a Solids-Free Sewer (C.5).

Generally, the removal of 50% of solids, 30 to 40% of BOD and a 1-log removal of E. coli can be expected in a well-designed and maintained septic tank, although efficiencies vary greatly depending on operation and maintenance and climatic conditions.

Design Considerations A septic tank should have at least two chambers. The first chamber should be at least 50% of the total length, and when there are only two chambers, it should be two thirds of the total length. Most of the solids settle out in the first chamber. The baffle, or the separation between the chambers, is to prevent scum and solids from escaping with the effluent. A T-shaped outlet pipe further reduces the scum and solids that are discharged.

Accessibility to all chambers (through access ports) is necessary for maintenance. Septic tanks should be vented for controlled release of odorous and potentially harmful gases.

The design of a septic tank depends on the number of users, the amount of water used per capita, the average annual temperature, the desludging frequency and the characteristics of the wastewater. The retention time should be 48 hours to achieve moderate treatment.

A variation of the septic tank is called an Aquaprivy. This is a simple storage and settling tank that is located directly below the toilet so that the excreta fall into it. The Aquaprivy has a low treatment efficiency.

Appropriateness This technology is most commonly applied at the household level. Larger, multi-chamber

septic tanks can be designed for groups of houses and/or public buildings (e.g., schools).
A septic tank is appropriate where there is a way of dispersing or transporting the effluent. If septic tanks are used in densely populated areas, onsite infiltration should not be used, otherwise, the ground will become oversaturated and contaminated, and wastewater may rise up to the surface, posing a serious health risk. Instead, the septic tanks should be connected to some type of Conveyance technology, through which the effluent is transported to a subsequent Treatment or Disposal site. Even though septic tanks are watertight, it is not recommended to construct them in areas with high groundwater tables or where there is frequent flooding.
Because the septic tank must be regularly desludged, a vacuum truck should be able to access the location. Often, septic tanks are installed in the home, under the kitchen or bathroom, which makes emptying difficult.
Septic tanks can be installed in every type of climate, although the efficiency will be lower in colder climates. They are not efficient at removing nutrients and pathogens.

Health Aspects/Acceptance Under normal operating conditions, users do not come in contact with the influent or effluent. Effluent, scum and sludge must be handled with care as they contain high levels of pathogenic organisms.
Users should be careful when opening the tank because noxious and flammable gases may be released.

Operation & Maintenance Because of the delicate ecology, care should be taken not to discharge harsh chemicals into the septic tank. Scum and sludge levels need to be monitored to ensure that the tank is functioning well. Generally, septic tanks should be emptied every 2 to 5 years. This is best done by using a Motorized Emptying and Transport technology (C.3), but Human-Powered Emptying (C.2) can also be an option.
Septic tanks should be checked from time to time to ensure that they are watertight.

Pros & Cons

+ Simple and robust technology
+ No electrical energy is required
+ Low operating costs
+ Long service life
+ Small land area required (can be built underground)
- Low reduction in pathogens, solids and organics
- Regular desludging must be ensured
- Effluent and sludge require further treatment and/or appropriate discharge

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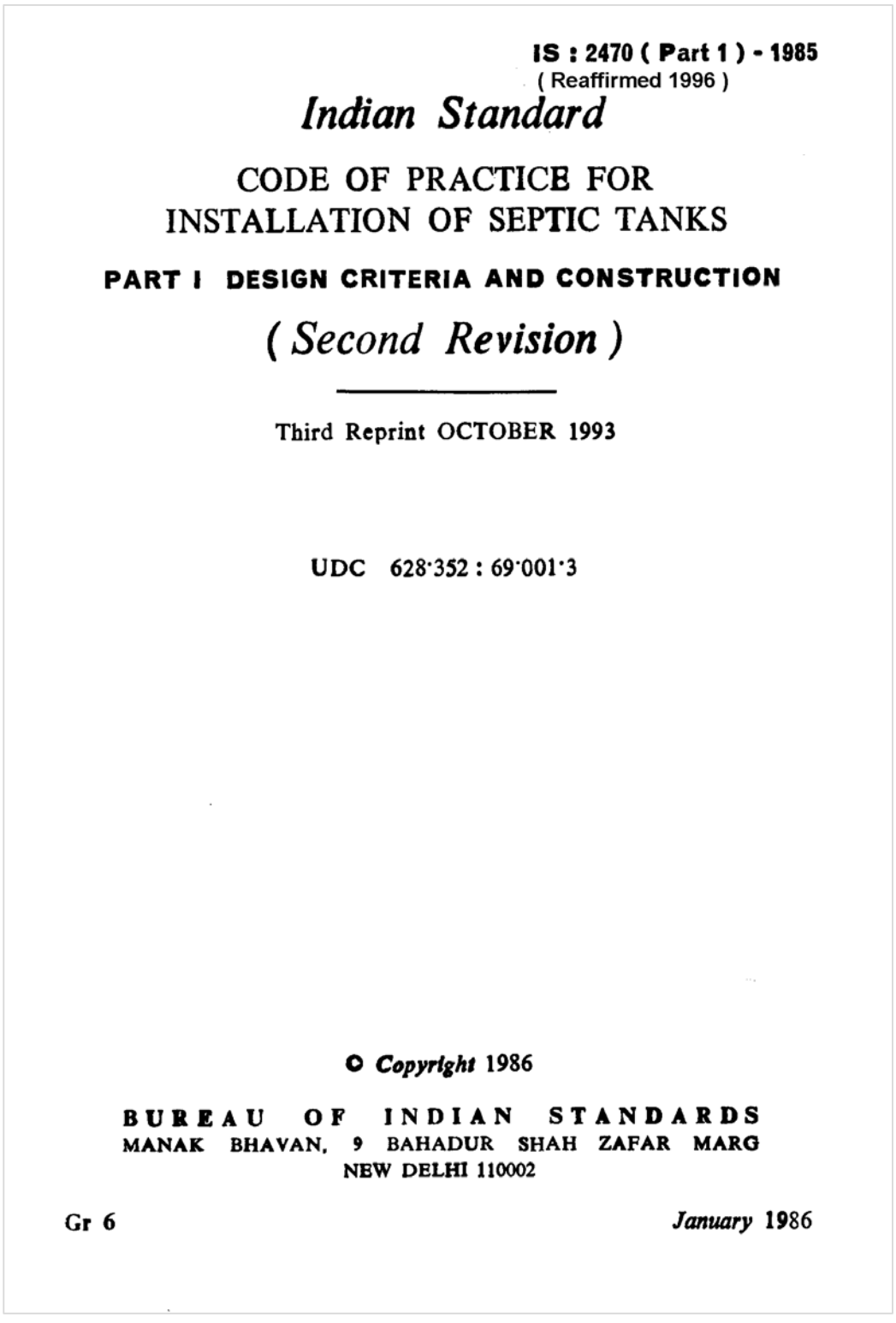
Urban Management Centre (UMC) made flashcards for identification of on-site sanitation systems. This can be downloaded from: http://umcasia.org/UserFiles/umc/file/Flashcards%20On-site%20sanitation.pdf

For installing septic tank, please refer IS Code 2470 – Code of practice for installation of septic tanks.



IS : 2470 (Part 1) - 1985
(Reaffirmed 1996)

Indian Standard

CODE OF PRACTICE FOR
INSTALLATION OF SEPTIC TANKS

PART I DESIGN CRITERIA AND CONSTRUCTION

(Second Revision)

Third Reprint OCTOBER 1993

UDC 628·352 : 69·001·3

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6 *January* 1986

IS code 2470 – Part 1 is available on:
https://ia801600.us.archive.org/3/items/gov.law.is.2470.1.1985/is.2470.1.1985.pdf

Recommended sizes of septic tanks based on number of users

Table 9.7 Recommended size of septic tank up to 20 users

No. of Users	Length (m)	Breadth (m)	Liquid depth (m) (cleaning interval of)	
			2 years	3 years
5	1.5	0.75	1.0	1.05
10	2.0	0.90	1.0	1.40
15	2.0	0.90	1.3	2.00
20	2.3	1.10	1.3	1.80

Note 1: The capacities are recommended on the assumption that discharge from only WC will be treated in the septic tank

Note 2: A provision of 300 mm should be made for free broad.

Note 3: The sizes of septic tank are based on certain assumption on peak discharges, as estimated in IS: 2470 (part 1) and while choosing the size of septic tank exact calculations shall be made.

Source: CPHEEO, 1993

Table 9.8 Recommended size of septic tank for housing colony upto 300 users

No. of Users	Length (m)	Breadth (m)	Liquid depth (cleaning interval of)	
			2 years	3 years
50	5.0	2.00	1.0	1.24
100	7.5	2.65	1.0	1.24
150	10.0	3.00	1.0	1.24
200	12.0	3.30	1.0	1.24
300	15.0	4.00	1.0	1.24

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.

Source: CPHEEO, 1993

9.3.4.2 Construction Details

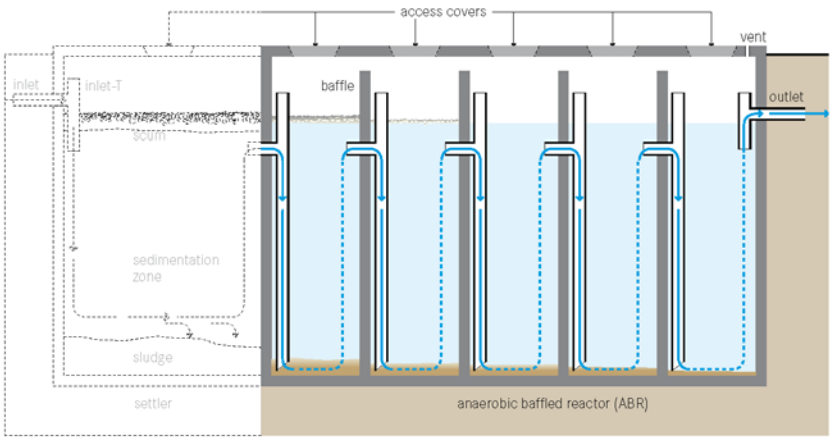
The inlet and outlet should not be located at such levels where the sludge or scum is formed as otherwise, the force of water entering or leaving the tank will unduly disturb the sludge or scum. Further, to avoid short-circuiting, the inlet and outlet should be located as far away as possible from each other and at different levels. Baffles are generally provided at both inlet and outlet and should dip 25 cm to 30 cm into and project 15 cm above the liquid. The baffles should be placed at a distance of one-fifth of the tank length from the mouth of the straight inlet pipe. The invert of the outlet pipe should be placed at a level 5 to 7 cm below the invert level of inlet pipe.

CPHEEO Manual on Sewerage and Sewage Treatment Systems, Part A Engineering. It can be downloaded from http://cpheeo.nic.in/Sewerage.aspx

T.3 Anaerobic Baffled Reactor (ABR)

Applicable to: **Systems 1, 6-9**

Application Level:	Management Level:	Inputs: Effluent, Blackwater, Brownwater, Greywater
★ Household	★ Household	Outputs: Effluent, Sludge
★★ Neighbourhood	★★ Shared	
City	★★ Public	



An anaerobic baffled reactor (ABR) is an improved Septic Tank (S.9) with a series of baffles under which the wastewater is forced to flow. The increased contact time with the active biomass (sludge) results in improved treatment.

The upflow chambers provide enhanced removal and digestion of organic matter. BOD may be reduced by up to 90%, which is far superior to its removal in a conventional Septic Tank.

Design Considerations The majority of settleable solids are removed in a sedimentation chamber in front of the actual ABR. Small-scale, stand-alone units typically have an integrated settling compartment (as shown in S.10), but primary sedimentation can also take place in a separate Settler (T.1) or another preceding technology (e.g., existing Septic Tanks). Designs without a settling compartment are of particular interest for (Semi-) Centralized Treatment plants that combine the ABR with another technology for primary settling, or where prefabricated, modular units are used.
Typical inflows range from 2 to 200 m^3 per day. Critical design parameters include a hydraulic retention time (HRT) between 48 to 72 hours, upflow velocity of the wastewater below 0.6 m/h and the number of upflow chambers (3 to 6). The connection between the chambers can be designed either with vertical pipes or baffles. Accessibility to all chambers (through access ports) is necessary for maintenance. Usually, the biogas produced in an ABR through anaerobic digestion is not collected because of its insufficient amount. The tank should be vented to allow for controlled release of odorous and potentially harmful gases.

Appropriateness This technology is easily adaptable and can be applied at the household level, in small neighbourhoods or even in bigger catchment areas. It is most appropriate where a relatively constant amount of blackwater and greywater is generated. A (semi-) centralized ABR is appropriate when there is a pre-existing Conveyance technology, such as a Simplified Sewer (C.4).
This technology is suitable for areas where land may be limited since the tank is most commonly installed underground and requires a small area. However, a vacuum truck should be able to access the location because the sludge must be regularly removed (particularly from the settler).

ABRs can be installed in every type of climate, although the efficiency is lower in colder climates. They are not efficient at removing nutrients and pathogens. The effluent usually requires further treatment.

Health Aspects/Acceptance Under normal operating conditions, users do not come in contact with the influent or effluent. Effluent, scum and sludge must be handled with care as they contain high levels of pathogenic organisms. The effluent contains odorous compounds that may have to be removed in a further polishing step. Care should be taken to design and locate the facility such that odours do not bother community members.

Operation & Maintenance An ABR requires a start-up period of several months to reach full treatment capacity since the slow growing anaerobic biomass first needs to be established in the reactor. To reduce start-up time, the ABR can be inoculated with anaerobic bacteria, e.g., by adding fresh cow dung or Septic Tank sludge. The added stock of active bacteria can then multiply and adapt to the incoming wastewater. Because of the delicate ecology, care should be taken not to discharge harsh chemicals into the ABR.
Scum and sludge levels need to be monitored to ensure that the tank is functioning well. Process operation in general is not required, and maintenance is limited to the removal of accumulated sludge and scum every 1 to 3 years. This is best done using a Motorized Emptying and Transport technology (C.3). The desludging frequency depends on the chosen pre-treatment steps, as well as on the design of the ABR.
ABR tanks should be checked from time to time to ensure that they are watertight.

Pros & Cons

+ Resistant to organic and hydraulic shock loads
+ No electrical energy is required
+ Low operating costs
+ Long service life
+ High reduction of BOD
+ Low sludge production; the sludge is stabilized
+ Moderate area requirement (can be built underground)

- Requires expert design and construction
- Low reduction of pathogens and nutrients
- Effluent and sludge require further treatment and/or appropriate discharge

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For more details of containment system, please refer “Compendium of Sanitation Systems and Technologies”, IWA, Eawag. This document can be downloaded from: http://www.iwa-network.org/wp-content/uploads/2016/06/Compendium-Sanitation-Systems-and-Technologies.pdf

Containment system – ECOSAN

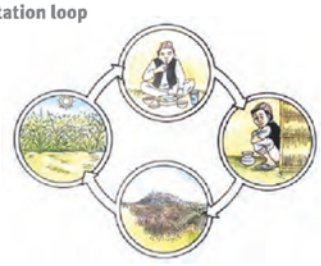
1 Introduction

1.1 Background

The current global trend of urbanization is creating a pressure on Nepal's eco-system. Nepal is struggling with the most rapid urbanization trend in the South Asian Sub-continent with approximately 15% of its total population living in 58 designated urban areas. This is expected to reach 23% by 2016 as the urban population is increasing at 6.6% per annum reflecting both an increase in migration to towns as an escape from rural poverty, conflict and the reclassification of emerging towns from villages to municipalities.

The present sanitation situation in Nepal indicates the coverage only about 46% of total population with access to some kind of latrine facilities. The scale of the problem is further illustrated by the present achievement made by the country to meet Millennium Development Goal (MDG) targets. The toilets constructed in some parts of the country are often failed to meet the required level of hygiene. The challenge at present is to increase the toilet coverage and its accessibility by increasing the depth of understanding of community to ensure usage and sustained behaviour. In all the circumstances, the toilet must be hygienic, safe and environmentally friendly and affordable.

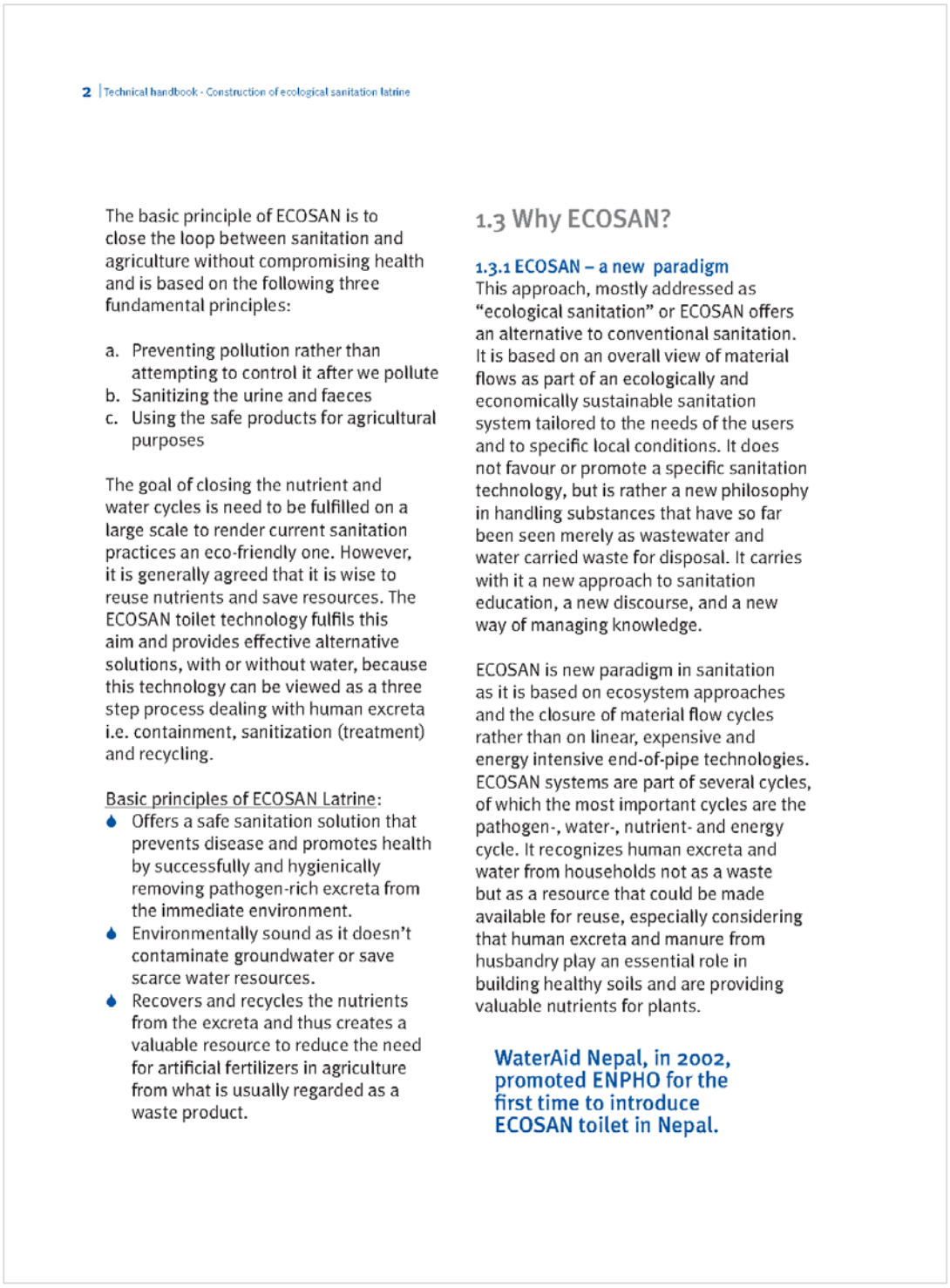
Figure 1:
ECOSAN - Closing the sanitation loop



Source: ENPHO

1.2 What is ECOSAN?

Ecological Sanitation (ECOSAN) is an environment friendly sustainable sanitation system which regards human waste as resource for agricultural purposes and food security. In contrast to the common practice of linear waste management which views waste or excreta as something that needs to be disposed, ECOSAN seeks to close the loop of nutrients cycle, conserve water and our surrounding environment.



2 | Technical handbook - Construction of ecological sanitation latrine

The basic principle of ECOSAN is to close the loop between sanitation and agriculture without compromising health and is based on the following three fundamental principles:

a. Preventing pollution rather than attempting to control it after we pollute
b. Sanitizing the urine and faeces
c. Using the safe products for agricultural purposes

The goal of closing the nutrient and water cycles is need to be fulfilled on a large scale to render current sanitation practices an eco-friendly one. However, it is generally agreed that it is wise to reuse nutrients and save resources. The ECOSAN toilet technology fulfils this aim and provides effective alternative solutions, with or without water, because this technology can be viewed as a three step process dealing with human excreta i.e. containment, sanitization (treatment) and recycling.

Basic principles of ECOSAN Latrine:

- Offers a safe sanitation solution that prevents disease and promotes health by successfully and hygienically removing pathogen-rich excreta from the immediate environment.
- Environmentally sound as it doesn't contaminate groundwater or save scarce water resources.
- Recovers and recycles the nutrients from the excreta and thus creates a valuable resource to reduce the need for artificial fertilizers in agriculture from what is usually regarded as a waste product.

1.3 Why ECOSAN?

1.3.1 ECOSAN – a new paradigm

This approach, mostly addressed as "ecological sanitation" or ECOSAN offers an alternative to conventional sanitation. It is based on an overall view of material flows as part of an ecologically and economically sustainable sanitation system tailored to the needs of the users and to specific local conditions. It does not favour or promote a specific sanitation technology, but is rather a new philosophy in handling substances that have so far been seen merely as wastewater and water carried waste for disposal. It carries with it a new approach to sanitation education, a new discourse, and a new way of managing knowledge.

ECOSAN is new paradigm in sanitation as it is based on ecosystem approaches and the closure of material flow cycles rather than on linear, expensive and energy intensive end-of-pipe technologies. ECOSAN systems are part of several cycles, of which the most important cycles are the pathogen-, water-, nutrient- and energy cycle. It recognizes human excreta and water from households not as a waste but as a resource that could be made available for reuse, especially considering that human excreta and manure from husbandry play an essential role in building healthy soils and are providing valuable nutrients for plants.

WaterAid Nepal, in 2002, promoted ENPHO for the first time to introduce ECOSAN toilet in Nepal.

More details on ECOSAN is available in "Technical handbook on construction of ecological sanitation latrine", WaterAid, September 2011. It can be downloaded from:
https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjPi82jk5_WAhUHK48KHavbBDAQFggqMAA&url=http%3A%2F%2Fwww.wateraid.org%2F~%2Fmedia%2FPublications%2Fconstruction-of-ecological-sanitation-latrine.pdf&usg=AFQjCNEyKrGR2Flnd3boUxsMsqCZk_i4BA

Conveyance – Geo-tube bags

stations built by the public utility AAWASA, to reduce, by an average of 12 km, the travel distance to the treatment sites that are located at the outskirts of the city. Only the utility trucks are allowed use of the transfer stations. Capacity limitations are so severe that only 35% of the utility trucks are using these stations. One of the stations has already been demolished to clear the land for residential construction. The operations of the remaining existing sites has been compromised due to improper use.

Box 3: Use of geo-tube for fecal sludge storage

The geo-tube material is made of a porous membrane with the sludge received through a hose from the truck. Discharge can be achieved by using a pump or gravity. Sludge in the geo-tube is gradually dewatered by leaching through the porous membrane, and the leachate is treated in the nearby sewage treatment plant, while the solids are retained inside. Exposure to the outdoor heat further dries the remaining sludge, and the geo tube is eventually lifted onto a truck and transported out to a landfill or a recovery facility.

In Malaysia the public utility is evaluating the use of geo tube as a novel transfer station (See Box 3). A pilot project was executed successfully by IWK in 2010 by locating geo tube in several strategic locations (at existing sewage treatment plants) to shorten the travel time for the trucks.

The data showed that the operational cost per emptying event was reduced by 8%, revenues increased by 35% due to more trips per day being possible and overall operations expenses decreased by 37%. The model, when applied to the medium-size operator in Melaka, demonstrated that the geo-tube extension into the "standard" FSM service model is a key determinant in improving the financial viability of the medium-size business.

Figure 46: Geo-tube before and after use in Malaysia

The advantages of using a geo-tube as opposed to a conventional sludge drying bed (SDB) are numerous and include: (1) that it can be used under all weather conditions whereas a sludge drying bed is effective only in dry weather unless built with a roof; (2) The Geo-tube or Geobag

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More details is available on:
http://www.sswm.info/sites/default/files/reference_attachments/CHOWDHRY%20KONE%202012%20Business%20Analysis%20of%20Fecal%20Sludge%20Management.pdf

READING MATERIAL - SESSION 3
SEPTAGE TREATMENT AND REUSE / DISPOSAL

Method of wastewater treatment:

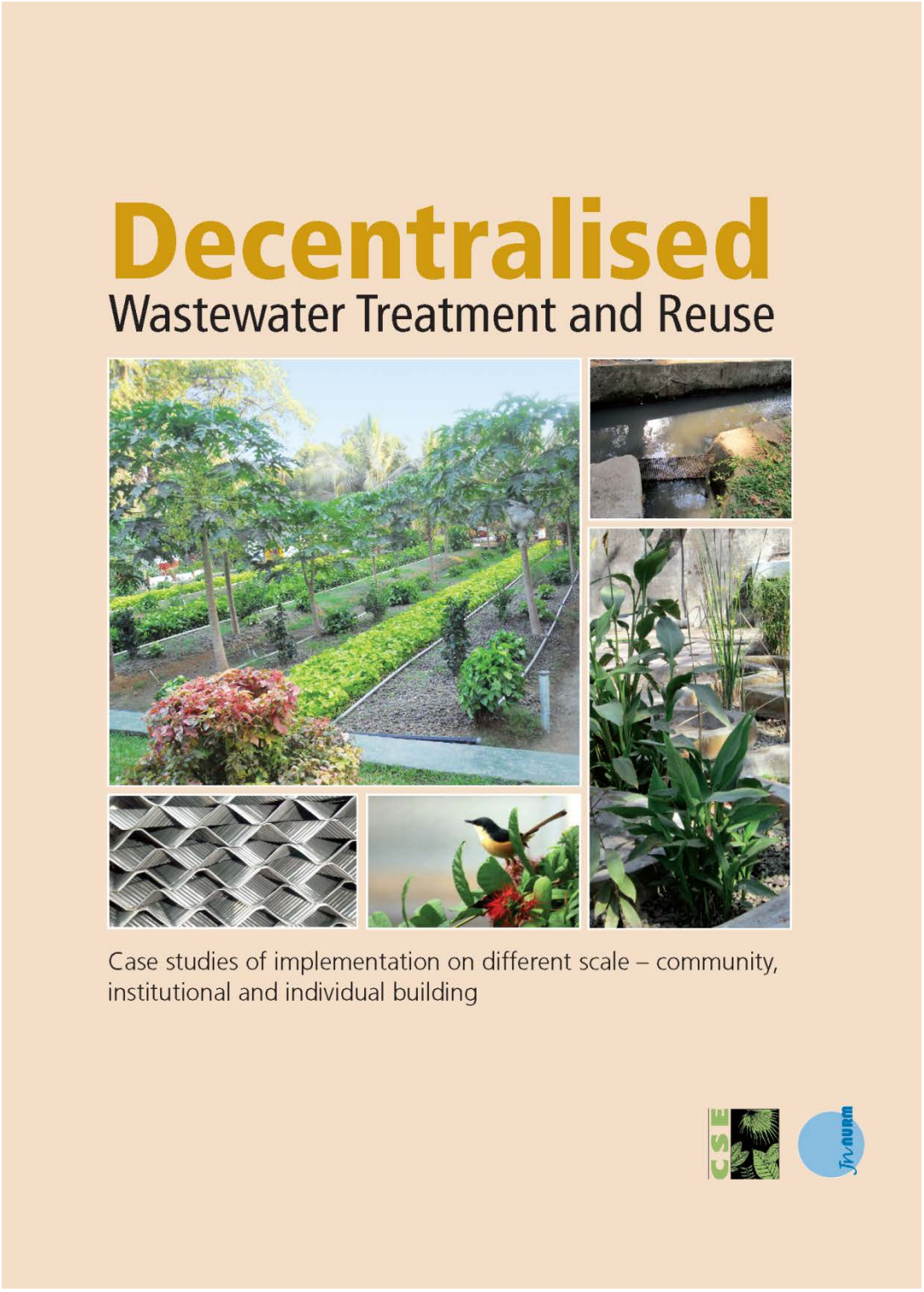
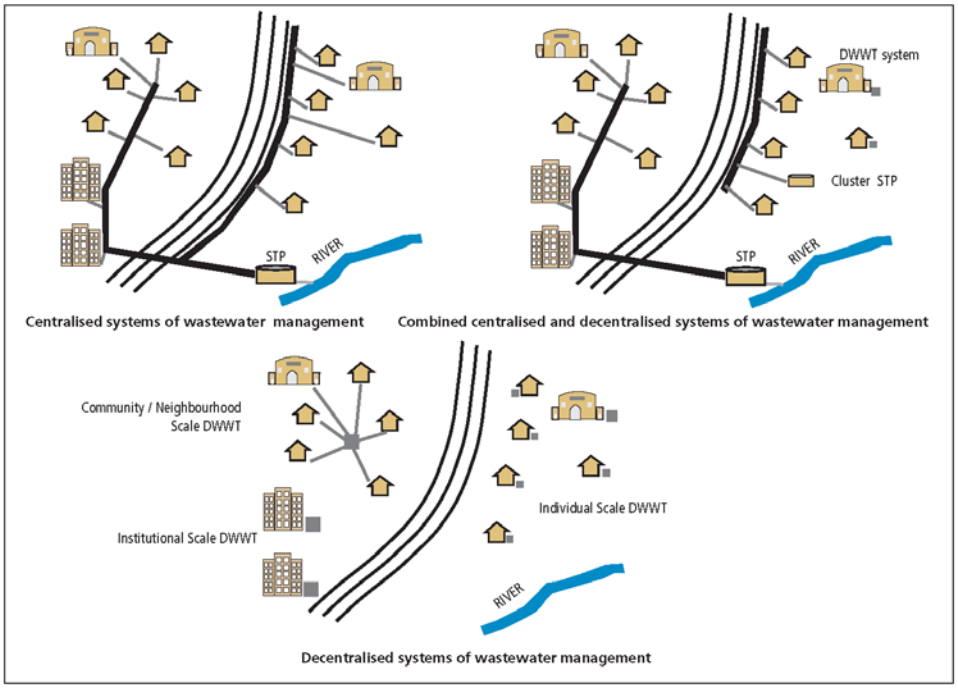


DIAGRAM 1 Schematic representation of centralised, combined and decentralised wastewater management system



Source: *CSE TEAM*

DWWT – Potential of local reuse and recycle

Individual household, cluster of building (neighbourhood) or an institutional building, all offer immense potential of local reuse and recycle:

- Non-potable urban uses – toilet flushing, car washing, fire protection, and make-up water for centrally air-conditioned buildings
- Reuse in landscape and agriculture-commercial nurseries, parks/ gardens, roadside/ roadway median strips, golf courses, green belts and irrigation
- Recreational/ environmental uses – development of fisheries, ponds, lakes replenishment, marshes and wetlands
- Aquifer recharge – for replenishment and sustainable groundwater use
- Other industrial non–potable uses like cooling, boiler feed and process water

affordable wastewater treatment various reforms and policies in recent year have made provisions for mainstreaming DWWT and local reuse. The revised manual on 'Sewerage and sewage treatment system' published by Central Public Health and Environmental Engineering Organisation (CPHEEO) in 2013 – has a new chapter dedicated on 'Decentralised sewerage system' (chapter 8, Part A; Engineering) describing the concept as 'localised collection and localised treatment of excreta and sullage in micro zones within a major habitation keeping it in tandem with densification and progressively duplicating it as and when other micro zones densify'.[4]

According to CPCB the decentralised treated wastewater can achieve the standards prescribed and can be recycled and reused.[5]

In all this, growing towns and cities are struggling to find the right answers to treat and clean waste, all at a time, when costs are rising. The ULBs should find scope in decentralisation and exploit a new opportunity in providing sanitation keeping in mind the principle of 'affordability, acceptability and manageability of the treatment' and type of reuse.

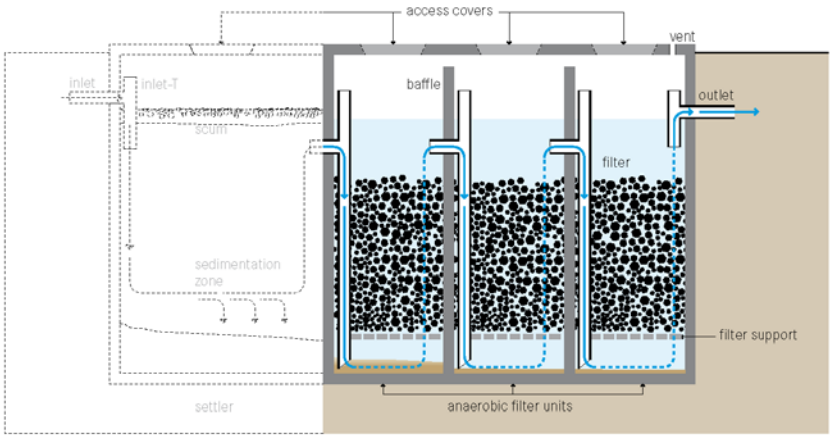
For more details, please download this document from:
http://www.cseindia.org/userfiles/decentralised_wasterwater_treatment_reuse.pdf

Various technology modules for on-site sanitation:

Anaerobic Filter

T.4 Anaerobic Filter | Applicable to: **Systems 1, 6-9**

Application Level:	Management Level:	Inputs: Effluent, Blackwater, Brownwater, Greywater
Household	Household	Outputs: Effluent, Sludge
Neighbourhood	Shared	
City	Public	



An anaerobic filter is a fixed-bed biological reactor with one or more filtration chambers in series. As wastewater flows through the filter, particles are trapped and organic matter is degraded by the active biomass that is attached to the surface of the filter material.

With this technology, suspended solids and BOD removal can be as high as 90%, but is typically between 50% and 80%. Nitrogen removal is limited and normally does not exceed 15% in terms of total nitrogen (TN).

Design Considerations Pre- and primary treatment is essential to remove solids and garbage that may clog the filter. The majority of settleable solids are removed in a sedimentation chamber in front of the anaerobic filter. Small-scale, stand-alone units typically have an integrated settling compartment (as shown in S.11), but primary sedimentation can also take place in a separate Settler (T.1) or another preceding technology (e.g., existing Septic Tanks). Designs without a settling compartment are of particular interest for (Semi-) Centralized Treatment plants that combine the anaerobic filter with other technologies, such as the Anaerobic Baffled Reactor (ABR, T.3).

Anaerobic filters are usually operated in upflow mode because there is less risk that the fixed biomass will be washed out. The water level should cover the filter media by at least 0.3 m to guarantee an even flow regime. The hydraulic retention time (HRT) is the most important design parameter influencing filter performance. An HRT of 12 to 36 hours is recommended.

The ideal filter should have a large surface area for bacteria to grow, with pores large enough to prevent clogging. The surface area ensures increased contact between the organic matter and the attached biomass that effectively degrades it. Ideally, the material should provide between 90 to 300 m^2 of surface area per m^3 of occupied reactor volume. Typical filter material sizes range from 12 to 55 mm in diameter. Materials commonly used include gravel, crushed rocks or bricks, cinder, pumice, or specially formed plastic pieces, depending on local availability. The connection between the chambers can be designed either with vertical pipes or baffles. Accessibility to all chambers (through access ports) is necessary for maintenance. The tank should be

vented to allow for controlled release of odorous and potentially harmful gases.

Appropriateness This technology is easily adaptable and can be applied at the household level, in small neighbourhoods or even in bigger catchment areas. It is most appropriate where a relatively constant amount of blackwater and greywater is generated. The anaerobic filter can be used for secondary treatment, to reduce the organic loading rate for a subsequent aerobic treatment step, or for polishing.
This technology is suitable for areas where land may be limited since the tank is most commonly installed underground and requires a small area. Accessibility by vacuum truck is important for desludging.
Anaerobic filters can be installed in every type of climate, although the efficiency is lower in colder climates. They are not efficient at removing nutrients and pathogens. Depending on the filter material, however, complete removal of worm eggs may be achieved. The effluent usually requires further treatment.

Health Aspects/Acceptance Under normal operating conditions, users do not come in contact with the influent or effluent. Effluent, scum and sludge must be handled with care as they contain high levels of pathogenic organisms. The effluent contains odorous compounds that may have to be removed in a further polishing step. Care should be taken to design and locate the facility such that odours do not bother community members.

Operation & Maintenance An anaerobic filter requires a start-up period of 6 to 9 months to reach full treatment capacity since the slow growing anaerobic biomass first needs to be established on the filter media. To reduce start-up time, the filter can be inoculated with anaerobic bacteria, e.g., by spraying Septic Tank sludge onto the filter material. The flow should be gradually increased over time. Because of the delicate ecology, care should be taken not to discharge harsh chemicals into the anaerobic filter.
Scum and sludge levels need to be monitored to ensure that the tank is functioning well. Over time, solids will clog the pores of the filter. As well, the growing bacterial mass will become too thick, break off and eventually clog pores. When the efficiency decreases, the filter must be cleaned. This is done by running the system in reverse mode (backwashing) or by removing and cleaning the filter material.
Anaerobic filter tanks should be checked from time to time to ensure that they are watertight.

Pros & Cons

+ No electrical energy is required
+ Low operating costs
+ Long service life
+ High reduction of BOD and solids
+ Low sludge production; the sludge is stabilized
+ Moderate area requirement (can be built underground)
- Requires expert design and construction
- Low reduction of pathogens and nutrients
- Effluent and sludge require further treatment and/or appropriate discharge
- Risk of clogging, depending on pre- and primary treatment
- Removing and cleaning the clogged filter media is cumbersome

References & Further Reading

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Available at: www.sandec.ch
(Short summary including case studies – p. 28)

_ von Sperling, M. and de Lemos Chernicharo, C. A. (2005). *Biological Wastewater Treatment in Warm Climate Regions, Volume One.* IWA Publishing, London, UK. pp. 728-804.
Available at: www.iwawaterwiki.org
(Detailed design instructions)

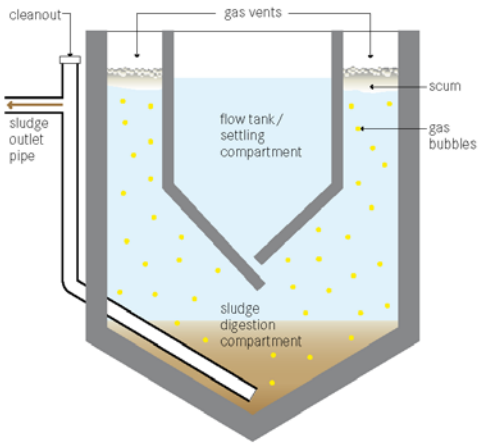
_ Ulrich, A. (Ed.), Reuter, S. (Ed.), Gutterer, B. (Ed.), Sasse, L., Panzerbieter, T. and Reckerzügel, T. (2009). *Decentralised Wastewater Treatment Systems (DEWATS) and Sanitation in Developing Countries. A Practical Guide.* WEDC, Loughborough University, Leicestershire, UK.
(Design summary including Excel spreadsheets for design calculations)

Imhoff tank

T.2 Imhoff Tank

Applicable to: **Systems 1, 6-9**

Application Level:	Management Level:	Inputs: Blackwater, Brownwater, Greywater
Household	Household	Outputs: Effluent, Sludge
Neighbourhood	Shared	
City	Public	



The Imhoff tank is a primary treatment technology for raw wastewater, designed for solid-liquid separation and digestion of the settled sludge. It consists of a V-shaped settling compartment above a tapering sludge digestion chamber with gas vents.

The Imhoff tank is a robust and effective settler that causes a suspended solids reduction of 50 to 70%, COD reduction of 25 to 50%, and leads to potentially good sludge stabilization – depending on the design and conditions. The settling compartment has a circular or rectangular shape with V-shaped walls and a slot at the bottom, allowing solids to settle into the digestion compartment, while preventing foul gas from rising up and disturbing the settling process. Gas produced in the digestion chamber rises into the gas vents at the edge of the reactor. It transports sludge particles to the water surface, creating a scum layer. The sludge accumulates in the sludge digestion compartment, and is compacted and partially stabilized through anaerobic digestion.

Design Considerations The Imhoff tank is usually built underground with reinforced concrete. It can, however, also be built above ground, which makes sludge removal easier due to gravity, although it still requires pumping up of the influent. Small prefabricated Imhoff tanks are also available on the market. Hydraulic retention time is usually not more than 2 to 4 hours to preserve an aerobic effluent for further treatment or discharge. T-shaped pipes or baffles are used at the inlet and the outlet to reduce velocity and prevent scum from leaving the system. The total water depth in the tank from the bottom to the water surface may reach 7 to 9.5 m. The bottom of the settling compartment is typically sloped 1.25 to 1.75 vertical to 1 horizontal and the slot opening can be 150 to 300 mm wide. The walls of the sludge digestion compartment should have an inclination of 45° or more. This allows the sludge to slide down to the centre where it can be removed. Dimensioning of the anaerobic digestion compartment depends mainly on sludge production per population equivalent, on the targeted degree of sludge stabilization (linked to the desludging frequency) and the temperature. The digestion chamber is usually designed for 4 to 12 months sludge storage capacity to allow for sufficient anaerobic digestion. In colder climates longer sludge retention time and, therefore, a greater volume

is needed. For desludging, a pipe and pump have to be installed or access provided for vacuum trucks and mobile pumps. A bar screen or grit chamber (see PRE, p. 100) is recommended before the Imhoff tank to prevent coarse material from disturbing the system.

Appropriateness Imhoff tanks are recommended for domestic or mixed wastewater flows between 50 and 20,000 population equivalents. They are able to treat high organic loads and are resistant against organic shock loads. Space requirements are low.
Imhoff tanks can be used in warm and cold climates. As the tank is very high, it can be built underground if the groundwater table is low and the location is not flood prone.

Health Aspects/Acceptance As the effluent is almost odourless, it is a good option for primary treatment if subsequent treatment takes place, e.g., in open ponds, constructed wetlands or trickling filters. Gases produced in low quantities may, however, generate odours locally. Pathogen removal is low and all outputs should be treated. Appropriate protective clothing is necessary for workers who may come in contact with the effluent, scum or sludge.

Operation & Maintenance Operation and maintenance are possible at low cost, if trained personnel are in charge. Flow paths have to be kept open and cleaned out weekly, while scum in the settling compartment and the gas vents has to be removed daily if necessary. Stabilized sludge from the bottom of the digestion compartment should be removed according to the design. A minimum clearance of 50 cm between the sludge blanket and the slot of the settling chamber has to be ensured at all times.

Pros & Cons

+ Solid-liquid separation and sludge stabilization are combined in one single unit
+ Resistant against organic shock loads
+ Small land area required
+ The effluent is not septic (with low odour)
+ Low operating costs

- Very high (or deep) infrastructure; depth may be a problem in case of high groundwater table
- Requires expert design and construction
- Low reduction of pathogens
- Effluent, sludge and scum require further treatment

References & Further Reading

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(Case study providing general information about Imhoff tanks and insights into implementation and operational problems. Recommendations for O&M are provided.)

_ McLean, R. C. (2009). *Honduras Wastewater Treatment: Chemically Enhanced Primary Treatment and Sustainable Secondary Treatment Technologies for Use with Imhoff Tanks.* Master thesis, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, US.
(Case study including a detailed description of the functionality of the Imhoff tank)

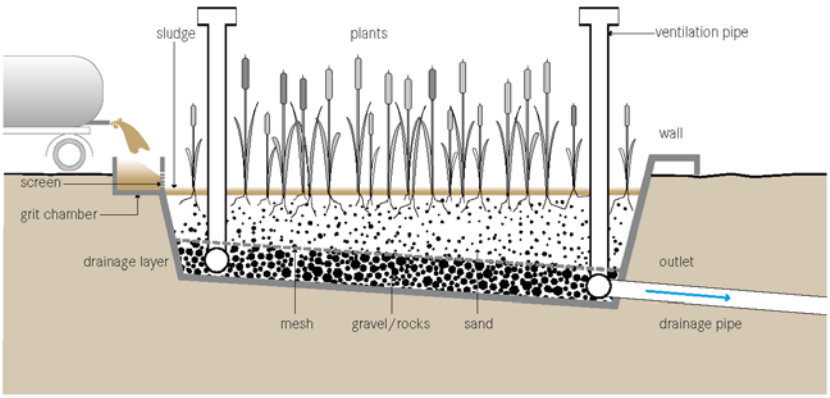
_ Ulrich, A. (Ed.), Reuter, S. (Ed.), Gutterer, B. (Ed.), Sasse, L., Panzerbieter, T. and Reckerzügel, T. (2009). *Decentralised Wastewater Treatment Systems (DEWATS) and Sanitation in Developing Countries. A Practical Guide.* WEDC, Loughborough University, Leicestershire, UK.
(Comprehensive handbook about planning and implementation of decentralized wastewater treatment options. It includes case studies and Excel spreadsheets for design calculations.)

_ WSP (Ed.) (2008). *Philippines Sanitation Sourcebook and Decision Aid.* Water and Sanitation Program, Washington, D.C., US.
Available at: documents.worldbank.org/curated/en/home
(Basic information about low-cost decentralized sanitation technologies for decision makers. Presents fact sheets about 23 selected options, including the Imhoff tank.)

T.15 Planted Drying Beds

Applicable to: **Systems 1, 6-9**

Application Level:	Management Level:	Inputs: Sludge
Household	Household	Outputs: Sludge, Effluent, Biomass
Neighbourhood	Shared	
City	Public	



A planted drying bed is similar to an Unplanted Drying Bed (T.14), but has the added benefit of transpiration and enhanced sludge treatment due to the plants. The key improvement of the planted bed over the unplanted bed is that the filters do not need to be desludged after each feeding/drying cycle. Fresh sludge can be directly applied onto the previous layer; the plants and their root systems maintain the porosity of the filter.

This technology has the benefit of dewatering and stabilizing the sludge. Also, the roots of the plants create pathways through the thickening sludge that allow water to easily escape.

The appearance of the bed is similar to a Vertical Flow Constructed Wetland (T.9). The beds are filled with sand and gravel to support the vegetation. Instead of effluent, sludge is applied to the surface and the filtrate flows down through the subsurface where it is collected in drains.

Design Considerations Ventilation pipes connected to the drainage system contribute to aerobic conditions in the filter. A general design for layering the bed is: (1) 250 mm of coarse gravel (grain diameter of 20 mm); (2) 250 mm of fine gravel (grain diameter of 5 mm); and (3) 100 to 150 mm of sand. Free space (1 m) should be left above the top of the sand layer to account for about 3 to 5 years of accumulation.

Reeds (*Phragmites* sp.), cattails (*Typha* sp.) antelope grass (*Echinochloa* sp.) and papyrus (*Cyperus papyrus*) are suitable plants, depending on the climate. Local, non-invasive species can be used if they grow in humid environments, are resistant to salty water and readily reproduce after cutting.

Sludge should be applied in layers between 75 to 100 mm thick and reapplied every 3 to 7 days, depending on the sludge characteristics, the environment and operating constraints. Sludge application rates of 100 to 250 kg/m^2/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/m^2/year are typical. Two or more parallel beds can be alternately used to allow for sufficient degradation and pathogen reduction of the top layer of sludge before it is removed.

The leachate that is collected in the drainage pipes must be treated properly, depending on where it is discharged.

Appropriateness This technology is effective at decreasing the sludge volume (down to 50%) through decomposition and drying, which is especially important when the sludge needs to be transported elsewhere for end-use or disposal.
Because of their area requirements, planted drying beds are most appropriate for small to medium communities with populations up to 100,000 people, but they can also be used in bigger cities. If designed to service urban areas, planted drying beds should be at the border of the community, but within economic reach for motorized emptying operators.

Health Aspects/Acceptance Because of the pleasing aesthetics, there should be few problems with acceptance, especially if located sufficiently away from dense housing. Undisturbed plantations can attract wildlife, including poisonous snakes.
Faecal sludge is hazardous and anyone working with it should wear protective clothing, boots and gloves. The degree of pathogen reduction in the sludge will vary with the climate. Depending on the desired end-use, further storage and drying might be required.

Operation & Maintenance Trained staff for operation and maintenance is required to ensure proper functioning. The drains must be maintained and the effluent properly collected and disposed of. The plants should have grown sufficiently before applying the sludge. The acclimation phase is crucial and requires much care. The plants should be periodically thinned and/or harvested. After 3 to 5 years the sludge can be removed.

Pros & Cons

+ Can handle high loading
+ Better sludge treatment than in Unplanted Drying Beds
+ Can be built and repaired with locally available materials
+ Relatively low capital costs; low operating costs
+ Fruit or forage growing in the beds can generate income
+ No electrical energy required
- Requires a large land area
- Odours and flies may be noticeable
- Long storage times
- Labour intensive removal
- Requires expert design and construction
- Leachate requires further treatment

References & Further Reading

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_ Koottatep, T., Surinkul, N., Polprasert, C., Kamal, A. S. M., Koné, D., Montangero, A., Heinss, U. and Strauss, M. (2005). *Treatment of Septage in Constructed Wetlands in Tropical Climate – Lessons Learnt after Seven Years of Operation.* Water Science & Technology 51 (9): 119-126.
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Available at: www.sandec.ch
(Detailed book compiling the current state of knowledge on all aspects related to FSM)

_ Tchobanoglous, G., Burton, F. L. and Stensel, H. D. (2004). Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy, 4th Ed. (Internat. Ed.). McGraw-Hill, New York, US. p. 1578.

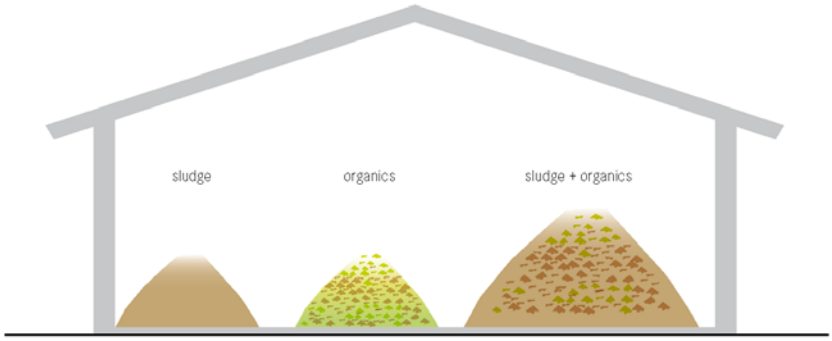
These are the treatment technologies for septage. For information of more treatment technologies, please refer “Compendium of Sanitation Systems and Technologies”, IWA, Eawag. This document can be downloaded from: http://www.iwa-network.org/wp-content/uploads/2016/06/Compendium-Sanitation-Systems-and-Technologies.pdf

Co-composting

T.16 Co-Composting

Applicable to: **Systems 1, 6-9**

Application Level:	Management Level:	Inputs: Sludge, Organics
Household	Household	
Neighbourhood	Shared	Outputs: Compost
City	Public	



Co-composting is the controlled aerobic degradation of organics, using more than one feedstock (faecal sludge and organic solid waste). Faecal sludge has a high moisture and nitrogen content, while biodegradable solid waste is high in organic carbon and has good bulking properties (i.e., it allows air to flow and circulate). By combining the two, the benefits of each can be used to optimize the process and the product.

There are two types of co-composting designs: open and in-vessel. In open composting, the mixed material (sludge and solid waste) is piled into long heaps called windrows and left to decompose. Windrow piles are periodically turned to provide oxygen and ensure that all parts of the pile are subjected to the same heat treatment. In-vessel composting requires controlled moisture and air supply, as well as mechanical mixing. Therefore, it is not generally appropriate for decentralized facilities. Although the composting process seems like a simple, passive technology, a well-functioning facility requires careful planning and design to avoid failure.

Design Considerations The facility should be located close to the sources of organic waste and faecal sludge to minimize transport costs, but still at a distance away from homes and businesses to minimize nuisances. Depending on the climate and available space, the facility may be covered to prevent excess evaporation and/or provide protection from rain and wind.
For dewatered sludge, a ratio of 1:2 to 1:3 of sludge to solid waste should be used. Liquid sludge should be used at a ratio of 1:5 to 1:10 of sludge to solid waste. Windrow piles should be at least 1 m high and insulated with compost or soil to promote an even distribution of heat inside the pile.

Appropriateness A co-composting facility is only appropriate when there is an available source of well-sorted biodegradable solid waste. Solid waste containing plastics and garbage must first be sorted. When carefully done, co-composting can produce a clean, pleasant, beneficial soil conditioner.
Since moisture plays an important role in the composting process, covered facilities are especially recommended where there is heavy rainfall.

Apart from technical considerations, composting only makes sense if there is a demand for the product (from paying customers). In order to find buyers, a consistent and good quality compost has to be produced; this depends on good initial sorting and a well-controlled thermophilic process.

Health Aspects/Acceptance Maintaining the temperature in the pile between 55 and 60 °C can reduce the pathogen load in sludge to a level safe to touch and work with. Although the finished compost can be safely handled, care should be taken when dealing with the sludge, regardless of the previous treatment. If the material is found to be dusty, workers should wear protective clothing and use appropriate respiratory equipment. Proper ventilation and dust control are important.

Operation & Maintenance The mixture must be carefully designed so that it has the proper C:N ratio, moisture and oxygen content. If facilities exist, it would be useful to monitor helminth egg inactivation as a proxy measure of sterilization.

A well-trained staff is necessary for the operation and maintenance of the facility. Maintenance staff must carefully monitor the quality of the input material, and keep track of the inflows, outflows, turning schedules, and maturing times to ensure a high quality product. Forced aeration systems must be carefully controlled and monitored.

Turning must be periodically done with either a front-end loader or by hand. Robust grinders for shredding large pieces of solid waste (i.e., small branches and coconut shells) and pile turners help to optimize the process, reduce manual labour, and ensure a more homogenous end product.

Pros & Cons

+ Relatively straightforward to set up and maintain with appropriate training
+ Provides a valuable resource that can improve local agriculture and food production
+ A high removal of helminth eggs is possible (< 1 viable egg/g TS)
+ Can be built and repaired with locally available materials
+ Low capital and operating costs
+ No electrical energy required
- Requires a large land area (that is well located)
- Long storage times
- Requires expert design and operation by skilled personnel
- Labour intensive
- Compost is too bulky to be economically transported over long distances

References & Further Reading

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Available at: www.sandec.ch
(Detailed book compiling the current state of knowledge on all aspects related to FSM)

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Available at: www.sandec.ch

Compost Filter Several variations of the compost filter exist. Its concept is based on combined filtration and aerobic digestion of solids. Unlike a Septic Tank (S.9), where solids settle to the bottom and degrade under anaerobic conditions, the solids are separated from liquids by a porous medium (filter bed or bag) in a compost filter. They remain on/in the filter and are then broken down by the aerobic organisms that survive in the organic matrix. Maintaining a low volume of water in the collected solids is essential to the success of the compost filter. Thereby, the filter is able to maintain aerobic conditions without being saturated. This can be ensured by regularly adding layers of straw or wood chips to it. Different design variations exist. There are permanent filters made, for example, from concrete, or removable filter bags that can be used to support the organic filter material. In addition, the design determines how frequently the accumulating solids need to be removed and further treated, as well as how long the process can continue without replacing the filter. A double-chamber design works on the principle of alternation (as with Dehydration Vaults for faeces, S.7, or Twin Pits for Pour Flush, S.6); each side can be used for a year, and the content is then allowed to rest and decompose while the other side is in use. There are also designs that work continuously with a single chamber (e.g., the Biofil Digester, see references). Essential to the compost filter design is secondary treatment of the effluent, e.g., in a Constructed Wetland (T.7-T.9) and/or Waste Stabilization Ponds (T.5). Depending on the intended end-use, the composted solids may also require further treatment.

LaDePa Sludge Pelletizer The Latrine Dehydration and Pasteurisation (LaDePa) pelletizer is a sludge drying and pasteurization technology capable of producing a dry, pelletized soil amender from pit latrine sludge. It can be fed at a rate of about 1,000 kg/h sludge (30-35% solids content) and the output rate is about 300 kg/h dried pellets (60-65 % solids content). Garbage that ends up in pits (plastic bags, shoes, etc.) is separated from the sludge by a screw compactor: the screw pushes the sludge through 6 mm holes onto a porous, continuous steel belt, while the waste material is ejected through a separate outlet so that it can be collected and disposed of.

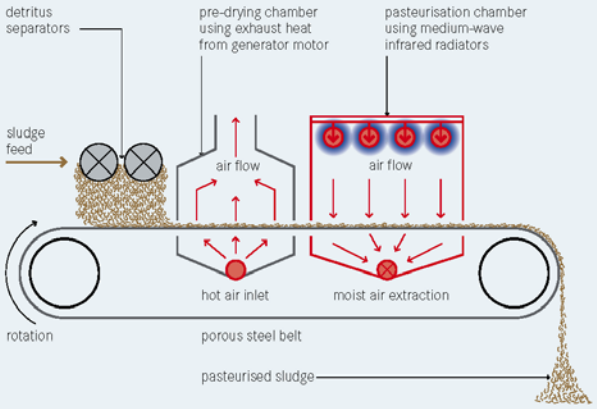


Figure 6: Schematic of the LaDePa sludge pelletizer

The extruded sludge falls in an open matrix of spaghetti-like strands, in a layer varying in thickness from 25-40 mm, onto the porous belt and passes first through a pre-drying section that utilizes the waste heat from the internal combustion engine of the power plant. The partially dried sludge pellets then travel through a patented "Parseps Dryer" that makes use of medium-wave infrared radiation. The pellets are, thereby, pasteurized and dried by using an extractor fan that draws the hot air through the porous belt and the open matrix of sludge. This increases the drying capability without increasing the energy output. The pellets that emerge are free of pathogens and suitable for all edible crops. The whole process takes 16 minutes. An important disadvantage of the LaDePa process is that it is relatively energy intensive and relies on a constant source of energy (electricity/diesel).

The eThekwini Municipality in Durban, South Africa, has been running LaDePa trials for about 2 years. Evidence from the trials, in conjunction with their VIP pit emptying program, indicates that they should be able to treat approximately 2,000 t of VIP sludge a year with one plant. The product has a registered trademark (GrowEthek) and, once the product has been licensed as a low nutrient fertilizer, it will be bagged and sold. Based on the sale price of GrowEthek, the LaDePa generates about $27/h, which can offset the operating costs. The LaDePa was designed by Particle Separation Systems (PSS), which offers the equipment on a rental basis or for sale. If the rental option is preferred, there is an establishment fee and a maintenance contract. If the equipment is purchased outright, there would still be a maintenance contract, but no establishment fee.

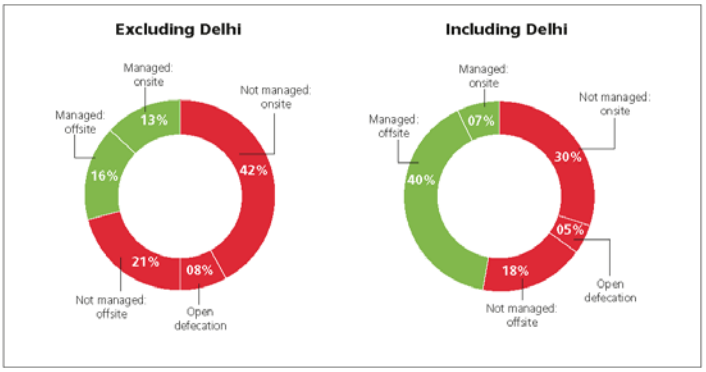
Struvite Production from Urine Urine contains most of the excess nutrients excreted from the body. Nitrogen and phosphorus are two elements essential for plant growth and are present in urine in significant amounts (concentrations vary dramatically, but values around 250 mg/L PO_4-P and 2,500 mg/L NH_4-N are not atypical). In order to take advantage of the nutrients, including potassium, sulphur, etc., stored urine can be directly applied to crops and fields (see D.2), or processed into a solid fertilizer called struvite (NH_4MgPO_4-$6H_2O$). Struvite is produced by adding some kind of soluble magnesium source (magnesium chloride, bittern or wood ash) to the urine. Magnesium binds with the phosphorus and nitrogen, and precipitates out into a white, crystalline form. Struvite crystals must be filtered out of the solution, dried and then processed into a useable form. It is currently produced in Durban, South Africa, from 1,000 litres of urine per day that is collected from household urine-diverting dry toilets. When there is no use or desire for urine-derived nutrients (e.g., in dense urban areas), struvite is a convenient way of producing a compact nutrient product that can be easily stored, transported and used when and where it is needed. A disadvantage, however, is that struvite production produces an equivalent volume of effluent with a high pH and ammonium concentration that requires further treatment. Other important elements, such as potassium, also remain in the solution. Yet, struvite production is simple, requiring little more than a mixing chamber and filter, and has been proven to work in many countries and contexts. As a first step in a nutrient recovery strategy, it is effective, but should not be implemented without a subsequent effluent treatment strategy. Examples of effective effluent management are drip irrigation systems that distribute the liquid directly onto crop roots, although the distribution is limited by head and available area, or nitrification of the urine (which is still in the development phase).

Struvite can also be recovered from wastewater streams, specifically from digester supernatant, which has higher concentrations of phosphorus than blackwater, though the mixing and dosing technology are more complicated. Ostara (see references) is one of several companies that has installed their proprietary technologies at large wastewater treatment plants.

For more reading materials on treatment technology, apart from Compendium of Sanitation Systems and Technologies, Septage Management - A Practitioner's Guide is also helpful which is available on: http://www.swachhbharaturban.in:8080/sbm/content/writereaddata/Septage%20Management%20A%20Practitioner%E2%80%99s%20Guide%20with%20SBM%20logo.pdf

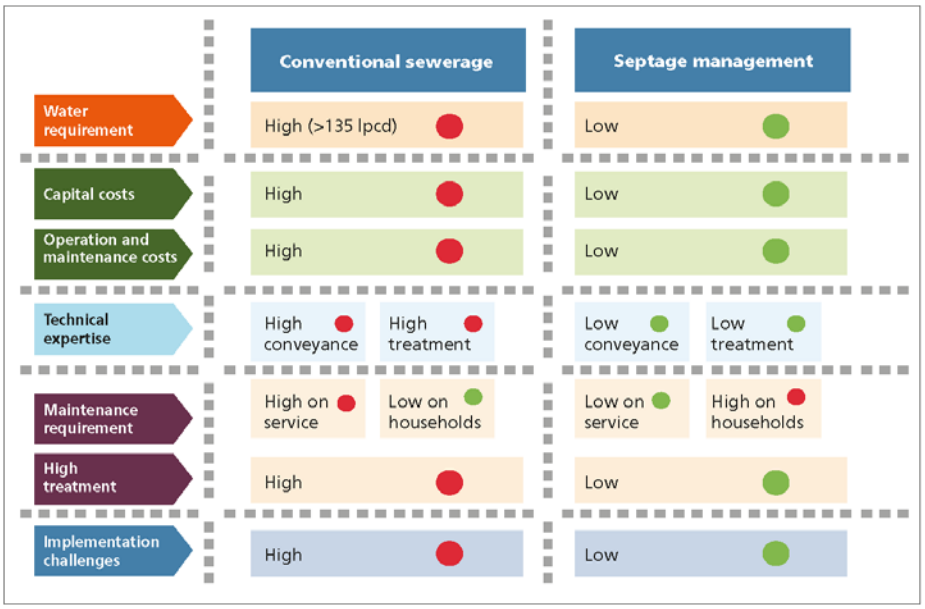
Comparison of centralized and decentralized method of treatment

Figure 3: Status of excreta management of 27 cities



Source: Compiled by CSE, 2016

Figure 4: Benefits of septage management over a conventional sewerage system



Source: Septage management guidelines, UDD, GoM, 2016

Figure 4: Benefits of septage management over a conventional sewerage system depicts that septage management, once implemented, can prove to be a sustainable step towards citywide sanitation due to its advantages over conventional sewerage systems.

This is taken from Septage Management - A Practitioner's Guide.

READING MATERIAL - SESSION 4
PLANNING FOR FSSM AND ITS FINANCING

In high subsoil water level: Where the subsoil water level rises to less than 300 mm below ground level, the top of the pits should be raised by 300 mm above the likely subsoil water level and earth should be filled all round the pits and latrine floor raised as stated above. A typical pour flush latrine with leach pits in high subsoil water level is shown in Figure 9.6

In rocky strata: In rocky strata with soil layer in between, the leach pits can be designed on the same principle as those for low subsoil water level and taking the long term infiltrative capacity as 20 l/m^2/d. However, in rocks with fissures, chalk formations, old root channels, pollution can flow to very long distances; hence these conditions demand careful investigation and adoption of pollution safeguards as stated in paragraph below.

In black cotton soil: Pits in black cotton soil should be designed taking infiltrative rate of 10 l/m^2/d. However a vertical fill (envelope) 300 mm in width with sand, gravel or ballast of small sizes should be provided all round the pit outside the pit lining.

Where space is a constraint: Where circular pits of standard sizes cannot be constructed due to space constraints, deeper pit with small diameter (not less than 750 mm), or combined oval, square or rectangular pits divided into two equal compartments by a partition wall may be provided. In case of combined pits and the partition wall should not have holes. The partition wall should go 225 mm deeper than the pit lining and plastered on both sides with cement mortar. A typical pour flush latrine with combined pits is shown in Figure 9.7

Design example of leach pit is given in Appendix A.9.1.

9.3.3.2 Construction of Pour Flush Latrine

9.3.3.2.1 Squatting Pan and Trap

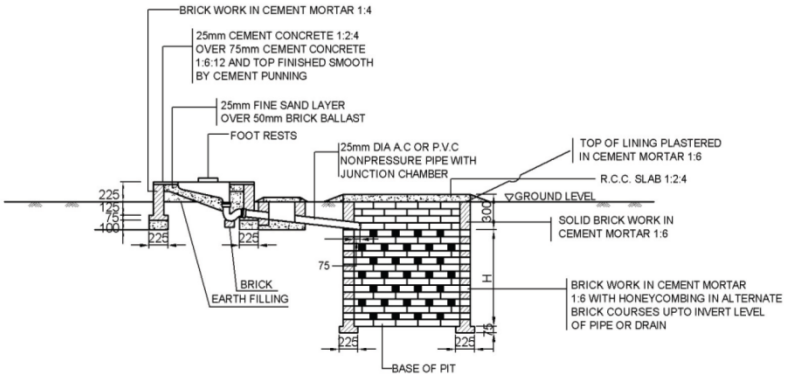
The pan could be ceramic, GRP, PVC, PP, Cement Concrete or Cement Mosaic. Ceramic are the best but costliest. Mosaic or cement concrete pans have the advantage that these can be manufactured locally by trained masons but the surface tends to become rough after long use. Their acceptance is less compared to other types. Traps for ceramic pans are made of the same material but in case of GRP pans, HDPE traps are used. For mosaic pans, traps are of cement concrete.

9.3.3.2.2 Foot Rests

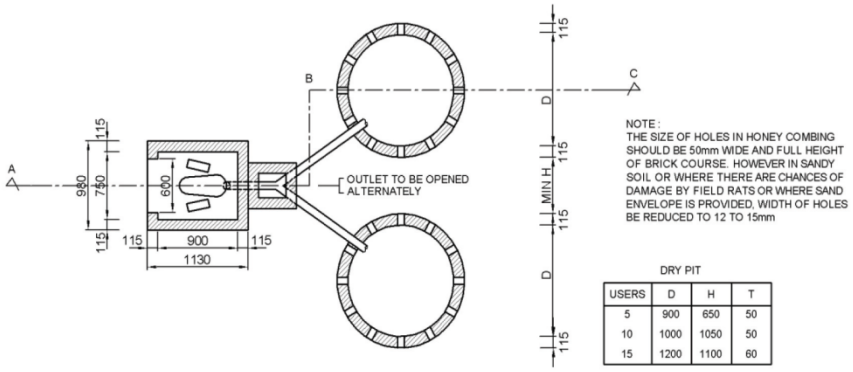
These can be of ceramic, cement concrete, cement mosaics or brick plastered. The top of the footrest should be about 20 mm above the floor level and inclined slightly outwards in the front.

9.3.3.2.3 Pit Lining

The pits should be lined to avoid collapsing. Bricks joined in 1:6 cement mortar are most commonly used for lining. Locally manufactured bricks should be used wherever available. Stones or laterite bricks cement concrete rings could also be used depending upon their availability and cost. However, for ease of construction, use of concrete rings will be advantageous where the subsoil water level is above the pit bottom.



SECTION A B C



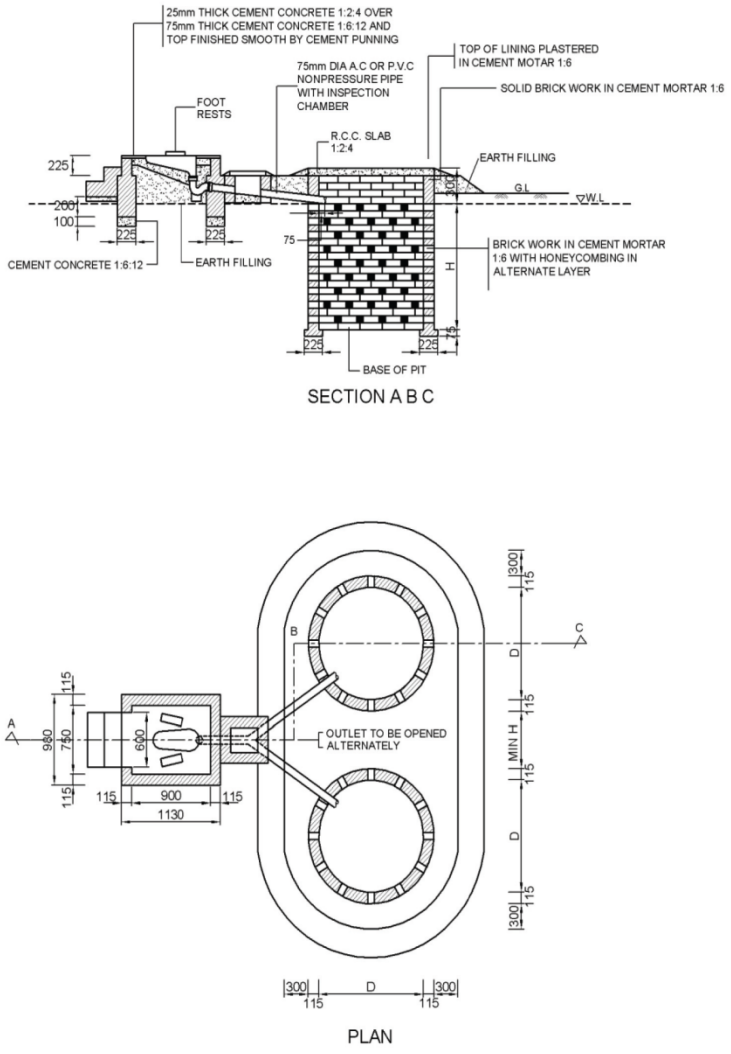
DRY PIT

USERS	D	H	T
5	900	650	50
10	1000	1050	50
15	1200	1100	60

PLAN

Source: CPHEEO, 1993

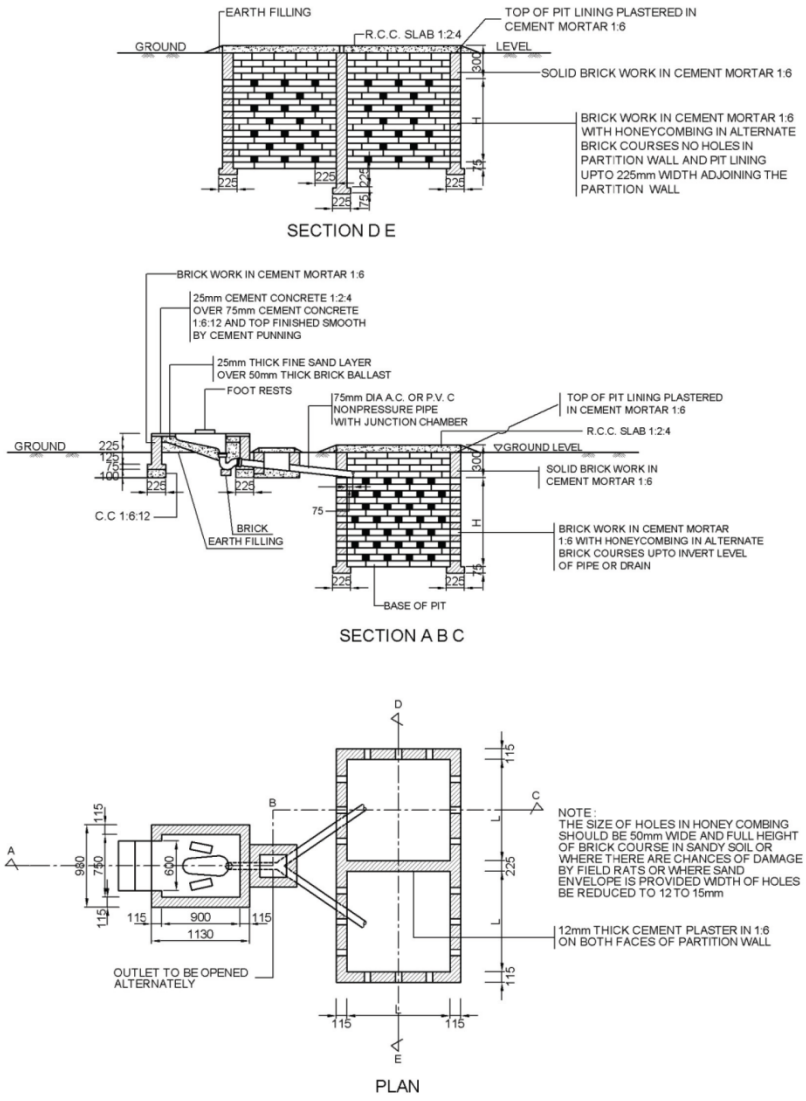
Figure 9.4 Pour flush latrine with circular pits



Source:CPHEEO, 1993

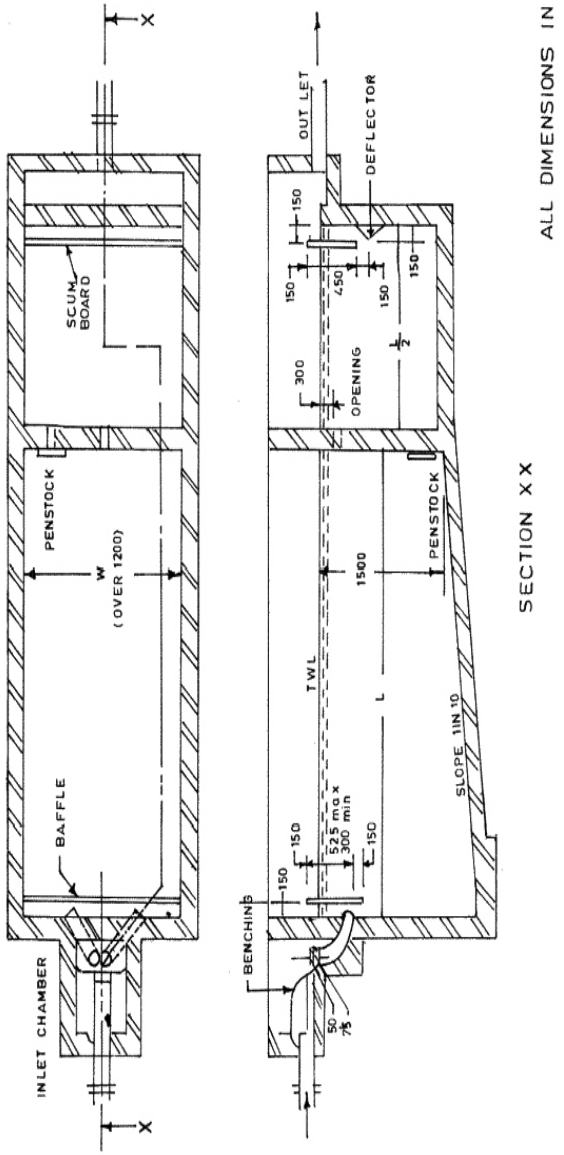
Figure 9.6 Leach pits in high subsoil water level

9 - 12



Source:CPHEEO, 1993

Figure 9.7 Pour flush latrine with combined pits



TYPICAL SKETCH OF TWO COMPARTMENT SEPTIC TANK FOR POPULATIONS OVER 50 (IS : 2470 (PART 1)-1985)

Source: CPHEEO, 1993

Figure 9.8 Structure of a septic tank

9 - 21

For more details of on-site sanitation systems, please refer “Chapter 9 On-Site Sanitation” of CPHEEO Manual on Sewerage and Sewage Treatment Systems: Part A Engineering, 2013

Criteria for identifying new septage treatment site:

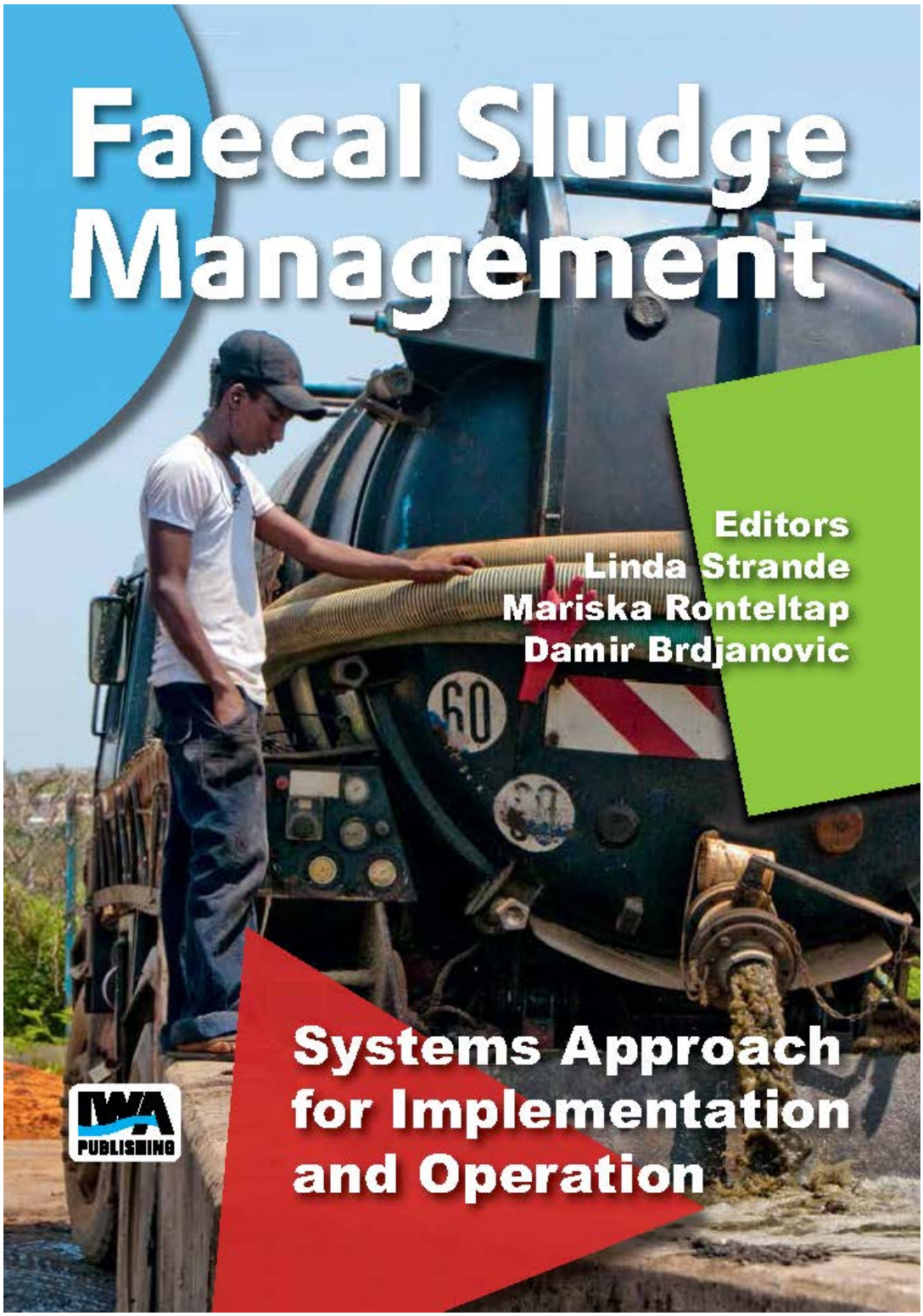


Figure 14.13 Faecal sludge trucks stuck in traffic, Dakar, Senegal (photo: Linda Strande).

It is fundamental to involve the private collection and transport service providers in the selection process, as they are most affected. Their practices, constraints and needs should be understood, especially:

- their routes and disposal sites;
- the problems they face on the streets (traffic, police fees);
- the average distance and duration of the trips; and
- the money they gain per trip, in total and after deducting the fuel cost and maintenance costs of the trucks.

They will be able to say whether it is *practically* and *financially* possible for them to drive and deliver to the sites listed (see also Section 14.3.3 and Chapter 4).

14.4.1 Identification of treatment sites

The identification of existing sites, former sites and potential sites is carried out through discussions with the key stakeholders. The following stakeholders may be particularly helpful:

Manual and mechanical FS operators: They have knowledge of the discharge sites. It is also important to ask about former sites, or direct delivering to farming areas. It should be borne in mind that they may be reluctant to talk about sites that are illegal.

Enduser: Firstly, areas where sludge is used should be identified. Then, for example, if it is agriculture, farmers can provide information on where they find the sludge. They can also give information about former dumping sites, or temporary sites. It is interesting to cross-check this with the information from emptying service providers. This also gives indications on how the enduse market could be structured.

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Table 14.3 Criteria for site evaluation with *sine qua non* (essential) conditions

Criteria	*Sine qua non* conditions
1. Average transport distance for mechanical service providers	Acceptability and affordability for service providers, as defined during interviews
2. Accessibility	Ease of access
3. Surface area	Surface area > 0.3 ha
4. Land ownership and price	Guarantee to be able to buy, at a reasonable price
5. Neighbourhood/potential for urbanisation	Risk of future access due to urbanisation
6. Topography	No risk of flooding
7. Soil type	Free soil (unconsolidated)
8. Groundwater table	> 2 m. deep
9. Opportunities for disposal of treated effluent and sludge	Must have disposal and enduse possibilities

Municipal authorities: The state may own available land. This would be a good option, as the municipality would then immediately be more involved.

Traditional authorities: Very often, land is still in the hands of traditional cultural leaders. They may be willing to provide land for public interest.

Politicians, landowners, town planners, residents, operators and users are all likely to have differing priorities and requirements as to where the infrastructure is located. Decisions may be heavily biased. Political pressures or available space may override what is considered appropriate for the user and host community (Scott, 2013). Siting infrastructure in the wrong location is likely to impact adversely on the long-term sustainability of the service.

It is common for cities not to have an updated land registry. Particular emphasis should be placed on finding out who owns the identified sites. GPS and Google Earth (see also Section 14.2.5) can be valuable tools to reference and assess the areas surrounding the sites and they can replace missing or outdated maps.

14.4.2 Characterisation and evaluation criteria

Nine criteria are proposed in Table 14.3 to characterise and evaluate potential sites, providing a good basis for decision-making. Some circumstances can lead to the immediate exclusion of a site. These are expressed as *sine qua non* conditions; if any of them is not valid, the site is considered as not appropriate.

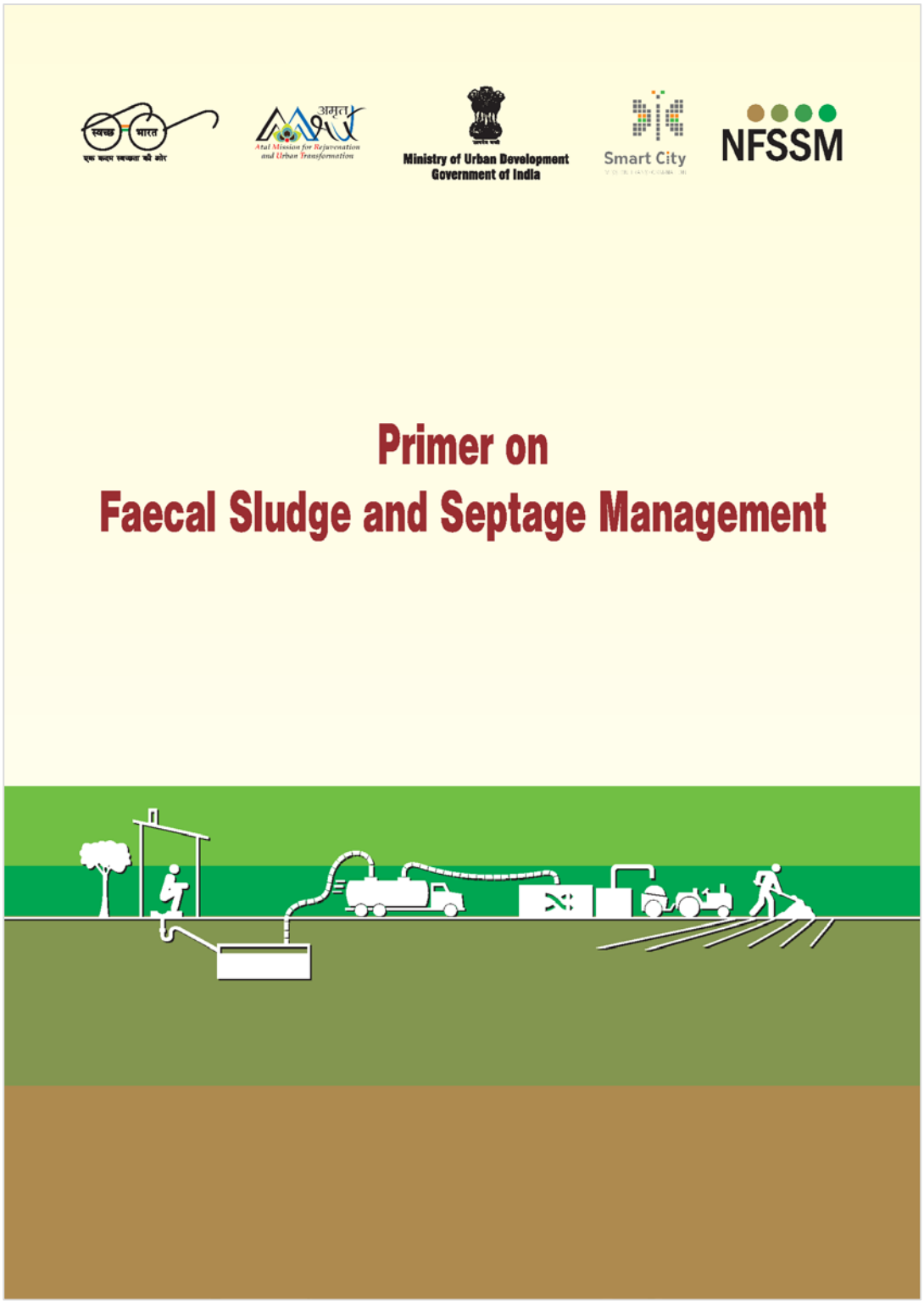
Additionally the following information should be collected for each existing site:

- when the site is used (seasonality?);
- frequency of use; and
- city neighbourhoods that are served by this site.

Distance from emptying to delivering and accessibility of the site are major issues. A site that is too far away or has poor accessibility may also result in FS operators reverting to the former unsafe disposal sites. Collection service providers and vacuum truck drivers are always aware of haulage time and cost. The haulage of relatively small FS volumes (5-10 m^3 per truck) on congested roads over long distances in large urban agglomerations is financially unfeasible. A site that is too far away implies fewer trips per day, less revenue and more fuel costs for the FS operators. Very often they will add these costs to

For more details, please refer this document which is available on:
http://cseindia.org/fsm/images/book_faecal-sludge-fsm.pdf

Potential sources for CAPEX, OPEX and revenue sources:



10

4.2 Financial Assessment

To ensure financial sustainability of FSM services, it is important to assess capacity for financing of both capital and O&M expenditure over the planned period. This can start with an assessment of financial requirements for both capital and O&M expenditures, along with subsequent tariff restructuring, to make the system sustainable.

The assessment also provides guidance on potential sources of finance for meeting these expenditures including funding through external grants, private sector investments, user contributions, external debt or through local government internal resources.

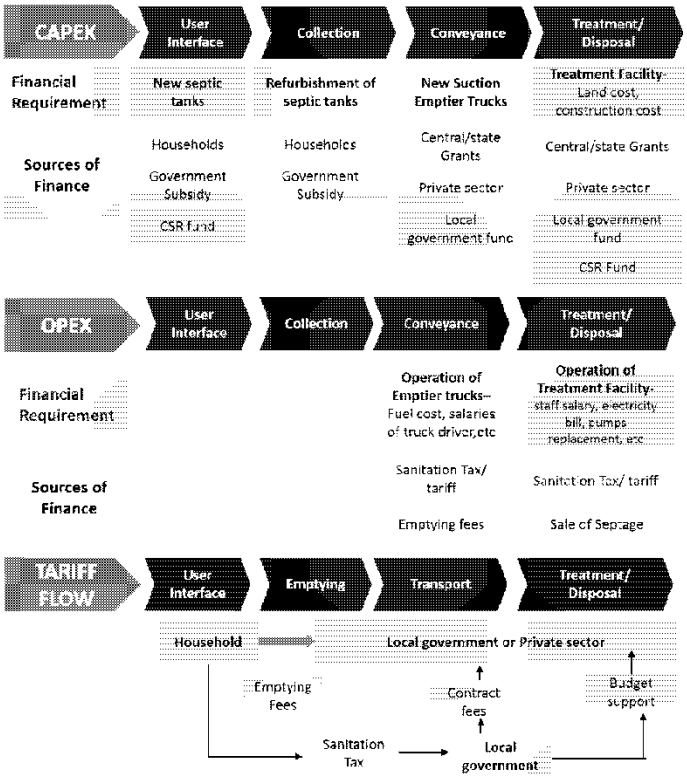
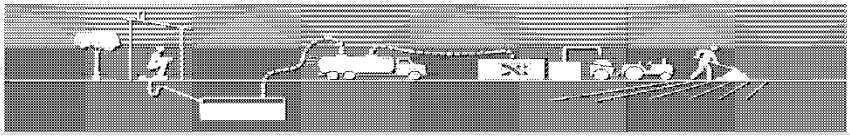


Figure 7: Financial Assessment and structuring



Primer on Faecal Sludge and Septage Management can be downloaded from: http://www.swachhbharaturban.in:8080/sbm/content/writereaddata/Primer%20on%20Faecal%20Sludge%20&%20Septage%20Management.pdf

READING MATERIAL - SESSION 5
IEC AND BCC FOR FSSM

Definition of IEC and BCC by UNESCO

Behavior Change Communication:
BCC is a process of working with individuals, communities and societies to:
- develop communication strategies to promote positive behaviors which are appropriate to their settings; AND
- provide a supportive environment which will enable people to initiate and sustain positive behaviors.

What is the difference between BCC and IEC?
Experience has shown that providing people with information and telling them how they should behave ("teaching" them) is not enough to bring about behavior change. While providing information to help people to make a personal decision is a necessary part of behavior change, BCC recognizes that behavior is not only a matter of having information and making a personal choice. Behavior change also requires a supportive environment. Community and society provide the supportive environment necessary for behavior change. IEC is thus part of BCC while BCC builds on IEC.

Related Resources:

BCC & Reproductive Health (Family Health International)

Communication/Behaviour Change Tools Number 1: *Entertainment-Education* (UNFPA)

Communication/Behavior Change Tools Number 2: *Effectively Using Hotlines for BCC in Population and RH* (UNFPA)

Reproductive Health in Refugee Situations: Appendix One - IEC Programmes (UNFPA)

Behaviour Change Communication and the fight against HIV and AIDS among young people (UNFPA, 2006)

National IEC BCC Strategic Framework for HIV AIDS Programme (National AIDS Control Organisation, 2004)

Tweet

General Information
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Our priorities
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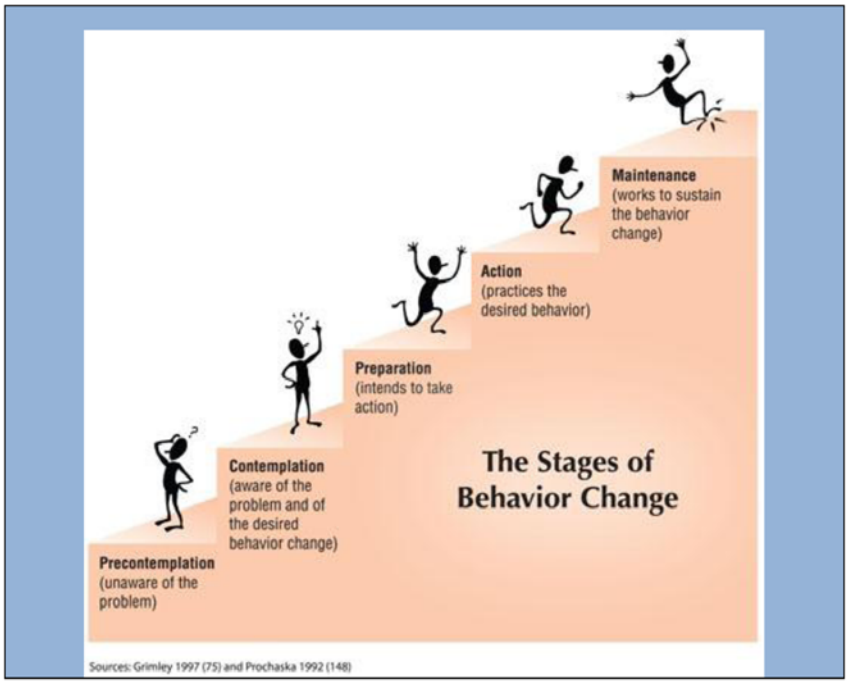
- Gender Equality
- Education for All
- Sustainable Development

Source: http://www.unescobkk.org/education/hivaids/adolescent-reproductive-sexual-health-arsh/information-resources-publications/advocacy-iec-bcc

Stages for planning BCC



Behavior Change Models Case Study

Stages of Change Model

You as a health professional may encounter someone with drug abuse problem who has not yet acknowledged it as a problem or you could encounter someone who is concerned enough about the problem to actively seek to do something about it. Obviously the intervention that you would use for each of these people would be very different. By being aware of the stage that an individual is at, you can assist them to set realistic goals that will enable them to move forward through stages of change.

For example, by giving a person who is using drugs and who is not really interested in changing their behavior some targeted information about the dangers of drug use this may allow them to move to a stage where they come back to see you requesting further information or perhaps move onto the next stage where they may go to a treatment center and actually give up drugs and stay a non user.

Role Play.

Select two participants randomly from the larger group. Using the Stages of Change Model ask the two participants to role play for the rest of the group a Health Professional assisting to move an Injecting Drug User from the Contemplation Stage to the Decision Stage.

More details on IEC and BCC is available in "BEHAVIOR CHANGE COMMUNICATION (BCC) Learning Resource Package", Facilitator's guide, USAID|Afghanistan. It can be downloaded from:
http://moph.gov.af/Content/Media/Documents/01_BCC_LRP-Facilitator%27sManual-English171220111138146635533 25325.pdf

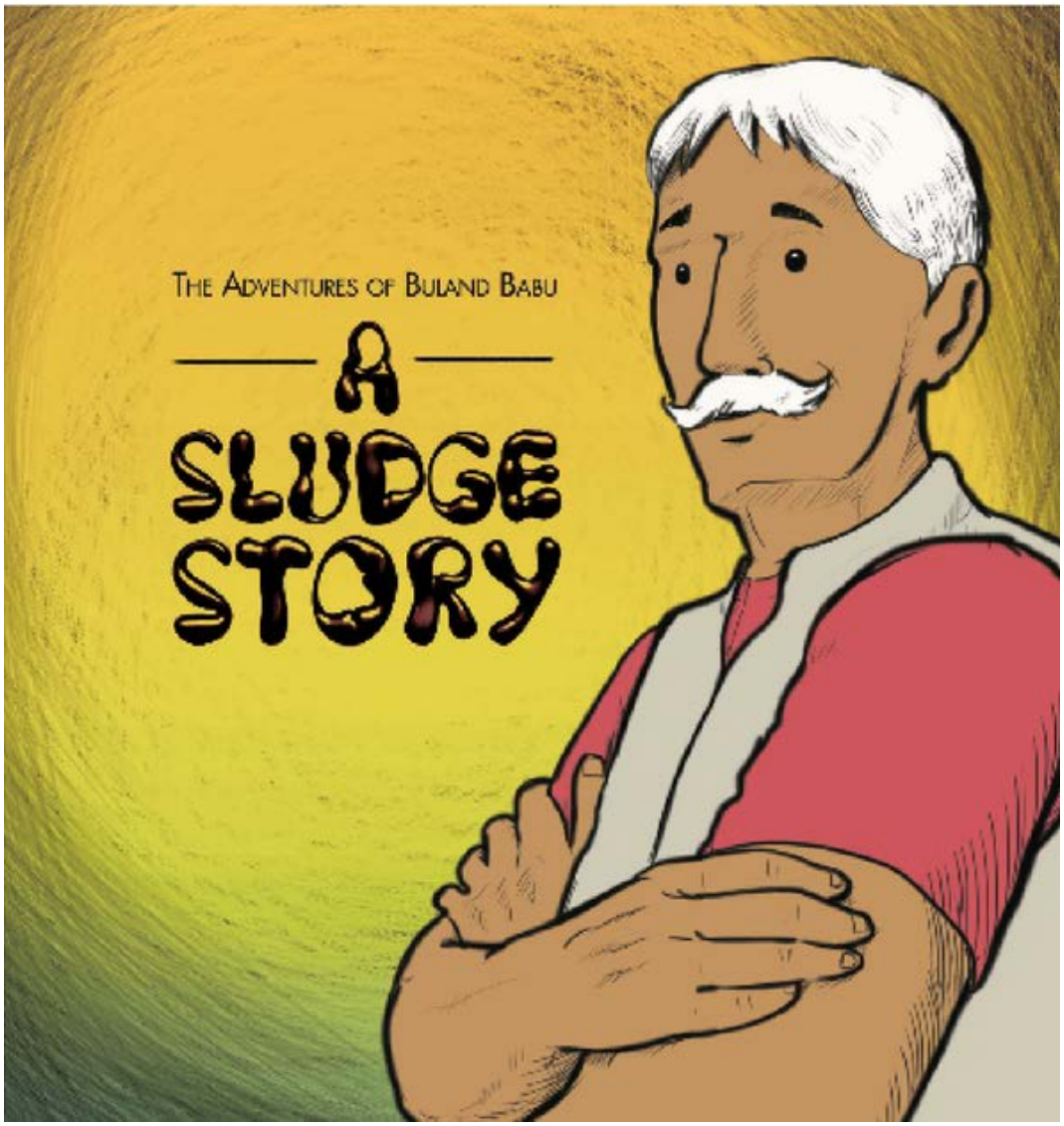
IEC materials


Don't overload the commode!
septicsmart
www.epa.gov/septicsmart
A toilet is not a trash can. Disposable diapers and wipes, feminine hygiene products, cigarette butts and cat litter can damage septic systems. Learn more at epa.gov/septicsmart.
EPA
United States Environmental Protection Agency


Don't strain your drain!
septicsmart
www.epa.gov/septicsmart
Use water efficiently and stagger use of water-based appliances. This can improve septic system operation and reduce risk of failure. Learn more at epa.gov/septicsmart.
EPA
United States Environmental Protection Agency

More IEC materials can be downloaded from: https://www.epa.gov/septic/septic-systems-outreach-toolkit and *https://www.iwk.com.my/news-and-advertisement/english?page=4*

IEC for residents



The Bangalore based organization, CDD Society, introduced Buland Babu - a comic book to create awareness for need of proper treatment of septage. This book can be viewed on following link: http://swachhindia.ndtv.com/comic-book-returns-time-teach-india-importance-human-waste-treatment-8807/

Case Study: “SepticSmart Week”, Environmental Protection Agency, USA

Sewage and Wastewater Elimination Education Program (SWEEP)

About 23,000 households in Licking County, Ohio, are located outside of areas served by central sewers and must treat and dispose of wastewater on their own lots. In order to proactively address new septic system regulations forthcoming in Ohio, the Licking County Health Department (LCHD) sought to increase homeowners; awareness on proper care and maintenance of these septic systems. Made possible by a grant from the Ohio Environmental Protection Agency (EPA) in 2011, through the Ohio Environmental Education Fund, the heath department launched the Sewage and Wastewater Elimination Education Program (SWEEP).

SWEEP, which ran from May 2012 to August 2012, featured homeowner-assisted information gathering and a series of LCHD-led educational workshops.

PROGRAM ELEMENTS

The program began with a direct mailing designed to both inform homeowners of the program and guide them through gathering basic information about their septic systems. Nearly 10,000 direct mailings were sent to homeowners in the health department's septic system database during the program's launch in May 2012.

LCHD conducted water quality workshops that educated Licking County homeowners on the importance of septic system maintenance, arsenic testing, home radon testing, and using rain barrels to reduce stormwater runoff.

GOALS & OBJECTIVES

The program was initiated in order to better develop LCHD's septic system operation and maintenance program. The goals and objectives of the SWEEP program were two-fold:

- Update the health department's septic system database regarding the number, variety, and maintenance of homeowner septic systems.
- Educate homeowners on the importance of regular septic system maintenance.

A secondary goal of the program was to test the arsenic levels of residential well water throughout the county, accomplished through a partnership with the U.S. Geological Survey.

The direct mailing contained:

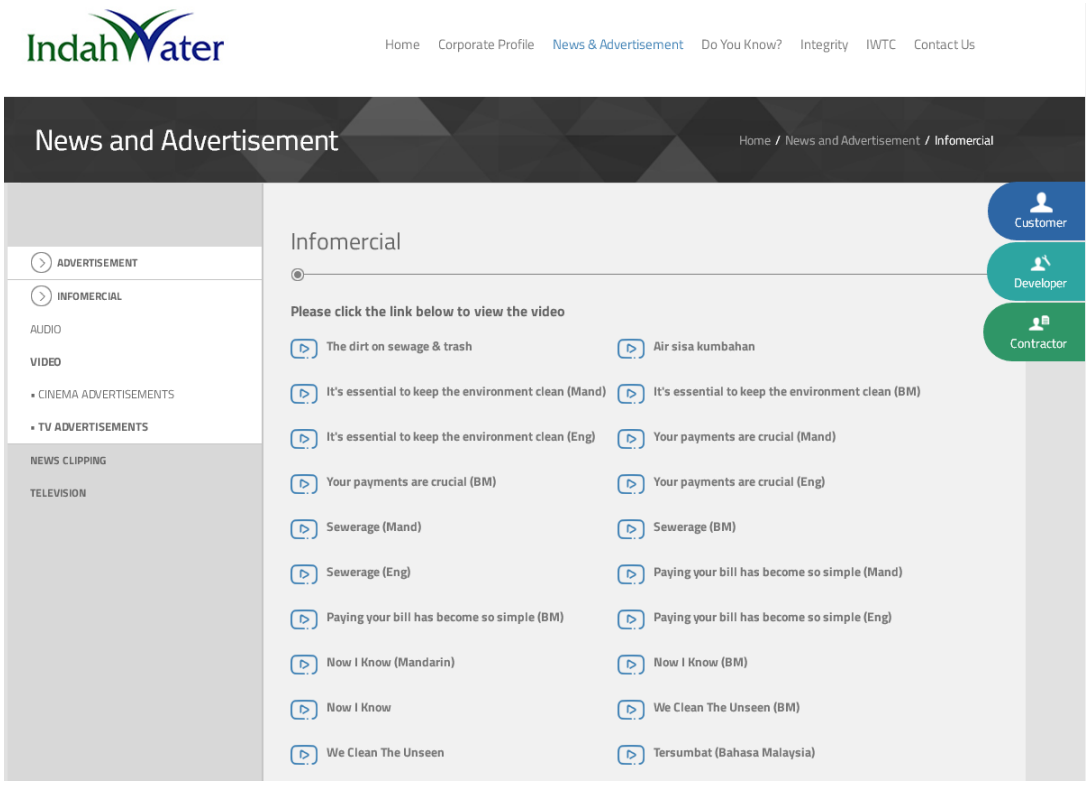
- A cover letter describing the SWEEP program.
- A fact sheet on different types of septic systems installed in Licking County.
- A pre-paid, pre-addressed postcard containing a brief questionnaire about what type of septic system each homeowner had and when it was last pumped.
- A flyer promoting the homeowner education workshops.

In addition to SWEEP flyers posted throughout the county, a press release was sent to local media, resulting in both radio newscasts and newspaper articles about the program.

After the direct mailing, the LCHD held three homeowner training and education workshops on septic system performance and maintenance at school buildings in three different areas of the county.

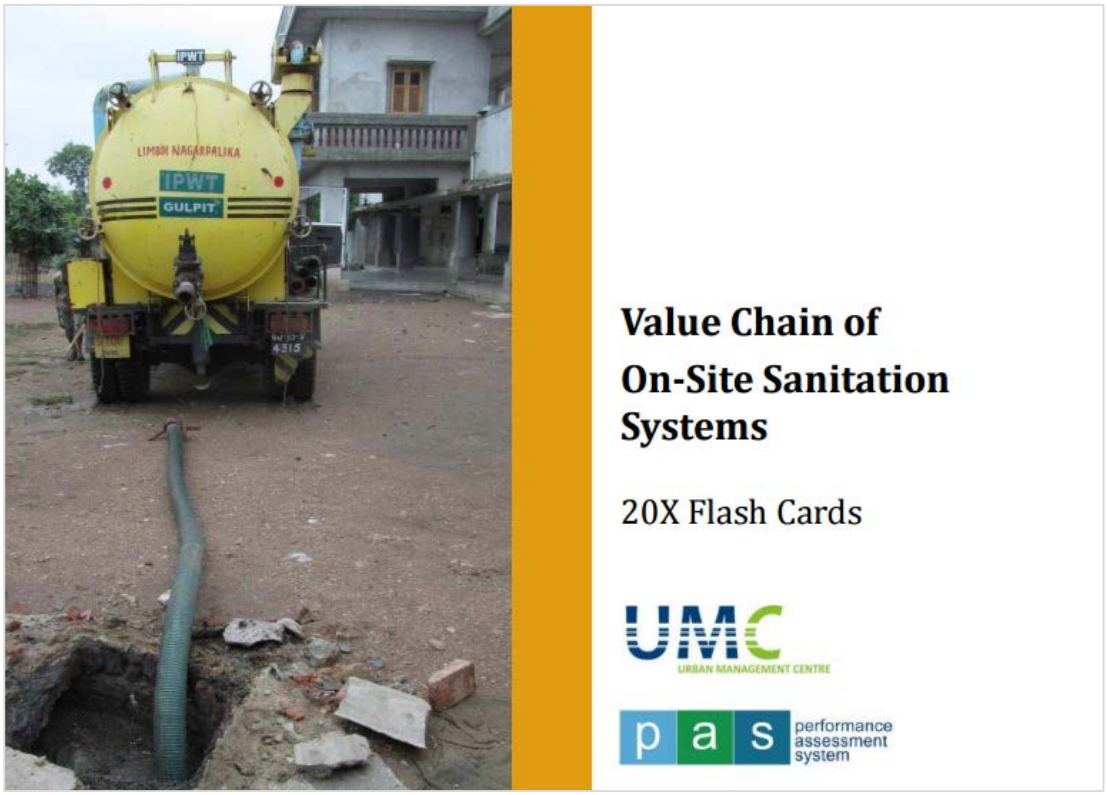
Download the full document from: https://www.epa.gov/sites/production/files/2015-06/documents/septicsmart_casestudy_sweep508.pdf

IEC through commercial advertisement



Indah Water Konsortium (IWK) Malaysia has made number of commercial advertisement (Infromercial) as a part of IEC, which is available on: https://www.iwk.com.my/news-and-advertisement/tv-advertisements

Creating awareness in residents through flash cards - Value Chain of On-Site Sanitation Systems



This flash cards help to create awareness in HHs for identifying On-site Sanitation systems and functions. Flash cards are available on the website of UMC. Downloadable link is: http://umcasia.org/UserFiles/umc/file/Flashcards%20On-site%20sanitation.pdf

UMC also conducted focused group discussion (FGD) in Visakhapatnam as a part of IEC and creating awareness in people for safe management of waste water coming from toilets. To get more details on this project please go to: http://umcasia.org/content.php?id=100

Notes:

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